CRANFIELD UNIVERSITY

CRANFIELD SCHOOL OF MANAGEMENT

PhD

2004

GRAHAM LEASK

STRATEGIC GROUPS AND COMPETITIVE GROUPS IN THE UK PHARMACEUTICAL INDUSTRY 1993 – 2002.

PROFESSOR DAVID PARKER

1st DECEMBER 2004

ABSTRACT

Strategic group research originated in the 1970s and a number of notable studies centered on the US pharmaceutical industry. Results were however, conflicting. This thesis explores the nature of strategic groups and the related concept of competitive groups in the UK pharmaceutical industry during the period 1993 to 2002. The research follows three related themes. The first research theme identifies two stable strategic time periods each of five years duration across the period studied. Within each of these time periods strategic groups were identified using a combination of Ward's method and a K means clustering algorithm and the presence of a relatively stable strategic group structure was confirmed. A statistically significant relationship between these strategic groups and performance is demonstrated using three performance measures. The second research theme then explores the movement of firms between strategic groups and finds some support for the proposition that firms moving between strategic groups move to more advantageous positions. The relationship between strategic groups and mergers is also investigated and this research finds that mergers between firms occur preferentially across strategic groups rather than within strategic groups. This relationship is confirmed as highly statistically significant. Finally in the third research theme the relationship between strategic groups, *how* firms compete and competitive groups, *where* firms compete, are investigated. Six different competitive groups are identified, all but one of which is concentrated around a dominant therapeutic area. This finding suggests that direct competition between firms is reduced by market segmentation. A weak relationship was found between competitive groups and performance but when competitive groups (*where firms compete)* and strategic groups

how firms compete) are examined in combination a strong statistically significant relationship with performance was found.

ACKNOWLEDGEMENTS

I wish to express my thanks to Professor David Parker, Cranfield University, for his invaluable support, patience and guidance whilst supervising my doctoral research. Without David's encouragement and wealth of experience this would indeed have been a far more arduous process and a far less rewarding one.

I thank my beautiful wife Penny for her constant support and encouragement. Unprompted Penny shouldered the task of reading numbers of drafts without complaint and provided a stream of helpful comments that aided both my clarity and understanding.

I also wish to acknowledge the stalwart support and encouragement of my friend Dr Martyn Broad whose practical knowledge and insight into the UK healthcare system provided an additional benefit.

This thesis would not have been possible without access to the IMS databases for which I would like to formally thank Alan Johnson and Gerry Williams of IMS Health. On many occasions the practical knowledge and wealth of experience of Alan Johnson proved of great help to me and this research is the richer for his insights.

I also acknowledge the constant encouragement of my colleagues and friends at Aston University. In particular my thanks to Mike Hussey for his patience and guidance together with Liz Blackford for help in the final preparation of this manuscript.

Finally I would like to thank my parents James and Louisa Leask for encouraging the spirit of enquiry during my formative years. Without their inspiration this thesis would probably never have been attempted.

CONTENTS

CONTENTS OF FIGURES

CONTENTS OF TABLES

CHAPTER ONE

INTRODUCTION

1.1 The research

The aim of this research is to explore the relationship between strategic choice and performance in the UK pharmaceutical industry. The UK pharmaceutical industry was chosen as the setting for this research for two reasons. First, the UK pharmaceutical market is the sixth largest in the world but, with the exception of inclusion within a study of five E.C. countries (Martens, 1988), the UK market has been largely ignored. Second, the UK market is unusual in that the National Health Service (NHS), represented by the government, is virtually the sole purchaser of ethical pharmaceuticals. Ethical pharmaceuticals are those available only via prescription and not available for purchase by the general public.

This research covers strategic choice in the UK pharmaceutical industry during the ten years from 1993 to 2002, a time period which is interesting because it encompasses perhaps the greatest changes to affect the National Health Service since its inception in 1948. The research reported in this thesis explores the dynamics between firms that occurred during this turbulent period. In this study the strategic group concept is used as a vehicle to compare and contrast the strategies of firms.

1.2 What are strategic groups and why are they important?

Classification has always been an important part of scientific enquiry because in order to make sense of diversity and to compare and contrast objects, be they firms, animals or plants etc it is useful to separate each into like and dissimilar forms. The term

strategic groups was introduced by Hunt (1972), who, in his industrial organization study of the US "White Goods" industry, first discovered, contrary to existing opinion, that different groups of firms, each pursuing alternative strategies, were present in that industry. However, despite the fact that Hunt first identified strategic groups the most popular definition of a strategic group is that provided by Porter (1980):

> "A strategic group is the group of firms in an industry following the same or a similar strategy along the strategic dimensions"(Porter, 1980 p 129).

Within this definition strategic dimensions reflect the critical choices that firms make in choosing to compete. The strategic group idea was an important contribution to the industrial organization (IO) literature because it offered the opportunity to accurately classify firm's strategies and compare and contrast the implications of a given set of strategic choices. Prior to this discovery, it was assumed that firms within a given industry each followed the same optimal strategy, where performance differences were solely attributable to the relative application of scale.

From its origin in IO research, the strategic groups concept was rapidly disseminated into strategic management theory, where it provided the opportunity to compare firms in terms of "how they compete". It offered a finer grained analysis of Porter's generic strategy continuum from low cost to differentiation. This opportunity sparked a large number of studies during the 1980s which produced rather equivocal results when it came to the link between strategic group membership and performance.

This lack of a consistent link to performance can be traced to three main criticisms of strategic group research. Firstly, much of the theory base which underpins the strategic

group concept stems from IO research that was supported by little in the way of empirical results. The strategic management stream of strategic group research followed on from this but, until relatively recently, contributed little to theory development. The result was a large number of separate research studies but little, if any, consistency between the IO and strategic management streams.

Secondly, these strategic management studies, even when conducted in the same industry, tended to operationalize strategy differently and there was little, if any, agreement on what constituted the main strategic choice variables within a given industry. This problem was compounded by a similar lack of consistency between the performance measures deployed. Thus the ability to draw valid comparisons between studies remained severely limited.

Thirdly, the widespread use of exploratory techniques such as cluster analysis, often without a strong and consistent research design, gave support to the criticism that strategic groups were an artefact of method rather than a valid grouping of firms.

Despite these early problems, however, arguably strategic group theory has emerged as a valuable research approach within strategic management and the modern researcher has the advantage of some excellent guidance as to how to conduct valid and consistent strategic group research. The ability to classify firms accurately according to the strategies which they deploy, allows the researcher to both compare and contrast the performance consequences of firms' strategy choices and to explore in detail the competitive dynamics of the industry in question.

1.3 The structure of this research

Chapter two presents a review of the literature pertaining to strategic group research. By necessity this is a selective review but it presents an overview of strategic group research to date, its theory base and main themes. The chapter concentrates mainly upon discussing the key theories that underpin the strategic group concept and research within industries most relevant to pharmaceuticals. The chapter concludes by stating the research questions addressed in this thesis.

Strategy does not occur in isolation but represents the firms' investments in building a strong market position. The environment surrounding the firm is therefore important because the opportunities and threats which each firm senses in its surroundings may be expected to impact upon the choice of strategy. As mentioned above the UK pharmaceutical market is unusual in being dominated by one main purchaser, the NHS, whose actions directly impinge upon the pharmaceutical firms that operate in the UK. Chapter three presents an overview of the key changes that occurred to the pharmaceutical industry's environment in the UK during the years encompassed by the research, namely 1993 – 2002.

The key to any classification system is to understand the criteria by which objects, such as firms, are grouped. Chapter four examines strategic choice in the pharmaceutical industry and exposes the drivers which impact upon firms' strategies. An important objective of this chapter is to acquaint the reader with the reasons why firms' strategies differ within the UK pharmaceutical industry and to present a list of variables which

may accurately reflect firms' strategies and which may be used to distinguish between them.

The importance of method within strategic group research cannot be overestimated. Given the often voiced criticism that cluster analysis will produce clusters regardless of the true structure inherent in the data, it is important to deal effectively and confidently with this challenge. Fortunately, the modern researcher has the benefit of a number of excellent books and articles that provide precise advice on how to ensure that the analysis conducted is both valid, reproducible and accurate. In addition, the capabilities of the modern PC have moved on since the early empirical studies of strategic groups, and available clustering methods have similarly advanced. Chapter five presents the methodology and methods employed in this research and places particular emphasis upon addressing the earlier criticisms of method.

A common weakness of strategic group research is the lack of comparability between studies. The research in this thesis aims in part to address this. The research presented in chapter six was conducted as far as possible, adopting the methods and variables, according to earlier strategic group research. That is to say that the period studied was first divided into stable strategic time periods and variables chosen wherever possible were equivalent to those employed in previous research.

Chapter seven presents research upon the competitive dynamics within the UK pharmaceutical industry, during the ten years from 1993 to 2002. During this period there were several successive waves of consolidation in the pharmaceutical industry and

eighteen mergers. Previous research, as discussed in chapter six, specifically excluded merged firms, an omission which the research in this chapter seeks in part to redress.

Chapter eight builds upon the research presented in chapter six and introduces the idea of competitive groups as representing *where* firms compete, as distinct from strategic groups which describe firms in terms of *how* they compete. The relationships between these two classifications are then explored and their performance implications tested. This chapter, therefore, brings together the two dimensions of Porter's generic strategies. The first continuum, from low cost to differentiation, is represented by strategic groups and the second, from broad to niche market, is represented by competitive groups.

Chapter nine then presents an overview of the research reported in this thesis. These results are then discussed in the light of previous strategic group research. Then in the final chapter conclusions are drawn and suggestions for further avenues of enquiry emanating from the findings are proposed.

CHAPTER 2

LITERATURE REVIEW

The attraction of strategic group theory is the ability to compare and contrast strategic choices between groups of firms within a given industry. Despite concerns expressed as to the validity of the strategic group concept (Barney *et al.*, 1990), to date no widely accepted equivalent alternative has emerged. This chapter presents the origins of strategic group research, exposes the theoretical foundations which underpin the idea and contrasts the different perspectives through which strategic group research has been pursued. A complementary classification but not widely accepted, is the concept of competitive groups, this classification is also presented and the similarities and differences to strategic groups are discussed. The principal difference between these two classifications is that strategic group membership describes *how* firms compete i.e. strategy adopted, as compared to competitive groups which describe *where* firms compete, i.e. choice of markets served. In effect these two classifications approximate to the two dimensions described by Porter's generic strategies. Strategic groups offer a finer grained alternative to Porter's low cost- differentiation strategy dimension. In contrast competitive groups provide a more precise classification of Porter's scope dimension which differentiates between broad and niche market choices (Porter, 1980).The chapter concludes with a review of the gaps exposed in the current research before presenting the questions that the research reported in this thesis seeks to address.

In contrast to previous research (Cool, 1985; Fiegenbaum, 1987; Martens, 1988), it is not the aim here to address the broader strategy literature. This is a well trodden path and the breadth and diversity of strategic group research both warrants and merits more

focused attention. The focus here is firmly upon the origins, contribution and opportunities of the strategic group literature, particularly that research directly relevant to and situated upon the pharmaceutical industry. The aim of this chapter is to endorse the value of strategic group research as a means effectively to classify strategy and to position the current study within the wider context of strategic group research. Wherever possible direct links to previous pharmaceutical-based strategic group studies will be made clear, but one of the enduring problems of attempting to review strategic group literature is the diversity of studies in numerous empirical settings.

2.1 Origin and Definitions: The Early Industrial Organisation (IO) Studies

The term "strategic group" was first coined by Hunt in 1972 in his thesis on "Competition in the Major Home Appliance Industry". Here, contrary to expectation, Hunt discovered a number of different groups of firms within an industry pursuing asymmetric strategies. This observation was of interest because it ran contrary to existing theory drawing from economics. At this time it was thought that all firms within a given industry would follow the optimal strategy for "wealth maximisation" within that industry. Differences between firms were not thought to arise through implementation of different strategies but mainly through the effect of the application of relative scale. Hunt named the groups of firms he identified "strategic groups" and defined a strategic group as:

> "a group of firms within the industry that are highly symmetric with respect to cost structure, the degree of vertical integration, and the degree of product differentiation, formal organisation, control systems, management rewards/punishments, and the personal views and preferences for various possible outcomes."(Hunt, 1972, p 8)

Hunt's observation gave rise to a plethora of strategic group studies, but the strategic group idea was disseminated more widely with the publication of the book "Competitive Strategy" by Michael Porter in 1980. This introduced the idea of strategic groups to a wider readership including practitioners and provided a since widely employed definition of strategic groups as:

> "the group of firms in an industry following the same or a similar strategy along the strategic dimensions". (Porter, 1980, p129)

This definition stems from two earlier statements by Porter, who had suggested; "that the strategy of the firm is the vector representing its choice for each of the major decision variables" (Porter, 1976).This statement was then developed in a later paper into:

> "An industry can thus be viewed as composed of clusters or groups of firms, where each group consists of firms following similar strategies in terms of the key decision variables … I define such groups as strategic groups. Firms within a strategic group resemble one another closely. Between strategic groups however, the situation is different" (Porter, 1979, p 215).

Porter then proposed a number of "strategic dimensions" that should capture the possible differences among the strategic options of companies in a given industry. Note the reference to a specific industry. These dimensions are composed of various competitive methods that are listed as (Porter, 1980, p127-128):

1. Specialisation
2. Brand identification
3. Push versus pull. Here, push refers to where the firm seeks to build an identified brand with the consumer where the consumer is motivated to ask for or actively seek the product. In contrast a pull strategy relies upon the support of distribution channels in selling the product.
4. Channel selection
5. Product quality
6. Technological leadership
7. Vertical integration
8. Cost position

9. Service
10. Price policy
11. Leverage which refers to the ratio of debt to capital employed. A dimension that may also provide some indication as to the management's attitude to risk.
12. Relationship with the parent company
13. Relationship to home and host government

It is important to note here that while some assistance was provided by Porter in

defining which of these 13 strategic dimensions may be utilised, a general feature of strategic group research is a lack of consistency as to how the idea should be employed in practice. A reason for this, stems in many ways from the origins of strategic group research, which arises from not one but two potentially conflicting sources. In the first instance, strategic group research is a product of the Industrial Organisation (IO) branch of economic theory. A number of, if not the majority of, the early "strategic group studies" (Hergert, 1983; Hunt, 1972; Newman, 1973; Porter, 1973; Porter, 1976) followed this perspective, which centred on research conducted at Harvard University.

The theory that underpinned the IO perspective was the Structure-Conduct-Performance (SCP) paradigm (Bain, 1968; Mason, 1949), which proposed that industries were protected by entry barriers that prevented the free movement of firms into a given industry and hence allowed differential returns to persist. The assumptions that underlie the SCP paradigm were summarised in a recent review of strategic group theory (McGee, 2003):

1. Technology is common to all firms and the only differential refers to relative scale.
2. Production differs solely on scale and each firm owns one plant.
3. Price is set by larger firms.
4. No differences exist between firms except according to relative size.
5. Uncertainty and knowledge asymmetries do not exist.
6. Firms do not act opportunistically but rationally.
7. No asset specificity exists.
8. All firms in an industry are in direct competition.

Within industries all firms seek to maximise their profits and will attempt to follow the optimal strategy towards that end. All firms are not equal however, but differ in terms of relative size, where factors such as innovation or technological endowment are deemed to be a function of scale.

In other words, in IO theory the structure of the industry in terms of the relative size of its incumbents was what ultimately determined firm success, and firm conduct was in effect determined by relative industry position. Later revisions of the SCP concept (Porter, 1979; Scherer, 1980) suggested that collusion between competing firms could affect profits, thus there was a shift in opinion from S>c>P i.e. with structure driving performance where firm conduct was assumed to express a relatively minor role towards S>C>P with conduct becoming perceived equally as important as a determinant of industry profits. Previously it was thought that conduct was constrained by industry structure and that structure acted as the primary driver of industry performance. The ability of firm decisions to affect industry structure was therefore now acknowledged.

The apparent paradox between the prevailing SCP theory and Hunt's subsequent observation prompted a number of studies aimed primarily at confirming the presence of intra-industry groups within a variety of industries. These intra-industry groups, or strategic groups, were interesting not only because they provided an opportunity to study the link between industry structure and performance, but because they provided the means to deconstruct industries into their salient parts and to compare and contrast

structural configurations between and across industries. These IO studies generally followed a common prescription.

1. A number of industries would be included in the study, frequently in excess of 10.
2. In direct support of the SCP paradigm, strategic choices would be reduced to no more than two or three variables (Hergert, 1983; Newman, 1973; Oster, 1982). Frequently one variable, namely FIRM SIZE, was taken as a proxy to represent strategic choice (Porter, 1973).
3. Studies were of short duration and presented a quick "snapshot" view across a variety of often largely unrelated industries. The assumption was made that industries were in essence undifferentiated, regardless of customer group served or technology platform applied.
4. The approach taken was invariably quantitative in nature. The selected variables were measured across a number of industries and groups were identified using either a strategic mapping technique (Harrigan, 1979) or through some form of clustering analysis. Availability of data appears to have been a principal driver of research activity, with the COMPUSTAT[1] database providing data on basic company statistics such as size, for a number of studies,, across a number of industries.
5. The perspective taken was top down using strategic groups as a unit to break industries down into smaller groupings of firms and to compare and contrast the result for competition.

---

[1] For more than 35 years Standard & Poor's COMPUSTAT data has been recognized as one of the financial information industry's leading resources for in-depth financial information on publicly traded companies in the US. and around the world. This database was widely used in some of the earlier IO-based strategic group studies.

The legacy of this early IO research remains today through providing the enduring definition of what is meant by the term "strategic group" (see Porter's definition above) and more importantly because the assumptions that underpinned the SCP paradigm are not dead but persist in the theories that underpin the strategic group concept today.

2.2 The Origins of Strategic Groups in Strategic Management Research

Concomitant with the work at Harvard, researchers at Purdue University in the USA were also pursuing the idea of grouping firms and exploring the relationship between market structure, conduct and performance. The SCP paradigm forms a starting point in common with the early Harvard studies but each set of researchers adopted markedly different perspectives.

The Purdue studies stem from two research theses. First, Hatten explored (via a simple equation) the idea of profitability as a function of strategic choice or conduct variables, which were under management control, and environmental or market structure variables, which were not (Hatten, 1974). This equation is simply presented as:

PROFITABILITY = f(Strategic choice variables, Environmental variables}

The context for Hatten's study was the US brewing industry during the period 1952 to 1971. This was an industry chosen firstly because its firms engaged in only one business, brewing, hence business strategy was being measured without cross-industry or cross- product contamination (Hatten, 1974; Schendel *et al.*, 1978, p1615). Secondly because the firms were each represented on the stock market and the required data sets

were readily available. A combination of cluster analysis and regression analysis was used to identify groups of firms and seven distinct groups were identified. These differed significantly in terms of profitability relationships from the industry average. A sub-industry structure of heterogeneous groups pursuing different strategies with different sets of performance relationships was therefore confirmed.

It is worth noting here that despite encompassing 20 years of data, no attempt was made in this study to pursue industry dynamics and especially to investigate the firms that were eliminated from the industry during the period studied. Given that the objective was to investigate the effect of strategic choice upon performance within a changing industry context, this would appear to be a significant omission.

A further study, by Patton, focused on same time period in the US brewing industry, but extended Hatten's work, moving beyond single equations to the use of a simultaneous equation model to investigate strategic choice and performance. Patton used size and geographical scope to split the industry into three groups, national, large regional and small regional brewers (Patton, 1976). The key differences between this approach and Hatten's was that Patton extended the left side of the equation from profitability, as measured by return on equity (ROE), to performance, which in addition included both market share, as a proxy for growth, and production efficiency.

Patton demonstrated that the strategy construct could be mathematically modelled and identified key relationships between multiple dimensions of performance, managerially controlled variables, and non-controllable variables describing the external environment.

The Purdue studies were aimed at assisting senior management to quantify the value of strategic choice on market performance by building a bridge between the *qualitative* approaches of corporate strategy and the model building techniques of IO. The early work at Purdue by Hatten and Patton established a pattern that was to become the norm for the majority of strategic group studies within strategic management. These traits included that of taking an industry specific context, using a number of different variables as proxies for strategy, considering the industry over a time period, and identifying strategic groups on the basis of an inductive "mathematical" approach rather than by prior theory. A common problem, which is repeated many times in subsequent strategic group studies is also exhibited. That is, despite a common industry and time period, the variables chosen to identify groups differ between studies and even between papers by the same researchers, which calls into question the researchers' ability objectively to select those variables that best describe strategic choice within a given industry. This latter point is illustrated in Table 2.1 that compares the Hatten and Patton published studies on strategic groups within the US brewing industry (Hatten *et al.*, 1978a; Hatten *et al.*, 1978b; Schendel *et al.*, 1978). The table shows that despite a similar sample size within the same industry, there is considerable variation in both the number of variables chosen to represent conduct and the nature of those variables.

Table 2.1 Strategic group studies in the US brewing industry

	Hatton & Schendel (1977)	Hatten, Schendel & Cooper (1978)	Schendel & Patton (1978)
Sample	13 Firms	13 Firms	12 Firms
Conduct Variables	3 Manufacturing 3 Marketing 2 Environmental	5 Manufacturing 5 Marketing 2 Financial 4 Environmental	16 Strategic & Operational 7 Environmental
Total Number of Conduct Variables	8	16	23
Dependent Variables	Return on Equity	Return on Equity	Return on Equity Production Efficiency Market Share

In conclusion, despite differences in approach within the IO and strategic management studies into strategic groups it is possible to discern a number of links to the SCP paradigm in both the early Harvard and Purdue studies. The principal Harvard studies adopted a theory of the heterogeneity of industries and through their cross-industry studies sought to deconstruct industries into a series of heterogeneous groups, each of which was homogeneous in character. In effect the SCP paradigm was shifted from industry to sub-industry level with entry barriers becoming intra-industry mobility barriers. But the same ideas of relative size, collusion, and performance being mainly a result of structural configuration, remained largely in place. In contrast, the Purdue studies gave greater importance to the firm's strategic decisions, but adopted originally a simplistic view. In these studies strategic choice was assumed to drive performance and between structure and performance the firm was seen as little more than a "black box". The general idea of strategy was over-simplified and ignored the process of strategy implementation or the ways in which tacit activities contribute to the building of competitive advantage (Barney, 1991; Barney, 1997).

The legacy of these early studies is, however still present and important in modern strategic group research. The Purdue strategic management approach has emerged as the dominant model in strategic group inquiry, which marks the shift from a multi-industry "snapshot," static, approach, based on mapping one or two variables, towards the single industry multivariate, often longitudinal, study based upon cluster analysis. This has become the norm in strategic group research today. The early Purdue approach, however, has contributed little to theory building (McGee, 2003). In contrast, while the methods employed by the IO researchers have declined, the theories provided by the Harvard School still provide the theoretical base that underpins the concept of strategic groups today.

2.3 The Twin Pillars of Modern Strategic Group Theory: Mobility barriers and the scope for collusion.

Post Hunt's observation, two key theories were proposed to explain persistent *intra*-industry performance differences. Both these theories emanated from IO research. Together they provide the complementary twin pillars upon which strategic group theory is still based. The first is the theory of *mobility barriers*. Caves and Porter suggested that firms cannot move at will within industries due to the presence of intra-industry barriers (Caves *et al.*, 1977). These barriers result from the collective actions of groups of firms within an industry, which protect each strategic grouping from outside competition. Firms within a strategic group are assumed to be sensitive to their interdependency and are therefore likely to react similarly to competitive changes. Activities like advertising or R&D research expenditure can create an effective barrier

to entry, which is difficult to vault without the expenditure of considerable time and money (Cool *et al.*, 1994; McGee *et al.*, 1986). In the pharmaceutical industry, for example, patents may provide a number of years of "market exclusivity". Mobility barriers are classified in the literature into those that are market related, such as advertising, sales force size and breadth of product line, and those that are asset related, such as product patents (McGee, 2003). There is a clear link between mobility barriers in strategic group research and the earlier work of Bain (1968) and Mason (1949) on industry entry barriers in IO research.

Intra-industry mobility barriers can arise as the result of "collective activities" by group members. But it appears equally plausible that firms may mimic the actions of a reference firm, recognised in some sense as the group "leader" (Fiegenbaum *et al.*, 1995), producing a similar result. In a study of the UK grocery retailing industry Curto observed that "companies have important reference points in the industry and what other firms do plays a part in the decision taken (Curto, 1998, p 352,)" The height of the mobility barrier is expected to determine the profit potential of a given strategic group, in accord with entry barrier theory (Bain, 1959; Mason, 1939). The distance between groups may be used as a proxy for the height of the mobility barriers separating them (Caves *et al.*, 1992; Caves *et al.*, 1977). It has also been suggested that companies may enter an industry via the least protected strategic group. Once inside the industry, they may then penetrate more profitable strategic groups through the acquisition of knowledge, relevant assets and experience (Caves *et al.*, 1977).Thus, a "stepping stone" theory has been advanced to explain intra-industry competition (Caves *et al.*, 1977; McGee *et al.*, 1986).

The second pillar of strategic group theory, alongside mobility barriers, proposes that intra-industry rivalry will be most severe when two conditions are present (Porter, 1976; Porter, 1979). First, when there is a marked difference in size between strategic groups there will be an in-balance in bargaining power. This may result in strong rivalry. If, however, the strategic groups are equally powerful then collusion is more likely to occur and an agreement may be reached on how to compete without costly and destructive competition. Secondly, if strategic groups serve the same markets, via common customers, and pursue similar strategies, then a common view of the market may emerge. With reputations intertwined, companies are more likely to co-operate in order to maximise returns and minimise marketing costs. In contrast if firms pursue common markets but employ different strategies they are less likely to co-operate and are more likely to compete away profits or engage in destructive price competition.

The height of the mobility barrier acts as some insulation from rivalry as does operation in non-related markets, but all things being equal firms that offer substitute products by different means are more likely to engage in destructive rivalry than those which apply closely similar strategies to common markets. The latter will be more likely to understand each other's motives and reach some "understanding" on how to compete. However, the concept of mobility barriers and intra-group structure is not seen as totally explanatory of performance differences. Moderator variables, such as firm specific attitudes to risk, different asset stocks or the ability to execute a given strategy, may all play a part in determining performance (Porter, 1979; Porter, 1980).

2.4 Two Further Decades of Strategic Group Research: Much Exploration but More Heat than Light?

From these origins, research on strategic groups then went into a phase during the 1980s where various researchers looked to verify the findings of the earlier research, in different industrial settings, and employing different performance variables. For example, Hergert (Hergert, 1983) explored the incidence of strategic groups within fifty US manufacturing industries; risk was independently used as a definitive variable by Ryans and Baird (Baird *et al.*, 1983; Ryans *et al.*, 1985), generic strategies by Dess and Davis (Dess *et al.*, 1984) and the industry life cycle by Primeaux (Primeaux, 1985). The research results were mixed. Contemporary reviews (McGee, 1985; McGee *et al.*, 1986) pointed to the sensitivity of strategic group analysis to the choice of variables adopted and to the difficulties of comparing strategies across different industries. The conclusion was that detailed knowledge and understanding of an industry and its context were necessary in order to specify adequately the variables to be included in any useful strategic group analysis. This was a clear criticism of earlier IO studies with their application of general concepts and tools of analysis across industries. This critique was later picked up and adapted by Barney and Hoskisson (Barney *et al.*, 1990), who argued that strategic groups are an artefact of the research methodology employed. In particular, the statistical technique of cluster analysis, commonly used in studies to identify strategic groupings, could be problematic.

Cluster analysis chooses the best fit for the data between, for example, a three group or four group solution, but it does not clarify whether clustering the data is appropriate in the first place (Ketchen *et al.*, 1996). This is because clustering analysis acts to combine

groups on the basis of a given similarity matrix. Groups are formed on the basis of relative distance, but cluster analysis relies strongly on the intuition of the researcher and provides no hard test as to whether clustering the data into groups is appropriate or not.

These criticisms of strategic group theory, as it had developed especially in the IO literature from 1972 to the mid-1980s, led to a further phase of research. This phase focused especially on a number of key themes, namely: (1) the further exploration of the concept of mobility barriers (Mascarenhas, 1989; Mascarenhas *et al.*, 1989); (2) how strategic groups form; (3) the stability of strategic groups over time (Cool, 1985; Cool *et al.*, 1994; Cool *et al.*, 1987a; Cool *et al.*, 1987b; Fiegenbaum, 1987; Fiegenbaum *et al.*, 1985; Fiegenbaum *et al.*, 1987; Martens, 1988; Oster, 1982); (4) the application of generic strategies; (5) the idea of cognitive groups (Porac *et al.*, 1994; Reger, 1988); (6) intra-group dynamics; and (7) the idea of natural selection and population ecology (Boeker, 1991; Carroll *et al.*, 1992; Hannan *et al.*, 1977). Each of these developments is now briefly reviewed.

2.5 Further Exploration of Mobility barriers

Research into mobility barriers and strategic groupings in the 1980s built on the ideas of Caves and Porter (Caves *et al.*, 1980; Caves *et al.*, 1977). McGee concluded that mobility barriers are a counterpart of group structures and arise from strategic decisions (McGee *et al.*, 1986). Decisions which affect the height of the mobility barrier are critical and may be expected to arise as the result of judgments that,

"cannot be readily imitated by firms outside the group without substantial costs,

substantial elapsed time or uncertainty about the outcome of the decisions"(McGee *et al.*, 1986, p 150).

McGee also proposed a useful taxonomy of mobility barriers, distinguishing between market-related strategies, industry-supply characteristics and firm characteristics. It is noteworthy that the mobility barriers included were endogenous to the firm and therefore were strategic decisions under management control (McGee, 2003; McGee *et al.*, 1986). All mobility barriers are not equal, however. Some, like pharmaceutical patents, are the result not just of heavy continued expenditure but require long periods of elapsed time to garner the experience and build the team necessary to produce productive, leading-edge, research. In contrast, mobility barriers like sales force size can be overcome by application of sufficient money, through for example a parent company with "deep pockets" financing the hire of appropriate numbers of salespeople from an outsourcing agency. Although not all companies can employ such tactics to equal effect, for example in a study of the grocery industry, it was found that "larger retailers were more able to take advantage of superstore development…than other companies because of their relative size" (Curto, 1998, p 345,).

Mascarenhas and Aaker (Mascarenhas *et al.*, 1989) studying the performance implications of strategic groups within the oil industry considered that the concept of mobility barriers was pivotal to the strategic group concept they, therefore, proposed a further definition of a strategic group, namely:

> "A grouping of businesses within an industry that is separated from other groupings of businesses by mobility barriers, barriers to entry and exit" (Mascarenhas *et al.*, 1989, p 475).

They concluded that mobility barriers are much more about "who you are" and are resource dependent than "what you do" or the actions taken. This position was supported by Mehra and Floyd (1998) who argued that industries are not equal, as originally assumed within IO research, but differ significantly in terms of product market heterogeneity, the available space for different strategic groups to occupy, and in terms of resource inimitability. These, they argue, are the building blocks of mobility barriers. Their theory proposes that strategic groups can only exist and persist over time if there is sufficient heterogeneity of market positions within the industry and firms possess the basis to build sustainable mobility barriers. A four cell model was then suggested by Mehra *and Floyd* based on two axes, the degree of product/market heterogeneity and the degree of resource inimitability. This theory seeks to explain why some industry studies have failed to find significant performance differences between groups. It proposes that the stability of groups and the number of expected groupings should be predictable in advance based on these two parameters (Mehra *et al.*, 1998).

Exploring the conditions under which sustainable performance differences may persist, (Dranove *et al.*, 1998) reiterate that an effective mobility barrier must be in place to prevent entry or imitation by outside competition and, in addition, a group-level effect must occur as the result of intra-group strategic interactions. These group interactions change the way firms compete. They may take the form of market power effects, such as the price fixing by some pharmaceutical companies that was recently alleged to have occurred within the UK (Burleigh, 2003 p. 480). Group interactions may lead to efficiency gains, for example through common co-promotion agreements. Alternatively, the group members may benefit from consumer preference. This may be due to an

enhanced group reputation or more effective promotion of products, for example through fielding a large sales force.

The findings of Dranove et al (1998) were confirmed in an empirical study of the Japanese Steel industry (Nair & Filler, 2003,). This study used cointegration analysis to examine the relationship between firm behaviour and strategic group membership. The authors concluded that strategies may take a long time to adjust and suggested that group membership determined interaction between members. These adjustments support the proposition that firm moves are often made in alignment with reference firms, but that when environmental shocks occur firms' responses vary and they may either converge towards a common strategy or diverge away from it.

In the studies by Mascarenhas and Aaker, mobility is higher between less protected similar groups because market entry requires overcoming relatively fewer mobility barriers. This finding is consistent with the argument in Caves and Porter (Caves *et al.*, 1977) and the "stepping stone" idea advanced by McGee and Thomas (McGee *et al.*, 1986). Therefore, Mascarenhas and Aaker provided a research focus based on a common strategy *conceptualisation* of strategic groups. The tacit element of strategic decisions was brought more squarely into the argument. They concluded from their research that:

> "The results suggest credibility for the strategic group concept motivated by mobility barriers ..... A high degree of group stability was observed, ... indicating that mobility barriers did exist ..." (Mascarenhas *et al.*, 1989, p 484).

Mobility barriers have continued to be a key concept that underpins the idea of strategic groups, providing the means by which sustained performance differences between

groups can exist (Porter, 1980). However, mobility barriers, as originally described (Caves *et al.*, 1977), included a policy of collusion in which firms could act in concert to promote their common interest by building high entry barriers in order to protect group profits. This idea, analogous to groups of residents building the walls of a medieval city to repel invaders, was not, however, born out by subsequent research. It seemed more probable that a number of firms made similar investments due to the similarity of strategies pursued by firms within a particular strategic group rather than because of collusion. For example, through focusing upon similar research and development targets, or by the deployment of similarly sized sales forces. This could be prompted by following the lead of an individual firm, perceived as a reference point by other group members (Bogner, 1991; Fiegenbaum *et al.*, 1995).

The question of which variables to select in order to define strategic groups therefore became a matter of *which* mobility barriers best describe the structural components of an industry that prevent the free movement of firms between groups. Arguably, only a handful of key decisions may prove to be of significance. For example, employing Porter's generic "differentiation" strategy (Porter, 1980), firms might invest heavily or selectively in research and development where patents provide an important mobility barrier. Recent research suggests that R&D presents a structural barrier based more upon the stochastic probability of finding a viable and attractive new product than being the result of similar or collusive actions by group members (Lee *et al.*, 2002):

> "we focus on the entry limiting effect due to the inherent difficulty of developing a high end product. Thus, it is more appropriate to consider this difficulty as a structural barrier than a barrier erected by incumbents" (Lee *et al.*, 2002, p 731.).

In conclusion, the use of mobility barriers to define strategic groups remains central to the theory. Strategic groups cannot persist without mobility barriers, therefore identification of meaningful strategic groups becomes, in part, a process of identifying the key strategic decisions that build and sustain market position within a given industry.

2.6 How strategic groups form?

Allied to the idea of mobility barriers as bulwarks that sustain intra-industry structure and allow group structure to persist over time, is the question as to how the differences that give rise to group positions develop in the first place. In their 1977 article, Caves and Porter infer that random differences result in different starting points for firms that make individual choices dependant, for example, upon their attitude to risk:

> "Assume an industry with firms virtually identical in all aspects except for random differences in scale. One firm undertakes an investment and alters its strategy to place entrants to the industry at a disadvantage. The investment in higher barriers also affects the firm's competitive posture vis-à-vis its actual rivals, who react either by matching the initiating strategy or by adopting different ones more suitable to their initial sizes. If the rivals opt for systematically different strategies, we have the basis for a group structure" (Caves *et al.*, 1977, p 253).

Tang and Thomas propose that strategic groups form because firms in an industry need to interpret similar sets of competitive cues and problems over time. Through imitative behaviour firms create group level beliefs about the competitive space and the authors suggest a model of spatial location competition, which posits that relocation costs determine the group structure of industries with differentiable products (Tang *et al.*, 1992). A firm's strategy is described as a location point in space surrounded by the variables that describe the firm's strategy. The height of mobility barriers is represented

by the costs of relocation inherent in these strategy variables. Some variables, for example research costs, represent more permanent investments that are difficult to alter, while others such as price or advertising are more easily adjusted. In industries with moderate to high relocation costs, a group structure is predicted. This model is similar to that proposed by Mehra *et al*, who suggested that a stable strategic group structure was an industry specific phenomenon, more likely to occur in industries with a combination of high product/market heterogeneity and strong differentiation based on inimitable factors, such as R&D (Mehra *et al.*, 1998).

The importance of market heterogeneity was also discussed by Duyster, who stated that:

> "as many companies compete in different markets, strategic group formation should not be identified in terms of the companies' main economic activities but in particular be related to their multi market competitive positioning" (Duyster *et al.*, 1995, p 361.).

Work on modelling the evolution of strategic group structures led the authors to conclude that four factors were important in determining whether stable strategic group structures will arise in a given industry, namely mobility barriers, the degree of interaction between high performers, the extent to which rivalry extends across firms pursuing dissimilar strategies, and the presence of dynamic capabilities. In particular, the authors demonstrate numerically that strategic groups are not likely to emerge and persist where dynamic capabilities, or the ability to refresh market positions, are absent (Lee *et al.*, 2002).

More recently these ideas have been extended by empirical work that proposes a mechanism where by innovators invested more consistently in antibiotic research than imitators in the US Pharmaceutical industry and that this difference over time gave rise

to a group structure:

> "We estimate that, on average, innovators introduced eight times as many new chemical entities as did imitators between 1940 and 1960. In contrast, imitators did not commit resources to R&D and remained peripheral to innovation. In sum, our results support a main theme in the strategic group literature: Strategic divergence can emerge and persist in an industry" (Lee, 2003).

Clearly the higher the relocation costs between different groups, the greater the group stability and visa-versa, a theme explored in the next section.

2.7 Strategic group stability

Oster's work on the stability of strategic group intra-industry structures over time (Oster, 1982) followed the methodology of Porter and defined strategic groups on the basis of high and low advertisers. She then explored the dynamics of strategic group membership within 19 US consumer goods industries, between 1971 and 1977. Her principal findings were that strategic groups were stable structures with a low degree of movement between groups. Oster's study deserves attention because it was the first attempt to assess empirically the extent of inter-group mobility. However, the method adopted can be criticised for the use of an overly-simple identification of group membership, i.e. low vs. high advertisers. Also, by measuring annual changes there is possibly an assumption that firms change group membership on an annual basis.

The work of several other researchers (Bogner, 1991; Cool, 1985; Fiegenbaum, 1987; Martens, 1988) on strategic group stability shared a common methodology. Firstly, an extensive industry analysis was conducted in order to identify industry specific variables. These were then operationalised to identify strategic groups. Secondly, stable strategic time periods (SSTPs) were identified between which changes in strategic group membership could be observed. Thirdly, an extensive industry analysis was

conducted in order to identify industry specific variables, which were then operationalised to identify strategic groups.

The three studies by Cool, Fiegenbaum and Martens explored the dynamics of strategic groups over a considerable time period and attempted to illustrate consistent performance differences between groups. The work of Cool (1985) focused on the US pharmaceutical industry between 1963 and 1982 and that of Fiegenbaum (1987) on the US insurance industry over a 15 year period. Fiegenbaum identified five to seven strategic groups within the period of his study, and found significant performance differences between the three main strategic groups that he identified for all SSTPs (with the exception of his risk adjusted performance measure, which was only significant for one stable strategic time period). An interesting element of the study was the attempt to measure firm movement towards industry benchmarks, where Fiegenbaum found some support for the idea of the strategic group as a reference point. Also, in contrast to Cool, who identified four SSTPs over a 20 year time span, Fiegenbaum identified nine, with the majority lasting for only one year. Fiegenbaum attributed this primarily to the degree of turbulence within the US insurance industry, driven by price and regulatory changes. However, it is worth noting that the US pharmaceutical industry also faced considerable turbulence during the 20 year period studied by Cool, so this explanation for the larger number of SSTP's found by Fiegenbaum may not be valid.

In another study, this time of railroad firm strategies before and after regulation, five strategic groups were identified and it was found that most firms changed their

strategies in response to environmental variation. Strategic changes involving innovation or contingency strategies proved the most profitable and the authors concluded that firms that changed their strategies out-performed those that did not (Smith *et al.*, 1987).

These studies illustrate some of the idiosyncrasy between different industries, which underlines the difficulty of making valid comparisons between very different industries. For example, despite the similarity in methodology and the performance measures chosen by both Cool and Fiegenbaum, the US insurance and pharmaceutical industries each operate to their own industry norms and rules of engagement. The drivers in one industry may be very different to those of another and caution should perhaps be taken when drawing conclusions on similarity across different industries.

The study by Martens (Martens, 1988) built on Cool's study and addressed the same industry, pharmaceuticals, although in Martens' case across five EC member countries. A longitudinal study was adopted, measuring strategic group dynamics encompassing 41 pharmaceutical companies over an eight year period, between 1978 and 1985. Martens observed that the strategic group structure is not a very stable phenomenon in the EC pharmaceutical industry and that firms in groups that had a relatively low strategic distance experienced many strategic group shifts. He concluded that:

> "..the pharmaceutical industry is not always structured into clear distinct strategic groups. the concept of strategic distance or strategic asymmetry can be relevant in this respect and certainly deserves further attention in the strategic group theory and research. Comparing pairs of strategic groups on several strategy dimensions may reveal the closeness of strategic groups and may also give an indication of the strategic groups from which most strategic group shifts may be expected" (Martens, 1988, p 344).

In a similar type of study, Bogner (1991) looked at the US pharmaceutical market for a period of 20 years between 1969 and 1988. Bogner studied strategic group dynamics and examined various hypotheses as to why firms change their grouping and under what circumstances. Using a methodology similar to that in previous strategic group research (Cool, 1985; Fiegenbaum, 1987; Martens, 1988) and two distinct sets of analysis, Bogner showed that patterns of strategic group dynamics certainly exist. But he also found that the underlying nature of these patterns is not consistent with what had been assumed to underlie strategic group structures and their dynamics in earlier research. Using paired questions, he first explored the extent to which strategic groups reflected past performance and whether strategic groups could be used accurately to predict future market positions. He then considered the effect of the environment using a similar set of paired questions, one reflecting past responses and the other future actions. He concluded that strategic groups are not simply cognitive creations but are derived from artefacts of strategic intent, resource allocations and product introductions. Strategic groups are based upon managers' decisions based on *individual* firm performance and objectives and not on some group homogeneity.

In a second set of questions Bogner explored whether firms change groups at times of environmental turbulence, something predicted by mobility barrier theory because barriers are likely to be lowered at a time of environmental flux. Contrary to expectation, firms were found to move at all times and the changes were not driven by a single environmental opportunity. This result is consistent with a less deterministic view of strategic group theory and stands in stark contrast especially to the conclusions from traditional IO. In particular it challenges the widely held belief that strategic groups are

differentially impacted by changes within the operating environment. Bogner concluded that the factors that led managers to move their firms out of a grouping are unrelated in time or focus to the occasional disruptions in the pattern of competition within the industry at large. He also concluded that a firm's ability to move is not wholly constrained by environmental or mobility barriers, whether during a stable strategic time period or at a break between SSTPs. Mobility barriers are discussed in terms of the result of *internal* choices within firms not in terms of uncontrollable external events.

Bogner argued that firms adjust their competitive position based on benchmarking within their strategic group. Economically profitable firms are ones that have the flexibility to act on changes in perception, manage to acquire appropriate assets, and change their competitive postures accordingly. If a firm is not performing to group standards, the reference position, then proactive choices can be made to improve competitiveness. His notion of the competitive group adds to the idea of strategic choice. Bogner's study supports the proposition that mobility barriers are not something in the environment imposed upon the firm but result from the firm's own actions.

2.8 The Application of Generic Strategies

The discussion so far has highlighted the richness of strategic group theory, as well as its weaknesses and some inconsistencies. One of the most enduring of these weaknesses is that without prior theory as to the number and broad differences between groups, it is difficult to defend against the charge that strategic groups are an artefact of the application of cluster analysis to a data set (Tang *et al.*, 1992; Thomas *et al.*, 1988). Moreover, a discussion of the development of strategic group theory alone cannot provide a conclusive comment on its value for future management research. To go further we need to establish the desirable characteristics of a strategy classification

scheme for research and assess obvious alternatives to that offered by strategic group theory (Leask *et al.*, 2003a).

Previous research has argued that the world of organizations is too complex to permit the development of any comprehensive typology capable of encompassing every form of organizational behaviour (Miles *et al.*, 1978). This is a sentiment supported by Hawes and Crittenden, who conclude: "Therefore it may be more appropriate to focus on a limited domain of competitive strategy that appears particularly amenable to understanding" (Hawes *et al.*, 1984, p 277).

When reviewing the use of generic strategy templates, for the study of competitive strategy, it is perhaps useful to reflect on what characteristics a strategy classification system should comprise of to provide a useful basis for management research and practice. The following suggestions are provided here to aid the comparison between generic strategy classifications and their use within strategic group research (Leask *et al.*, 2003b).

1. Provide a meaningful classification of strategies employed within an industry recognized by managers within that industry as valid.
2. Allow competitive dynamics over time to be effectively measured and evolutionary pathways traced.
3. Permit flexibility in the use of a wide range of different strategies utilizing both quantitative data and qualitative and "perceptual" information.
4. Enable a fine grained analysis of strategies within an industry, allowing a detailed and meaningful classification based on multiple possible groupings rather than a highly restricted set.
5. Be readily accessible to and useable by managers.

Two obvious alternative strategy classifications to strategic groups for research in strategic management are Porter's "generic strategies" and the Miles and Snow's "typologies".

Porter's approach to generic strategies plots companies along two simple dimensions, the breadth of their product/market offering against the choice of selling on price as "lowest cost producer" or differentiating on product benefits or other added value (Porter, 1980). Porter thus offers four broad positioning alternatives, namely broad market vs. focus and low cost vs. differentiation. The advantage of the generic strategies approach lies in its simplicity and comparative ease of application. All of the data necessary to populate the model are usually readily available. The principal weakness of generic strategy theory is that it represents a blunt and crude measure to identify and portray subtle patterns of strategic choice. It does not allow the sophisticated separation of different but broadly similar strategic choices nor does it recognize the importance of the relative position of firms in their ability to capitalize upon a given opportunity.

In the pharmaceutical industry, for example, a primary driver is the supply of new products. But Porter's classification does not allow for the separation of companies employing an extensive licensing programme within a differentiation strategy, for instance as pursued by the company Wyeth, as against a strategy based primarily upon researching own compounds, as adopted by Merck. It must also be recognized that research costs are likely to be a significant mobility barrier in the industry. Pharmaceutical companies are forced by the economics of the research process to employ a differentiated marketing approach, targeted at the broadest market possible, to recoup their research costs before patent expiry. Therefore, while the product/market dimension has some value within this industry, the differentiated vs. low cost dimension is too blunt to provide significant explanatory power.

Porter's generic strategies may, however, be perceived as supra groupings into which different sets of strategic groups may fit; a conclusion hinted at by Porter:

> "The three generic strategies represent three broad and consistent approaches to successful strategic positioning .... They are different broad types of strategic groups that can be successful depending on the economics of the particular industry"(Porter, 1980, p 152).

In other words, strategic group theory provides the potentially fine grained analysis that can be nested in the concept of generic strategy. In a study of 22 independent firms within the paint and allied products industry Dess and Davis tested Porter's assertion

that:

> "Firms oriented towards specific strategies should outperform firms characterized by Porter as "stuck in the middle". Porter maintains that this latter class of firms by failing to develop its strategy along at least one of these three categories is almost guaranteed low profitability(Porter, 1980, p 41)"

In a carefully designed study involving interviews of top management and the use of an expert panel, together with factor and cluster analyses, four separate patterns of strategy were uncovered analogous to focus, differentiation, low cost and "stuck in the middle". The three "generic strategies" consistently out performed firms that had failed to align to a specific generic strategy (Dess *et al.*, 1984). These results are consistent with similar research conducted on 54 firms within the Korean electronics industry, where once again four strategic groups were identified and firms without a clear cut generic strategy performed less well that those using generic strategies (Kim *et al.*, 1988). A simpler technique was employed to identify strategic groups following generic strategies in the airlines industry (Kling *et al.*, 1995). Using a competitive mapping technique (Porter, 1980, p152), cost per seat mile was mapped against airline quality rating, revealing strategic groups largely consistent with the prescriptions of the Porter model. Martens (1988) compared the strategic groups that he identified within the pharmaceutical industry in terms of generic strategies and found that "although some strategic groups resembled some of the generic strategy types…some groups had characteristics common to several generic strategy types" (Martens, 1988, p 344). He concluded that generic strategy types may be more valuable in comparing groups of firms stemming from several industries, in which a higher level of generalization is unavoidable.

The Miles and Snow typology (Miles *et al.*, 1978) differentiates firms into four groupings - defender, prospector, analyzer and reactor. Again two key dimensions are used to separate firms, namely breadth of product/market domain, a dimension also chosen by Porter, and the degree of environmental uncertainty. The nub of Miles and Snow's argument hinges on three points. Firstly, that managerial or strategic choice represents the primary link between an organization and its environment. Secondly, that management's ability to understand and manage the organization's interaction with its environment is the key to success. Thirdly, that a primary distinguishing factor between

organization types is the multiple ways that management responds to environmental cues. In essence, the Miles and Snow typology broadly classifies firms into three discernable strategic types and "reactors", which arguably represents a catch all category representing no clear strategy. This might be seen as similar to Porter's "stuck in the middle". The primary variables used to classify firms and position them along the two dimensions are product/market domain, growth engine, technology, planning, structure, control, performance appraisal and co-ordination. Clearly, the last five of these variables are all "internal" to the firm and effectively invisible to the external observer. Therefore, to apply Miles and Snow's typology in research requires the gathering of perceptual information. This brings with it the attendant problems of distinguishing between realized and intended strategy, while the mapping of evolutionary changes is also rendered problematic. Thus, while Miles and Snow's classification allows the consideration of a number of variables, the taxonomy presents problems with regard to data gathering, ease of application and interpretation. Despite these limitations, the Miles and Snow typology has been successfully used to identify strategic groups in a number of industries. A study of 478 US supermarket chain stores used an 18 variable Likert scale questionnaire to elicit strategy responses from senior executives. The data were analysed using cluster analysis and multivariate analysis of variance. The results revealed four distinct strategy types within the generic branded grocery market. The four strategic groups identified were aggressive initiators, conservative reactors, submissive defenders and non-participants. These were broadly similar to the classifications suggested by Miles and Snow. A significant difference was found between the strategic groups, with aggressive initiators consistently outperforming the other strategic groups (Hawes *et al.*, 1984).

In another study, of this time 47 US electronic manufacturing firms, a questionnaire was used to classify firms into four strategic groups. The authors found consistent differences between the analyzer and prospector groups, but a number of inconsistencies were found between the defender group and Miles and Snow's defender categorization. On balance, the findings offered modest support for the Miles and Snow typology (Smith *et al.*, 1989).

The combination of generic strategies with strategic group theory provides the ability to build a more solid and useful framework. A criticism of some strategic group research is that it lacks a sound theoretical base *a priori*. This charge stems from the suggestion that strategic groups are an artefact of method (Barney *et al.*, 1990). Use of generic strategies as a template provides a theoretical framework into which strategic group theory can be nested. Strategic group theory in exchange provides the means to classify firms' strategies with more precision than the differentiation low cost dichotomy that was suggested by Porter(Porter, 1980).

2.9 Cognitive groups

Another approach that developed in the 1980s to define strategic groups is referred to as "cognitive research". Cognitive research is based on the notion that perception is reality and that an understanding of decision processes can help to separate strategic groups. Cognitive groupings may be expected to capture both participant perceptions and indications of future action. The cognitive research theme encompasses the idea that managers construct market models based on their personal perceptions of competition, which may differ from objective reality. It is assumed that "through processes involving induction, problem solving and reasoning decision makers construct a mental model of the competitive environment" (Porac *et al.*, 1994, p. 119). These models are used both to determine *who* are the competition and *where* the corporate focus should be applied when competing. The outcome of realised strategy then rests, ultimately, upon the institutional and cognitive constructions of decision makers. Porac *et al.* introduce the idea of primary competitive groups, defined as

"the collection of firms that define each other as rivals" (Porac *et al.*, 1989, p. 414).

This is an approach similar to that of Bogner who introduced the idea of the "competitive group", which he defined as:

> "an intra-industry combination of firms which are following similar strategies. Where firms follow similar strategies because they have different historical backgrounds, that have provided them with different stocks or competencies or assets and because different managers have identified different ways in which they can compete in the industry" (Bogner, 1991, p. 496).

The cognitive approach to strategic groups comprises a minimum of two beliefs. Firstly, that the perceptions of managers about a firm's identity, its competitors, customers and

suppliers, determines the set of transactions that link the firm with its environment. Secondly, that perceptions determine industry recipes or generic strategies, which in turn delineate the actions necessary to compete in the firm's operating environment. An important assumption for groupings based on common perceptions is a common interpretation of external events, with future resource decisions based on these interpretations. In a study of strategic group perceptions among Chicago bankers, Reger (Reger, 1988) found strong evidence of consistent cognitive maps across respondents. While Porac *et al.*(Porac *et al.*, 1994) studying Scottish knitwear manufacturers, described the creation of cognitive communities, where industry "group think" results from managers in similarly placed firms interpreting the same environmental cues and attempting to solve similar problems.

A notable advantage of the cognitive research stream in strategic group theory is the recognition of the importance of management perceptions in defining the competition. The major weaknesses of the research relate to the relatively small samples used in the empirical analyses and the very discrete markets chosen. In the case of the Scottish knitwear market, for example, Porac *et al.* (Porac *et al.*, 1994) note the absence of sound and validated market data available to managers. This may have prompted a more active exchange of views between managers in participating companies than would be the case in larger, more data rich industries. It is also important to note that drawing up strategic groups based on cognitive factors provides an insight into *intended* strategy, while studies that include performance measures e.g. (Dess *et al.*, 1984) are comparing the outputs of *realized* strategy. This management perspective does, however, provide the opportunity to explore the mechanism behind the observed change in strategy and thus to add an additional dimesion to strategic group research (Curto, 1998,). An enduring problem in this type of research is that people do not always do what they say they will do - nor are they necessarily always truthful when revealing their intended strategy to researchers!

2.10 Intra-Group Performance

This empirical work draws heavily on the earlier research of Porter (Porter, 1976; Porter, 1979) that provides the primary theory base for intra-industry performance as discussed above. A number of studies have reported greater performance differences within strategic groups than between strategic groups (Cool, 1985; Cool *et al.*, 1987b; Martens, 1988). This result Porter explains in terms of the different abilities of firms within the same strategic group to implement their chosen strategy effectively:

> "The final factor entering into the analysis of a firm's position in its strategic group is its implementation ability. Not all firms pursuing the same strategy (thus in the same strategic group) will necessarily be equally profitable …Some firms are superior in their ability to organize and manage operations, develop creative advertising themes with equal budgets, make technological breakthroughs with the same expenditures on R&D, and so on. These sorts of skills are not structural advantages of the sort created by mobility barriers…but may well be relatively stable advantages. The firms that have superior implementation ability will be more profitable than other firms in the strategic group" (Porter, 1980, p 144).

> "Strengths and weaknesses in implementation, based on differences in a firm's ability to execute strategies, rest on people and managerial abilities. As such, they may be more ephemeral, though not necessarily"(Porter, 1980, p 150).

Recently this phenomenon, predicted to occur in industries with low product market heterogeneity and strong resource inimitability (Mehra *et al.*, 1998), has become the focus of a separate line of research (McNamara *et al.*, 2003). For example, a study of 54 US banking firms revealed significant performance difference within strategic groups for return on assets (ROA) and return on equity (ROE) as performance measures. The authors classified firms within groups into core and secondary firms. Finding that secondary firms outperformed core firms, the authors concluded that firm positioning within a group has performance implications (McNamara *et al.*, 2003). Faced with similar intra-group performance differences, in his study of the US pharmaceutical industry, Cool explains this finding in terms of different attitudes to risk by resident

firms (Cool, 1985; Cool *et al.*, 1987b). This explanation links strongly to the comments of Porter, described earlier, regarding people and managerial attitudes (Porter, 1980).

2.11 Population Ecology

The final theme that blossomed briefly in the 1990s was an approach to strategic groups based on the pioneering work of Hannan and Freeman (Hannan *et al.*, 1977), on the population ecology of organizations. This evolutionary view of strategy led to strategic groups being considered as equivalent to species. In 1991 Boeker studied the dynamics of three populations of US brewing firms over an 18 year period, applying a population ecology perspective to derive strategic groups. The approach adopted was to apply ecological models measuring primarily the effect of competition between populations and how environmental change impacted the size of each population (Boeker, 1991).This was followed in 1992 by a study from Carroll and Swaminathan, also on US brewing (Carroll *et al.*, 1992). These studies argued that strategic groups should be identified in terms of organizational form rather than perceived strategies, which can be highly normative in nature. In this analysis, organizational form encompasses not only the formal organizational structure but also "all factors that define a population's niche, including especially environmental factors" (Carroll *et al.*, 1992, p.68).

In other words, the environment, very broadly defined, determines the performance of firms. The result is a deterministic approach to strategic groups under which the scope for independent managerial decision making is severely constrained. This line of research has not been widely adopted, perhaps because some strategy researchers find such a strictly exogenous view of the formation and continuation of strategic groups unattractive. This exogenous view assumes that firm survival is a function of external forces such as the degree of competition and the relative availability of environmental resources an approach which differs markedly from this research which assumes that strategy is driven by strategic choice as measured by a largely endogenous set of decisions measured through such factors as market scope and resource deployment. The population ecology line of research is therefore not directly germane to the subject of this research and it need not be discussed further here.

In conclusion, from its origins in IO economics strategic group research has developed to encompass a variety of different themes within a large number of industry settings. This variety is driven primarily through strategic management research that represents the bulk of the more recent studies. Here, strategic group theory has frequently been used to apply a different lens to an established field of study, for example generic strategies, or population ecology. This diversity both in the central purpose of research and in the chosen industry setting perhaps contributes to confusion over what is meant by strategic groups and to the practical use of the strategic group concept. If strategic groups offer the means accurately to classify strategic choice then research must concentrate on industry specific studies sharing a common approach to the identification of strategic groups. To date, however, a common approach even within industries has not emerged. The next section of the chapter explores in more detail the previous strategic group research pertaining to pharmaceuticals.

2.12 The Pharmaceutical industry as a context for Strategic Group Research

A number of studies have already measured certain aspects of strategic groups and performance within the pharmaceutical industry (Bogner, 1991; Cool, 1985; Cool *et al.*, 1994; Cool *et al.*, 1988; Cool *et al.*, 1987b; Guedri, 1998; Martens, 1988; Osbourne, 1996; Voyer., 1993).

The study by Cool was the first devoted exclusively to the pharmaceutical industry and sought to confirm the presence of strategic groups within US pharmaceuticals over a twenty year period, from 1963 to 1982. Secondary archival data was used and fifteen variables, based upon scale, scope and resource commitments, were adopted to identify strategic groups across stable strategic time periods (SSTPs). Cool confirmed the presence of strategic groups, but the intra-industry group structure was found to change

significantly over the twenty years (Cool, 1985; Cool *et al.*, 1987b). Also, strategic groups were found to differ significantly in terms of performance, as measured by market share and weighted market share, though no significant difference was found with regard to profitability or risk adjusted performance (Cool, 1985; Cool *et al.*, 1988). A further interesting finding was that strategic group members in US pharmaceuticals displayed differences in performance whilst pursuing similar strategies. This was explained by differences in risk taking among strategic group members.

Cool's study was limited in it contained only 22 firms, all of which were resident in the US and had not engaged in merger activity. Arguably a modern strategic group study centered on pharmaceuticals would find this approach rather restrictive given the number of large multinational firms and the role that mergers have played in shaping the industry over the last twenty years (Pursche, 1996).

Corroboration for the strategic group structure as reported by Cool was provided by Osborne's research, also on the US pharmaceutical industry. Through analyzing letters to shareholders during the period 1963 to 1982 and using linguistic themes, "a topical schema which categorises words into related groups" (Osborne, 1996, p 15), the aim was to classify intended strategy into "thematic groups," in a direct parallel to the process of labeling strategic groups based on realized strategy. A statistically significant relationship was found between the strategic groups identified in Cool's study and the thematic groups identified by Osborne.

Employing a similar study design to that of Cool, Martens investigated the pharmaceutical industry in five European Community (EC) countries (Martens, 1988). This study is unusual in the inclusion of several countries and it is also notable because it appears to be the only strategic group research carried out on the UK pharmaceutical industry, prior to the research reported in this thesis. Forty one firms were selected for the study, which identified two stable strategic time periods within an eight year period, 1978-1985. The research employed six variables to identify the strategic groups, revealing a group structure of nine strategic groups in 1981 and ten in 1985. Martens, however, failed to find an unequivocal cluster solution for 1981. This led him to conclude that "the pharmaceutical industry is not always structured into clear distinct strategic groups" (Martens, 1988, p 344). Also, no consistent performance difference was found between the strategic groups he identified (Martens, 1988).

In his study of the US pharmaceutical industry Bogner primarily investigated the dynamics of inter-group movement over a twenty year period (Bogner, 1991). Thirty six firms were included in the study, which used four marketing variables and three R&D measures to identify strategic groups. Although the primary questions addressed by this research related to group stability over time, as discussed earlier in this chapter, Bogner did investigate whether the return on sales (ROS), return on net income (RONI) and return on assets (ROA) differed significantly between strategic groups. In accord with previous research (Cool, 1985; Fiegenbaum, 1987), a distinction was made between mean returns, the variation (or risk) associated with those returns, and the risk adjusted returns of the firms studied. No consistent significant performance difference was recorded between strategic groups for any of nine performance measures, although

Bogner does note (Bogner, 1991, p 467.) that the analysis was weakened by the elimination of many of the non-US firms from this part of the research due to a lack of data.

A later study involving Bogner *et al* explored the entry paths of European firms into the US pharmaceutical industry over a twenty year period (Bogner *et al.*, 1996). Seven strategic variables were selected through a combination of survey, product and patent data. The authors sought to test a number of the earlier assumptions with regard to mobility barriers (Caves *et al.*, 1977) and discovered that firms, as expected, followed an incremental path in trying to improve their competitive position. Contrary to expectation, however, firms did not enter the industry via the lowest mobility barrier. Entry appeared to be related more to the parent company's resource base, which was also found to exert a marked effect upon the final competitive position gained. No difference was found between the responses of immigrant and resident firms to environmental shocks (Bogner *et al.*, 1996).

In a more recent study Guedri examined the relationship between strategic groups, growth capability and performance in the global pharmaceutical industry (Guedri, 1998). Nine scope and three resource variables were used to identify strategic groups during the period 1995 to 1997 from a selection of 42 pharmaceutical firms. Four strategic groups were identified where member firms differed in both growth capability and performance, but no statistical performance difference was found between these groups. The strong intra-group differences are congruent with the earlier findings reported by Cool and Martens (Cool, 1985; Cool *et al.*, 1987b; Martens, 1988).

A limitation of the Guedri study is the exclusion of Japanese firms, although both Cool and Martens also excluded them. Points of note include the global perspective of the study, and the sophisticated use of clustering methods to determine groups. The method adopted involved the reduction of variables by the use of principle component analysis followed by the application of two clustering algorithms namely Wards method followed by a divisive clustering method.

From these earlier studies of pharmaceuticals a number of common elements appear. Firstly, in all cases a number of relatively stable strategic groups were found to exist, although significant changes to group membership were observed to take place over time. Secondly, several of the studies employed a largely common methodology, based upon identifying stable strategic time periods (SSTPs) within a more lengthy research period (Bogner, 1991; Cool, 1985; Cool *et al.*, 1987b; Fiegenbaum *et al.*, 1990; Martens, 1988). Thirdly, a common clustering algorithm was generally chosen, with Ward's method the most popular choice . Fourthly, the sample of firms selected generally excluded a number of possibly significant firms. For example, Cool excluded non US companies, while Guedri and Martens both excluded Japanese firms from their analyses (Cool, 1985; Cool *et al.*, 1987b; Guedri, 1998; Martens, 1988). Finally, the number of variables chosen to separate strategic groups varied between six and seventeen, with the variables chosen generally reflecting scale, scope and resource commitments (Cool, 1985; Cool *et al.*, 1987b; Fiegenbaum *et al.*, 1990; Guedri, 1998; Martens, 1988). A summary of the method, data and findings from these studies is provided in Table 2.2.

Table 2 Summary of Previous Strategic Group Studies Within the Pharmaceutical Industry[2]

	Cool 1985	Martens 1988	Fiegenbaum *et al* 1990	Bogner 1991	Guedri 1998
Industry Focus	US	5 E.C. Countries	Global	US	Global
Time Period	1963-1982	1978-1985	1974-1981	1969-1988	1995-1997
Number of Firms	22	42	22	41	42
Major Exclusions	Non-US Companies. Merged Companies. Generic Companies.	Some private companies.	None Listed.	Some non-US excluded from the performance analysis.	Japanese Companies.
Number of Strategic Groups Identified	4 to 6	9 to 10	3 or 4	4 to 6	4
Performance Variable Measured	Market share Weighted market share Return on sales Risk Adjusted Sets of Each of the Above	Percentage increase in Weighted market share over a 4 year period	Not Measured	Return on investment Return on net investment Return on assets	Return on assets
Data Source	IMS[3] Company Annual Reports	IMS Company Annual Reports	Compustat	IMS Company Annual Reports	Company Annual Reports

[2] It should be noted that some of these studies notably the study by of Cool (1985) provided the basis for a number of follow on studies and publications e.g. (Cool & Schendel, 1987b; Cool & Schendel, 1988; Cool & Dierickx, 1993,).

[3] IMS is an abbreviation for Intercontinental Medical Statistics. IMS provides the standard audits of market data for the pharmaceutical industry measuring sales and promotion.

There is much disagreement in the studies on the impact of strategic groups on performance. Cool concluded that market share differed significantly between groups within US pharmaceuticals for all time periods and weighted market share for all but one time period (Cool, 1985). No differences, however, were found between groups in terms of risk or risk-adjusted performance (Cool, 1985; Cool & Schendel, 1988,). It was, however, found that "over the 20-year period studied, different risk reward relationships characterize strategic investments of firms in the US pharmaceutical industry"(Cool & Schendel, 1988 p 219,). These relationships followed a pattern over the period studied and the authors concluded that "risk stems primarily from a discontinuity between past and current strategy, and not per se from the type of strategy currently employed" (Cool & Schendel, 1988 p 220,). Martens failed to find any performance difference between groups in terms of growth in weighted market share. This led him to postulate that within group performance differences may outweigh between group differences (Martens, 1988). Bogner and Guedri also reported no significant performance differences between strategic groups (Bogner, 1991; Guedri, 1998); but Voyer in his study of "cognitive groups" within the US pharmaceutical industry found significant differences in terms of profit, earning per share and return on equity (Voyer., 1993, p11).

A further study explored the impact of rivalry on firm's profits (Cool & Dierickx, 1993,). This study was prompted by the observation that although firm profits fell by 40% during the period 1963-1982, in the US pharmaceutical industry, factors such as industry concentration, segment interdependence and strategic distance between firms remained largely unchanged. An interesting observation was that the relative position of key strategic groups changed over time and that these configuration changes "were

linked to the effects of within and between group rivalry on performance" (Cool & Dierickx, 1993 p 57,) .The authors concluded that as innovation declined and product differentiation waned imitation became more prevalent leading to an increase in rivalry between firms. It was found that the most profitable firms were those that dominated their segment.

The general conclusion from a review of the published research is that there is strong evidence for the existence of strategic groups within the US pharmaceutical industry, though not for the link to performance differences. However, there has been much more limited investigation of other countries' pharmaceutical sectors. Also, while there is no strong evidence of performance differences between strategic groups, drawing conclusions is complicated by differences across studies in the way performance is defined and measured.

2.13 Key Research Questions Arising From This Literature Review

When the value of strategic groups in researching the link between strategy and performance was originally called into question (Barney *et al.*, 1990), a key issue was whether strategic groups represent a valid and useful concept or were strategic groups merely an artefact of the mathematical algorithms used inductively to discover strategic groups? In answer to whether strategic groups are a mathematical myth or a potentially useful concept, arguably on balance the research to date supports the value of the strategic group concept. This is because support for strategic groups, does not simply derive from a number of strong theories, or from inductive empirical support, but from a large number of different and unrelated sources drawn from a variety of industries. Cognitive research, for example (Porac *et al.*, 1989; Reger, 1988; Thomas. *et al.*, 1994), confirms that practicing managers make sense of the complexity of their competitive environment through shared mental models that identify who they are in competition

with and the available means to compete in their industry. This research provides face validity from practicing managers and indicates that grouping of industry participants into close and direct competitors, for example, is used by managers seeking to make sense of their firm's environment. Descriptions of these competitive groups (Bogner, 1991; Porac *et al.*, 1989) and cognitive groups (Porac *et al.*, 1989; Porac *et al.*, 1994; Thomas. *et al.*, 1994; Voyer., 1993) bears a strong resemblance to strategic groups, as described in various industries (Cool, 1985; Fiegenbaum, 1987; Ramsler, 1982). Similarities also occur in the work on thematic groups, where through identifying particular language phrases from annual reports and shareholders letters (Osbourne, 1996), intended strategies were classified into thematic groups. These the author claims correlate strongly with the strategic groups identified in previous research (Cool, 1985; Cool *et al.*, 1987b).

But, if strategic groups are valid, why has strategic group research not developed the deep underlying theory more clearly and why, in particular, have performance differences, the nub of much research, not been empirically proven between strategic groups. If strategy matters and strategic groups provide an accurate classification of different strategies within an industry, then surely it must be possible to explain at least some part of performance differences between firms in terms of their strategic group membership. One possible explanation for this apparent anomaly is suggested by Lee:

> "we believe such inconsistencies and disagreements stem partly from the nature of the verbal theory tradition in the field where untested assertions and hidden assumptions tend to confuse researchers" (Lee *et al.*, 2002, p 728).

Porter also suggests another valid explanation, by suggesting that differences within groups can be explained to some extent by firms' differing abilities to implement their chosen strategy effectively (Porter, 1980).

Possibly, therefore, the very diversity of strategic group research has clouded the issue. In particular, a number of the key theories that stemmed from IO economics (Caves *et al.*, 1977; Porter, 1979) were offered without much empirical support. Alternatively,

even when two studies tackle the same context there is little or no agreement between the analytical methods that should be adopted. For example, both Cool and Bogner investigated the US pharmaceutical industry over an overlapping period, but there is little agreement between the studies on the choice of companies included or the variables selected to delineate strategic groups (Bogner, 1991; Cool, 1985).

Strategic group theory potentially provides a theoretical framework to test whether one set of strategies is more effective than another and to analyse and chart competitive dynamics. This was the premise which gave rise to the large number of frequently conflicting studies since the 1970s. The results may be summarised as confirming that strategic groups exist in different industries, but that as yet no clear unambiguous link between strategic group membership and performance has been conclusively demonstrated. A number of the studies have focused upon the US pharmaceutical industry. These have yielded conflicting results with regard to any link between performance and strategic group membership (Bogner, 1991; Bogner *et al.*, 1996; Cool, 1985; Cool *et al.*, 1999; Cool *et al.*, 1988; Cool *et al.*, 1987b; Guedri, 1998; Osborne, 1996). This result in itself is perhaps perplexing given that:

1. The pharmaceutical industry is consistently cited as one of the world's most profitable industries (The Boston Consulting Group, 2000).
2. That the industry spends on average US$700m on each new chemical entity [NCE] that it produces and a further US$400m on marketing (Bastianelli *et al.*, 2001).
3. Analyst valuations of pharmaceutical companies differ widely based on current performance and future expectations (Lehman Brothers, 2003)

4. The long lead times of the industry and the observation that the performance outcome for a given NCE will vary widely dependent upon which company markets the product (Lehman Brothers, 2003).

These facts point to a conclusion that in order to remain highly profitable, pharmaceutical companies must be effective in executing their strategies or they will fail to cover the high costs of research, development and global marketing. Different strategies may be expected to result in markedly different company valuations, which are not simply the result of serendipity. It also appears that the company which is fortunate enough to uncover a blockbuster in the research process does not always win. Thus, the observation that to date strategic group research has not uncovered an unequivocal link to performance in the pharmaceutical industry does not match with expectation. To the contrary, the expectation is that *strategy will matter* in the pharmaceutical industry and that if strategic groups provide an accurate means of classifying pharmaceutical companies' strategies, then there should be performance differences between different strategic groups.

Therefore, the first question that we seek to address in the research reported in this thesis is therefore:

1. Do strategic groups that differ significantly in terms of performance exist within the UK pharmaceutical industry?

As we have seen, the presence of mobility barriers is generally well established in the strategic group literature, but two areas remain open to question. Firstly, do external environmental shocks lead to changes in strategy and hence a change in group membership, as originally predicted by Caves *et al* (1977)? Research here has been equivocal. On the one hand, the environmental shock of regulation has been shown to lead to a shift in strategy within the US railroad industry (Smith *et al.*, 1987); on the

other hand Bogner found no link between strategic group membership changes and environmental factors in US pharmaceuticals (Bogner, 1991). Secondly, do firms that change from one strategic group to another move to a more advantageous position as also suggested by Caves (1977).

The second question that we seek to answer in the research is therefore;

2. Do firms that move from one strategic group to another consistently move into a higher performing group and are such moves concomitant with environmental change?

A third question that arises from the idea of industry change and the observation that a number of mergers occurred during the period encompassed by this research is:

3. Do mergers occur more frequently between strategic groups or within strategic groups?

The final question relates to the predicted relationship between market heterogeneity and strategic groups. Much received theory suggests that the pharmaceutical industry will consist of unstable strategic groups that will differ more in intra-group performance than between groups (Mehra *et al.*, 1998). Porter suggests that interrelated markets and dissimilar strategies will lead to lower performance (Porter, 1976; Porter, 1979), a point recently reiterated (Lee *et al.*, 2002). Here, it is suggested that firms which address the same customer groups and who offer similar products are more likely to co-operate or collude if each approaches the market in essentially the same way. This is because market signals will be readily understood and acted upon and the companies will each recognize their mutual interdependence. If however one firm adopts a markedly different strategy then the firms are less likely to co-operate and damaging price competition is more likely to occur (Porter, 1976; Porter, 1979). Similarly, Porac emphasizes primary competitive groups, where companies compete through offering direct substitutes (Porac *et al.*, 1989). Therefore, if companies compete in the same

markets and direct their activities to common customers, they represent direct rivals, as distinct from companies that address the same customers but do not offer direct substitutes but instead offer either entirely unrelated or complementary products. Competitive groups, therefore, delineate *where* companies compete as distinct from strategic groups that classify firms in terms of *how* they compete. Here Porter suggests that companies in the same strategic group will compete less vigorously than rivals in different strategic groups because they will understand each others motives and achieve some competitive accommodation with each other. Two key dimensions will affect intra-industry performance, therefore first, how the companies compete in terms of strategy as identified by the strategic group to which they belong and, second, the relationship between companies in terms of the markets that they contest, as classified by the competitive group to which they belong (Porter, 1976; Porter, 1979). The fourth question we seek to address in this research is therefore;

4. What is the relationship between primary competitive groups and strategic groups within the UK pharmaceutical industry?

The next chapter turns to a description of the UK pharmaceutical industry and how it has evolved over the period 1993 to 2002. This alongside the literature review in this chapter provides the context for the research reported in later chapters.

CHAPTER 3

THE UK OPERATING ENVIRONMENT FOR PHARMACEUTICAL COMPANIES

3.1 Introduction

The aim of this chapter is threefold. Firstly to describe the UK operating environment in pharmaceuticals that existed during the period 1993 to 2002. It is important to gain this understanding because the strategy of pharmaceutical companies can be expected to be linked to the opportunities and threats that exist within the environment at that time (Andrews, 1987). Secondly, to chart the changes that occurred within the National Health Service (NHS) during the study period that will have directly impacted upon pharmaceutical companies because the NHS is virtually the sole purchaser of prescription medicines in this country (IMS, 2003). Thirdly, to illustrate the link between the UK Government, the NHS and the pharmaceutical industry, which sets the UK operating environment apart from the operating environments covered in the majority of previous strategic groups studies centred on the pharmaceutical industry (Bogner, 1991; Bogner *et al.*, 1996; Cool, 1985; Cool *et al.*, 1987b; Voyer., 1993).

In order to put these elements into context, however, it is necessary to explain how the UK pharmaceutical industry's operating environment in the 1990s changed relative to the 1980's and how the UK differs from other world health care systems. We also need to establish the overall pattern of the changes and to identify those variables that may reliably be used to represent environmental change.

It should be noted here that the health service organisation and provision between England and Wales is similar, while Scotland or Northern Ireland are managed differently. The primary aim of this chapter is, to isolate the key changes that occurred to the operating environment which may impact on pharmaceutical company strategy and not to discuss the merits of health care provision. Therefore, the remarks made in this chapter will address only the system of health care administration present within England and Wales, where the vast majority of the UK population resides. For example, in 1990 the resident population of the UK was 57.56 million with 50.87 million resident in England and Wales. By 2000 the population figures were 59.76 and 52.94 million respectively (Yuen, 2002, section 1 p13).

3.2 Pharmaceuticals and the UK Health Care System

A summary of the environmental changes that impacted upon the UK pharmaceutical industry are presented in Table 1. The UK Health Care System and particular changes introduced, summarized in Table 1, are addressed in detail below.

Table 3.1 Summary of Environmental Changes

Environmental Factor	1989-1991	1991-1997	1998-2002
GP Practice	Dispensing practice [16%] Non Dispensing practice [84%]	Individual practices, whether dispensing or not, now divided into Fund holding and Non-Fund holding practices	GP practices now grouped together and organised into Primary Care Groups (PCGs).
Retail Pharmacists	Assume a largely passive role dispensing medicines	Active role drawing up practice formularies, serving on local area prescribing committees and drawing up shared care guidelines	Active role working in practices, drawing up PCG wide formulary. Assuming supplementary prescribing roles Move towards splitting the prescribing role where the GP diagnoses and the pharmacist prescribes
Formularies	Restricted to hospitals	Individual practice formularies Trend towards reflecting local hospital formulary. Some bulk purchase of dressings and vaccines	PCG wide formularies that practices increasingly adhere to. Move towards bulk purchasing of pharmaceuticals.
Wholesalers	Provide a delivery system on behalf of the manufacturer to chemists, dispensing practices and hospitals. Heavy discounts on community products to hospitals via manufacturer contracts	Actively import and market parallel imported medicines	Source pharmaceuticals from lowest cost point of supply in Europe. Start to consider terms of bulk deals with PCGs. Price differences between the hospital and community price perceived as the "bargaining arena" in hospital contracts.
Environmental Factor	1989-1991	1991-1997	1998-2002
Hospitals	Provider driven via District	Power balance shifts away from the	Integrated within a primary care led

	Health Authority (DHA) Consultant opinion very strong influence	consultant towards the GP as "money follows the patient".	NHS
Influencers	Regional Pharmaceutical Officers advise	Active switching of GP prescribing habits by pharmaceutical and medical advisers. External health authority managed advisers using PACT figures	Internal pressure from GP "peers" to reduce costs and limit pharmaceutical choices. New products actively debated by prescribing committees
Government Advice	MeReC (Medicines Resource Centre Bulletins.	MeReC becomes part of National Prescribing Centre. West Midlands IMPACT scheme Postcode prescribing	NICE (National Institute of Clinical Excellence) issues influential "guidance" on prescribing matters.
Prescribing information	Ad Hoc	PACT Generic targets	PACT Generic targets
Treatment Priorities	Individual practice and hospital determined	Priority Areas	National Service Frameworks
Information	GP Computing in its infancy	All Fund holders must have an approved computer system chosen from a list of suppliers recommended by the Health Authority. PRODIGY	Advanced computer systems Electronic prescriptions NHS Net
Incentives		Prescribing incentives introduced	Performance benchmarks
NHS	Provider Driven	Customer Focused Contract Driven	Performance Driven
Potential Measures	Hospital vs. GP split	PACT six areas Generic % Parallel Imports Fund holder Coverage	PACT Generic % Parallel Imports NICE approvals

PAGE NUMBERS CUT OFF

IN

ORIGINAL

The UK National Health Service was established on the 5th July 1948, post the Second World War, with the founding principle that it was "free at the point of need, not according to ability to pay" (IMS, 2003, p 7; Yuen, 2002). This health service was funded out of taxation where the patient paid nothing, although later governments introduced a prescription charge per item, which currently stands at £6.20 (IMS, 2003, p 12).

This guiding principle of "free at the point of need funded out of taxation" sets the UK healthcare system apart from a number of other health care systems, where the model is for health service costs to be met through some combination of health insurance and personal contribution. In the US, for example, the employer provides health insurance as an increasingly important part of the employment package. For those who are elderly, unemployed or poor, they have to rely on Medicaid or Medicare, a state funded "safety net" that provides limited health treatment. In 1993, for example, 18% of the non-elderly US population were uninsured, 13% were covered by Medicaid or other public coverage, 8% had some form of private insurance, but 61%, (the vast majority) were covered through employment based insurance (Brown *et al.*, 1996, p 42.).

It is important to refer to the US market for two reasons. Firstly, the majority of pharmaceutical based strategic group studies are situated within the US pharmaceutical industry (Bogner, 1991; Bogner *et al.*, 1996; Cool, 1985; Cool *et al.*, 1987b). Secondly, the US is the world's largest and most important pharmaceutical market, which therefore may be assumed to be the prime focus of most pharmaceutical companies' strategic activity (Lehman Brothers, 2003). Within Europe an insurance based model exists within Austria, Belgium, France, Germany, Luxembourg, Netherlands and

Switzerland; while some form of tax funded health care system exists in Denmark, Finland, Greece, Italy, Ireland, Norway, Portugal, Spain, Sweden and the UK (Rosleff *et al.*, 1995). The insurance model is generally similar to that provided in Germany, where the state provides a basic health service for the poor and unemployed, but once a threshold income is reached, mandatory contributions must be made for health insurance. In contrast, within the UK:

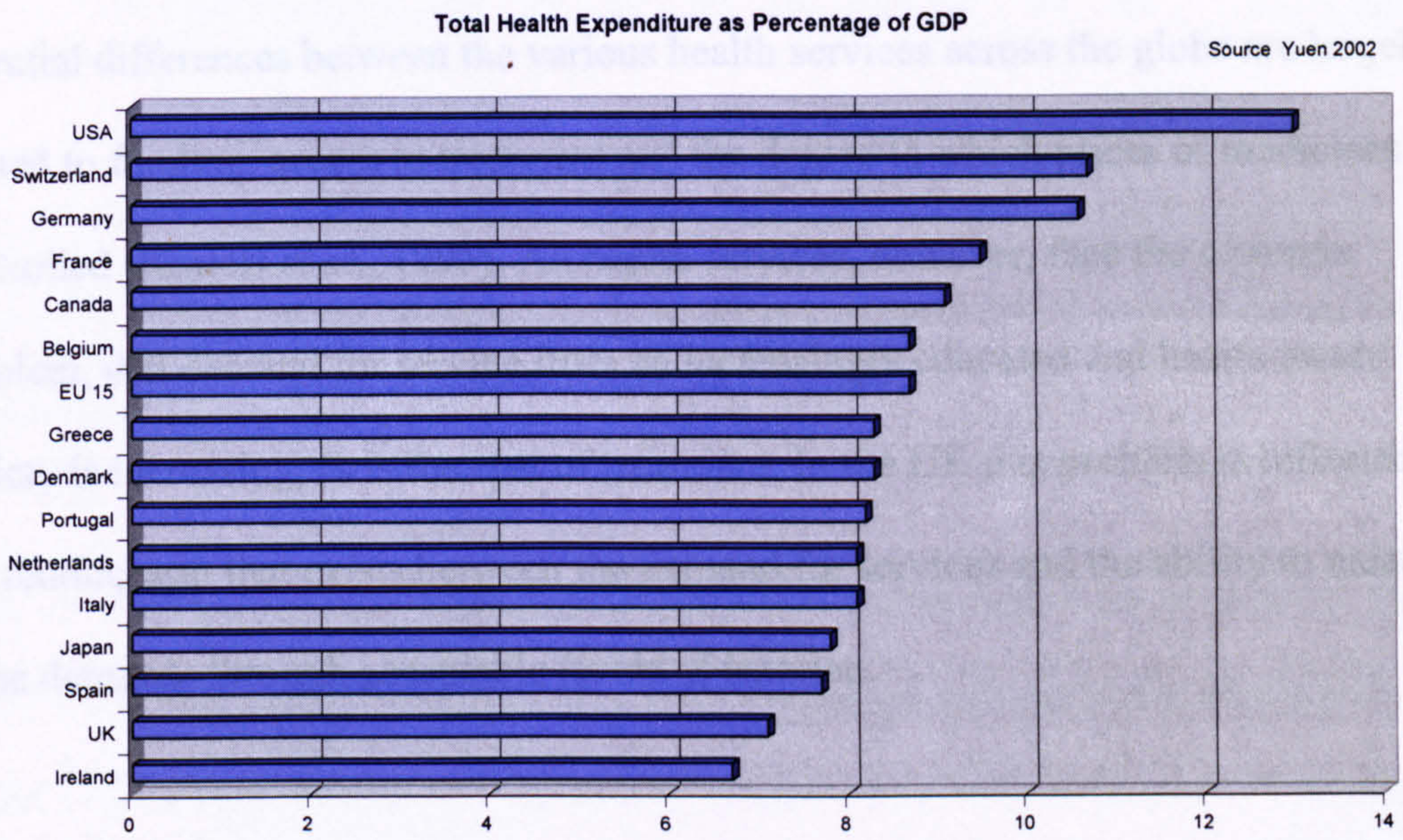
> "About 11% of the UK population is estimated to be covered by PMI (Private Medical Insurance) but penetration varies widely across the country – from about 20% in the South of England to 6% in the North East" (IMS, 2003, p 18).

Prior to the Thatcher reforms encapsulated in the White Paper "Working for Patients", published in 1989 and implemented with effect from April 1991, the UK pharmaceutical operating environment was comparatively benign. Each patient was registered with a general practitioner (GP), who diagnosed their condition and prescribed treatment. In the case of more persistent or serious conditions that required further investigation or a second opinion, the GP referred the patient to a hospital specialist. "Provision of hospital services accounts for 52% of NHS expenditure, a percentage that has remained about the same since the start of the NHS" (IMS, 2003p 16). Thus, under the UK system the GP acts as a "gatekeeper" dealing with all first consultations with the patient, except those cases where the patient arrives directly into hospital via the Accident and Emergency (A&E) Department. The effect of this is that the patient is usually treated within the primary care setting without recourse to more expensive secondary care (hospital) treatment. For example, a comparison in referral rates between the UK and Germany reported that:

> "For every 100 direct referrals recorded in the UK there were two indirect referrals whereas in Germany – there are as many indirect as direct referrals. These differences can probably be attributed to the traditionally strong GP-gate keeping role in the UK compared to the absence of such a role in Germany (Rosleff *et al.*, 1995, p 9).

Figure 3.1 illustrates that the UK spends less on health care provision as a proportion of GDP than most other developed countries. In terms of cost efficiency, for delivering a comprehensive health care system equably available to the entire resident population, the NHS seems to deliver good value compared to most other developed countries.

Figure 3.1 Total Health Expenditure as Percentage of GDP



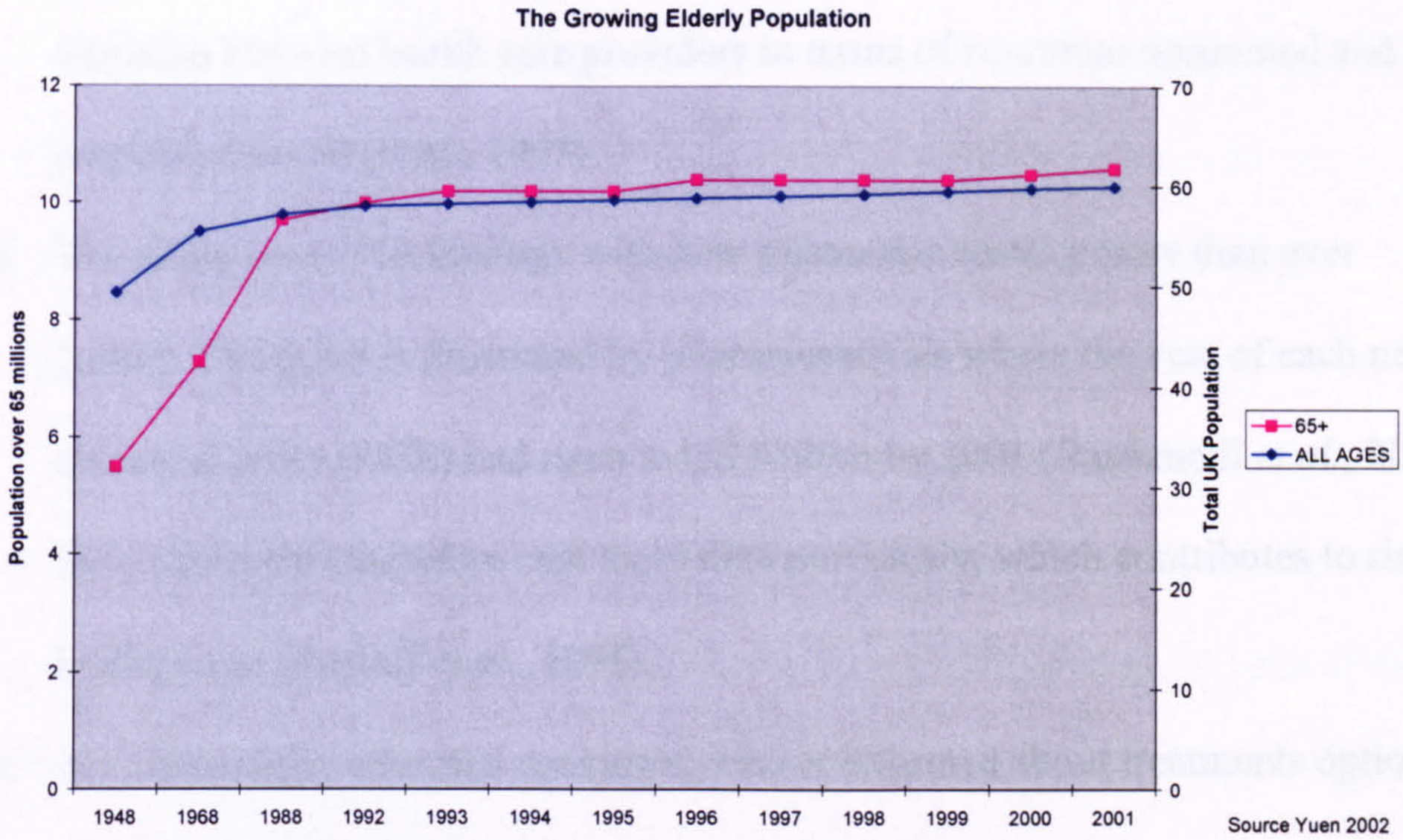
On average, each person in the UK saw their GP five times in 1993, although the figure is skewed by the elderly who visited their GP six to seven times (Yuen, 2002). The number of GP visits differs from country to country according to local custom with the French patient visiting a GP as much as 12 times per year, while the Japanese preference is strongly in favour of the hospital specialist. A key difference between the UK and a number of other countries is that UK patients must be referred by their GP to gain access to hospital treatment, with the exception of admissions via A&E. In many

other countries the patient is free to visit any number of general practitioners or to go direct to a specialist, should they wish.

In summary, therefore, the UK National Health Service differs from the health services of the United States and a number of other countries in that it is funded solely through taxation. The UK also differs in the use of the GP as a gatekeeper who controls access to more expensive secondary care services. In spite of these differences, all health services strive to promote the health of their resident population, to meet the needs of the sick and to cope with demand that is neither predictable nor uniform in nature. The essential differences between the various health services across the globe are largely related to funding, access to treatment and the degree to which prices of medicines are controlled (Rosleff *et al.*, 1995). All health services, however, face the common problem, that demand for service from an increasingly educated and health aware society is increasing, as is the cost of treatment. In the UK this problem is reflected in the funding gap that exists between the demand for services and the ability to meet those demands through acceptable levels of taxation.

Figure 3.2 illustrates the changing demographics of the UK population. Although the population over 65 represented only 10.2% of the population in 1948, by 2001 the proportion of the population over 65 had increased to 16.4% (Yuen, 2002).

Figure 3.2 The Growing Elderly Population



Expenditure on medicines for patients who are over 65 averages three times that of patients under 65 (Ball, 1992, p 30.). Expenditure on medicines is strongly driven by demographics.

In the UK this presents a problem for a health care system funded out of taxation. There is a rapidly growing gap between the cost of providing a comprehensive health service free to all at point of need and the funding available derived from taxation. Factors that may have contributed to the Thatcher government's desire to act and reform the NHS in the late 1980s were:

1. Changing demographics and in particular the demands that an increasingly large and growing elderly population was placing upon the health service (Rosleff *et al.*, 1995).

2. The perception of waste within the health service, illustrated by marked variation between health care providers in terms of resources consumed and outputs achieved (Ham, 1997).
3. The rising cost of technology with new treatments costing more than ever before. This point is illustrated by pharmaceuticals where the cost of each new chemical entity (NCE) had risen to US $700m by 2001 (Bastianelli *et al.*, 2001). New treatments therefore cost more than previously, which contributes to rising health costs (Rosleff *et al.*, 1995).
4. An increasingly educated consumer, who is informed about treatments options and who demands marked improvements in health care services. Here the growing availability of the internet certainly allowed some patients to research their condition more easily and thus to go "armed" for their visit to the doctor (Rosleff *et al.*, 1995).
5. The perceived importance of the health service as an issue for voters, as illustrated by the debate devoted to health care at election time (Ham, 1997).
6. The growing gap through the 1980s between government funding and the increasing demands upon the health service driven primarily by an ageing population and the cost of advances in medical technology. By 1987 this had reached a point where hospitals were forced to cancel non-urgent operations, close beds and leave staff vacancies unfilled in order to keep within budget (Ham, 1994, p 2.).

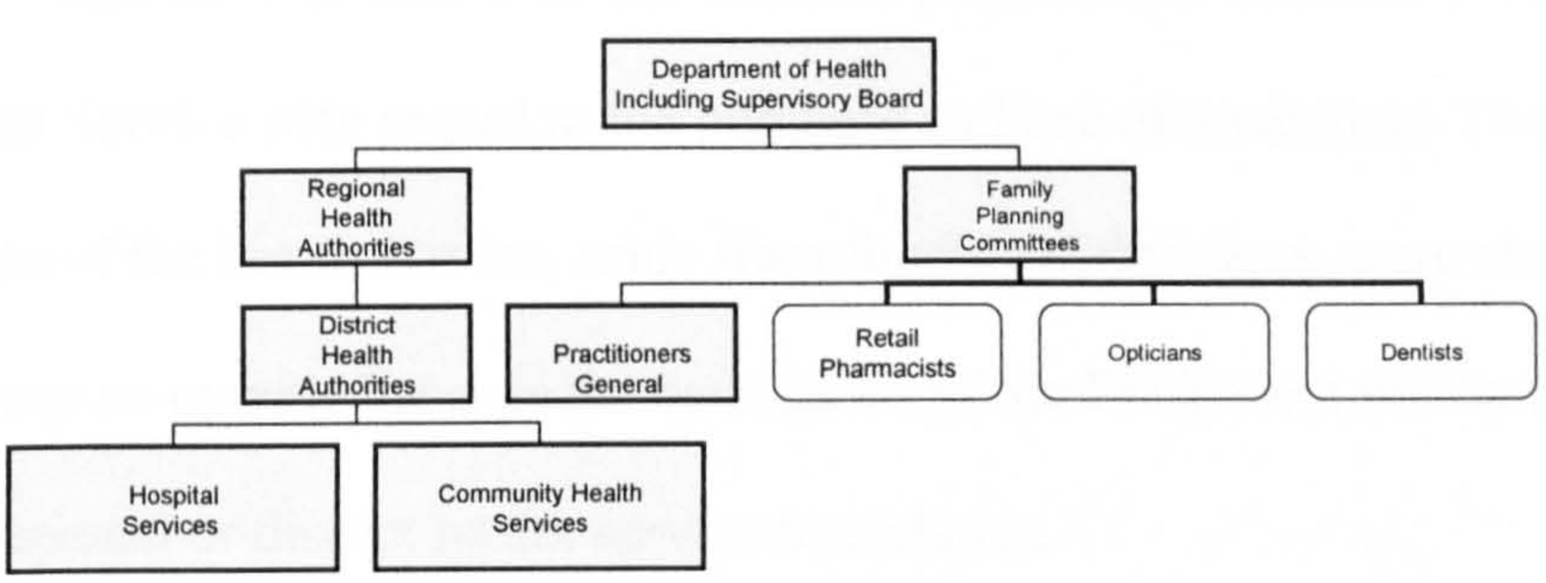
The net result was that in the late 1980s the Thatcher government decided to reform the NHS and to drive down costs and improve value for money by introducing competition via the creation of an "internal market"(HMSO, 1989). Ham points out, it is more accurate to use the term managed market; firstly, because competition amongst providers was not confined to the NHS, it also included providers from outside the NHS, (for example some minor surgical procedures like cataract operations could be performed more swiftly in France. (Ham, 1994, p 10).) Secondly, it was not the government's reported intention to introduce a "free market" but to graft some of the incentives present in commercial markets onto the NHS (Ham, 1994, p 10.).

In 1989 the government White Paper, "Working for Patients", was published which presented plans to radically reform the NHS with changes due to be implemented with effect from April 1991. Due to the availability of data, this research explores the UK operating environment not from the inception of this change in 1991, but with effect from 1993. The next section briefly describes the pharmaceutical companies' operating environment within the UK prior to the Thatcher reforms to highlight the differences that pharmaceutical strategy had to address after April 1991.

3.3 The NHS prior to the Thatcher Reforms

The general structure of the health service in England and Wales prior to April 1991 included a Health Service Supervisory Board that reported to the Department of Health. Figure 3.3 illustrates the structure of the Health Service in England and Wales prior to the Thatcher reforms of 1991.

Figure 3.3 NHS Structure Circa 1989



Source: (Ham, 1994)

The health service was managed by the Department of Health, which was organised into two groups. The first of these was responsible for secondary care administered through 14 Regional Health Authorities (RHAs), each of which in turn managed a series of District Health Authorities (DHAs). Each DHA was responsible for its resident hospitals and community health services. This side of the health service was fiscally controlled within the Hospital and Community Health Services Budget (HCHS) and was strongly cash limited. In contrast, the second group consisted of the Family Practitioner Committees (FPCs), which like their secondary care equivalents were geographically organised and funded via a formula related to their resident population. Unlike the Regional Health Authorities, however, the primary care side of the health service was not cash limited. This was because the General Medical Services budget,

which funded the activities of general practitioners, dentists, opticians and pharmacists, was not cash limited. It had open ended access to additional top ups from the Treasury department in order to provide the facility to cope with flu epidemics and other serious sporadic events. This difference in the availability and management of funding could in some ways be responsible for the different policies that operated across the National Health Service with regard to the purchase and use of medicines. These two primary organs of the health service, aside from funding differences, were also unlikely to actively co-operate because the boundaries of the FPCs were not co-terminus with either the regional or district health service boundaries.

Thus, from a pharmaceutical company's perspective the two areas of the health service, although joined in a common purpose, behaved differently when it came to the use and purchase of pharmaceuticals. Within secondary care each hospital ran a formulary which is a limited list of approved drugs. The principle aims of the formulary were to achieve consistency in medical treatments and to avoid purchase and stocking of too many product lines due to space and budget considerations. Within the hospital environment generally only consultants could prescribe off formulary. For significant sales to be achieved, therefore, new products had to gain entry to the formulary, which for a new medicine attempting to enter a crowded product category meant displacing an existing product.

Hospital formularies were administered by the pharmacy department with new pharmaceutical products formally proposed and discussed at a drug and therapeutics committee meeting. For a new medicine to be approved, it generally required the support of the relevant consultant together with the principal and information

pharmacists being convinced that the product offered a good balance between efficacy, safety and cost. In key teaching hospitals, gaining entry on the formulary presented a significant hurdle with some hospitals restricting their drug and therapeutic committee meetings to two or three a year. Teaching hospitals were also the principal source for quality clinical drug trials, which were a necessary step in gaining the data necessary for a successful product licence submission to the Medicines Control Agency (MCA).

Once a product had been listed on the formulary, the product would still not be widely used unless it was actively promoted to the resident physicians. Here, a second hurdle to widespread use was the difficulty within hospitals of getting the product routinely stocked on the ward trolley, and ensuring its access to junior medical staff. Here contract price was an issue as hospital pharmacies sought to manage their drug bill and hospitals purchased pharmaceuticals on annual or biannual contracts via a competitive tendering process. Therefore, in order to gain widespread hospital acceptance, the contract price had to be acceptable. A marked difference occurred between hospital only products and products that would be more widely used by general practitioners in primary care. This was because the latter products were often sold at a fraction of their price in the community (GP sector) in order to encourage widespread hospital referral.

In conclusion, within the secondary care or hospital setting, a formal hierarchy of doctors and pharmacists controlled which drugs would be used within the hospital and a strongly argued clinical case was necessary to gain access to the formulary which allowed junior doctors to use the product. Cost of treatment was an important metric within the "cash constrained" hospital environment and products that competed in widely used categories had to offer competitive contract prices to be seriously

considered. Despite this, there was considerable variation in the use and cost of medicines and other aspects of medical treatment between hospitals, districts and regions.

Within primary care a different set of circumstances pertained. General practitioners operated either as sole contractors to the Family Practitioner Committees or alternatively in general practice groups, consisting of two, three or more GPs. Each GP operated independently and generally made his or her own independent choices about which medicines should be used and whether to see representatives from pharmaceutical companies or not. Cash was not limited in the primary care setting and as gatekeepers, GPs did not consume the products which they prescribed, nor did they actively monitor their personal or practice's medical expenditure. The primary care (GP) market at this time was therefore relatively insensitive to price, unlike the secondary care (hospital) market.

Two different types of GP practices existed. The traditional GP practice that generated prescriptions, which were filled by the local chemist or the alternative dispensing channel prevalent in rural areas. Dispensing doctors represented approximately 16% of GPs and differed in several key respects. Firstly, because a significant proportion of their patients lived at least one mile from a chemist, a dispensing doctor could both prescribe and dispense for eligible patients. Nationally, approximately 41% of patients were eligible "dispensing patients", the remaining 59% collected their prescriptions from a retail chemist, although clearly the balance between dispensing and prescribing patients varied by location. GP practices in a rural setting could have 100% dispensing patients (Leask, 2002).

Secondly, dispensing practices were run along business lines with a limited selection of drugs prescribed by the resident partners that constituted a practice formulary. Thirdly, drug selection criteria included efficacy and safety but also the discount offered by the pharmaceutical supplier, which was an important source of practice revenue. The sum involved could be equivalent to an extra practice partner (Leask, 2002).

In conclusion, prior to the Thatcher reforms of 1991 the market for pharmaceuticals was largely price insensitive. The key decision makers important to the pharmaceutical companies consisted of GPs and hospital doctors. Pharmacists performed a largely passive role of dispensing prescriptions in primary care, although some pharmacists, for example those who served on the drugs and therapeutics committee, were important influencers within the hospital setting. The key figure in the UK pharmaceutical market was the GP:

> "...who accounts for about 80% of pharmaceutical expenditure. The average GP sees 140 patients a week during surgery and visits another 25 at home. Seventy per cent of these consultations result in a prescription, with the average person receiving between seven and eight scripts a year" (Davis, 1997, p 25).

This result was skewed still further by the introduction of the new GP contract in 1990.

This introduced incentives for running health promotion clinics, health checks for the elderly and for meeting vaccination, immunisation and cervical cancer screening targets (Ham, 1994, p 65). The net result of this was to encourage GPs to see more patients and write more prescriptions.

3.4 The Thatcher Reforms

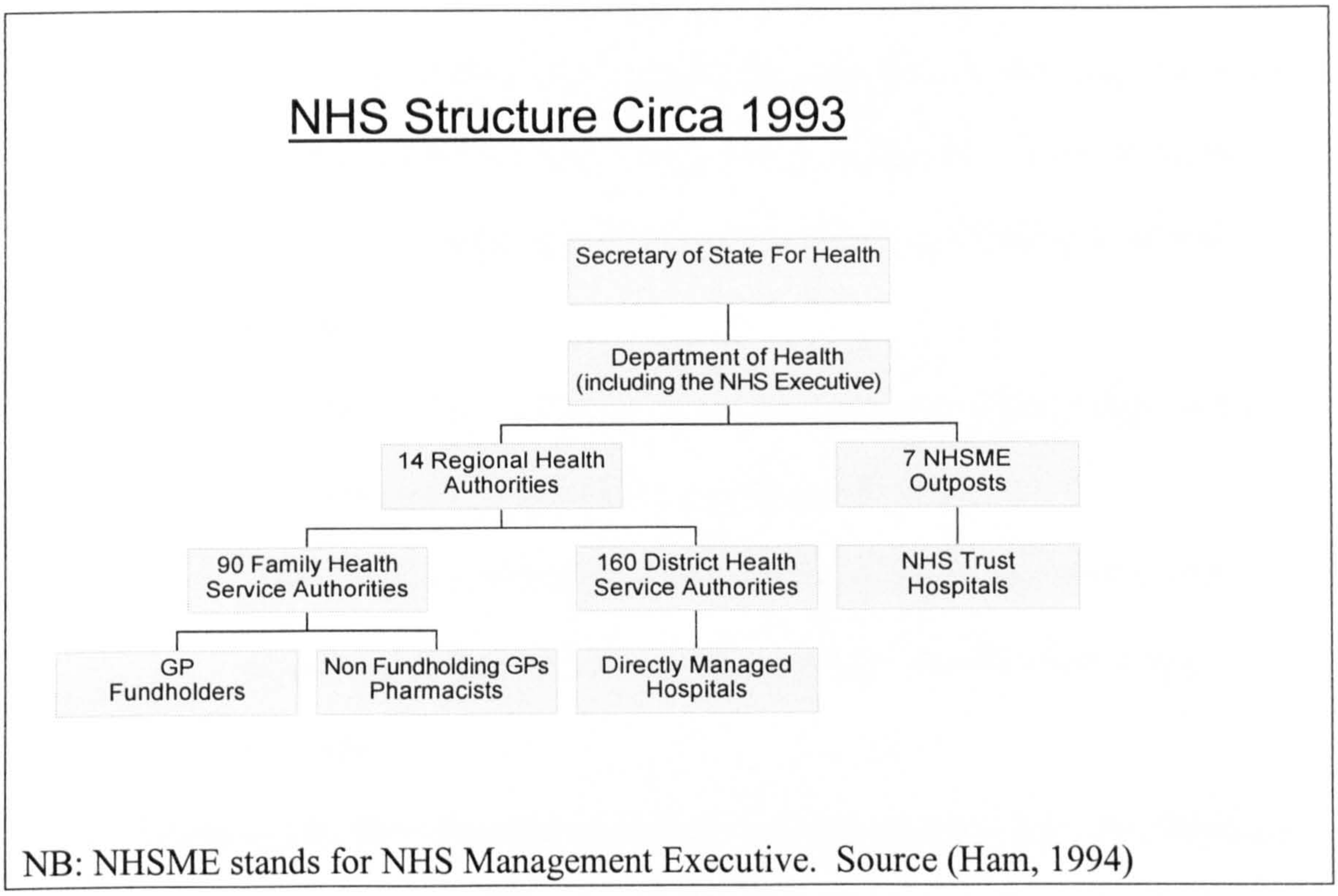
> "In 1991 Britain's government forced through one of the most sweeping transformations ever of a health care system, from an administered governmental service to an internal market of contracts between purchasers and providers" (Light, 1998, p 217).

The Thatcher reforms were not intended to revolutionise the NHS, because in comparison to other European health care systems the NHS appeared to deliver a comprehensive health care system at a lower proportion of GDP than most of our neighbours. Instead, the aim was to encourage emulation of the success achieved by the most efficient providers within the NHS. The aim was to shift from an internally focused "provider driven" service to a customer focused health service, where money followed the patient, and to reward good practice with additional resources. Thus the introduction of competition aimed to stimulate providers to improve efficiency without sacrificing quality.

> "This principle was designed to overcome the efficiency trap which existed before the reforms in which providers were in effect penalized for treating more patients because their income did not increase in line with productivity" (Ham, 1994, p 12).

The NHS structure circa 1993 is shown in figure 3.4.

Figure 3.4 NHS Structure Circa 1993



NB: NHSME stands for NHS Management Executive. Source (Ham, 1994)

The Thatcher reforms focused upon the following key changes.

1. The role of the Regional Health Authority (RHA) was expanded to encompass the management of both primary and secondary care. This had the effect of bringing control of both sides of the NHS under one authority. This was considered essential for the development of an integrated service and to increase fiscal control.

   "Unifying the family health authorities and district health authorities was an important step in eliminating a split budget around which there was considerable cost shunting" (Light, 1998, p 218).

The Primary Care prescribing role of the RHA can be summarised as follows

(Hepburn, 1992, p 91):

a. Allocation of firm budgets to FHSA.

b. Allocation of prescribing budgets to fund holding general practitioners.

c. Monitoring the indicative prescribing scheme (IPS) utilizing expenditure statements from the Prescription Pricing Authority[4] for firm budgets, indicative prescribing amounts (IPAs) and fund holding prescribing budgets.

d. Communication with the Department of Health and the FHSAs within the region both on quantity and quality of prescribing.

e. Addressing the problems which arise at the primary/secondary care interface and the production of prescribing protocols to aid in this process.

2. To create a market of buyers and sellers, the purchaser provider role carried out by the District Health Authorities was split. Under this arrangement, DHAs were now become solely responsible for the purchase of health care and were no longer held responsibility for the management of the hospitals, community service and ambulance units within their boundaries. In theory, this allowed the DHA to purchase health care from any reliable source either within or outside of the NHS. In reality, because the units that did not acquire NHS trust status remained the responsibility of the DHA, the purchaser provider split was muddied and there was a tendency for purchasers to rely on past relationships and to purchase little beyond their boundaries.

3. The mechanism to link purchaser with provider was via a service contract for which providers would compete. Individual health authority budgets were based on a capitation formula that applied significant factors such as age and sex to the

---

[4] The Prescription Princing Authority is responsible for the pricing of prescriptions and for the reimbursement of pharmacists.

resident population. Initially, contracts were "blunt instruments" or block contracts, where the broadly specified health needs of a given number of patients were contracted to a chosen health care provider, such as the local hospital, at a set price. In contrast, rarer conditions that required specialist treatment were contracted on a cost per case basis. Between these two extremes, a cost per volume contract became the norm as purchasers and providers gained experience and confidence in the contracting process.

4. Initially, acute hospitals with over 250 beds, were expected to apply for NHS Trust status (HMSO, 1989). This allowed a hospital the opportunity to take out commercial loans to develop its services and to opt out of national "Whitley" pay scales. This in turn provided more flexibility to attract good employees by paying market rates and build centres of excellence. In reality the "trust model" attracted all types of health care providers. The initial wave of 57 trusts that "went live" on the 1st of April 1991 consisted of acute hospitals, community health units and ambulance services. By 1994, over 90% of such units were working as NHS Trusts (Ham, 1994, p 14.).
5. General practitioners that belonged to practices with more than 11,500 patients were allowed to become Fund holders, which allowed the practice to manage its own budget. The budget covered three elements: practice staff costs, prescribing costs and a defined range of surgical procedures, which included diagnostic tests and investigations (Ham, 1994, p 20.; HMSO, 1989). This allowed GP Fund holders to shift patients to where waiting lists were shorter. This shift in power in favour of the Fund holding GP over the hospital consultant gave rise to the criticism that the Thatcher reforms were creating a "two tier" service (Ham, 1994, p. 21). In reality, fund holding became a driver for change within the

health service with practices engaging in active shared care protocols with their selected hospital providers to treat conditions such as diabetes and asthma.(Ham, 1994, p 47). A major incentive for change was provided by the carrot that fund holders could keep the savings made from their budget to invest in practice facilities. This allowed those GPs who owned their practice to fund building schemes that would benefit them personally when they retired and sold their share of the practice to an incoming partner. Clearly, this incentive did not apply equally, to those largely inner city GPs who rented or leased their premises.

The restriction on practice list size for prospective fund holders was progressively reduced, first to 9000, then 7000, and finally practices that could join together and field a list in excess of 3000 patients could become "community fund holders". The net result was that fund holding took off swiftly from 306 practices in 1991. By 1994, 2000 practices and 8,800 GPs were enrolled covering 36% of the population (Ham, 1994, p. 19). By 1996, the year before fund holding was abolished, the scheme covered more than 50% of the patient population in England.

6. Incentives were also extended to GPs under the "indicative prescribing scheme," which later became known as "prescribing budgets".

> "From 1 April 1991, each practice received an indicative amount for its drug spending from its FHSA. This is simply the best estimate that can be made of the practice's likely needs, given its historic pattern of spending, the special characteristics and interests of the practice and anticipated changes in legitimate demand for drugs" (Podger, 1992, p 9).

GPs that opted to spend less than their indicative amount and achieved their target could spend 50% locally on primary care projects jointly agreed with their Health Authority (Podger, 1992, p. 10). Under later schemes introduced, GPs

could earn up to £ 3000 per annum by keeping within their pre set prescribing budgets. The function of these prescribing budgets, which assumed in subsequent years that the incidence of spending would follow the same pattern as the previous year, was to provide "financial benchmarks against which practices' spending could be monitored and justification sought by the FHSA for marked divergence"(Podger, 1992, p. 9). The sting in the tail of the prescribing budget was that practices could be called to account for profligate or inappropriate prescribing.

7. To assist in measurement, new quarterly Prescribing Analysis and Cost (PACT) figures were developed by the Prescription Pricing Authority (PPA).

> "...effective purchasing cannot happen without good comparative data on price, product, quality and service....Effective American purchasing groups start by deciding what outcomes they want and then develop good data systems for all providers in the market area" (Light, 1998, p. 219).

These reports were sent routinely to practices and described at three levels of increasing detail how the practice measured up on prescribing.

a. Level 1 PACT reports compared practice prescribing costs, number of items and average cost per item against the FHSA average and the English national average. These reports were sent automatically to every GP (Ball, 1992, p. 28).

b. Level 2 PACT broke the level 1 information down into seven categories, namely the six major therapeutic groups that account for most prescribing cost and an 'all other' category. The six therapeutic areas were Cardiovascular, Gastrointestinal, Respiratory, Musculoskeletal, Central Nervous System and Infections. Level 2 was sent automatically to practices whose overall prescribing costs were 25% above their health authority average or 75% above in any one category (Ball, 1992, p. 28).

Later PACT reports combined levels 1 and 2 into one report which was sent automatically to all GPs.

c. Level 3 PACT, which detailed a full catalogue of all prescriptions issued during the quarter, was available on request but sent automatically to all training practices (Ball, 1992, p 29.).

8. Information technology was seen as an important driver. A pre requisite of fund holding was that practices must have, or install an "approved practice computer system" (HMSO, 1989). Later initiatives included the development of PRODIGY, a prescribing support system that incorporated the latest prescribing guidelines.

Concomitant with these changes, the Thatcher reforms introduced new roles within health authority management. A Medical Adviser and Pharmaceutical Adviser were introduced to call on GP practices and provide advice on medical management and prescribing issues (HMSO, 1989).

> "Major savings have come from challenging the customary practices of autonomous physicians" (Light, 1998, p 219).

These new staff reported into Directors of Public Health, who planned the overall health needs of the population based upon demographics and local priorities. Pharmaceutical advisers were particularly proactive serving on local area prescribing committees and assisting GP practices to set up practice formularies and increase generic prescribing.

> "The development of local formularies has been slow. GPs in general have not welcomed restrictions on clinical freedom and there have been few specific incentives to develop and maintain a formulary" (IMS, 1996, p. 28).

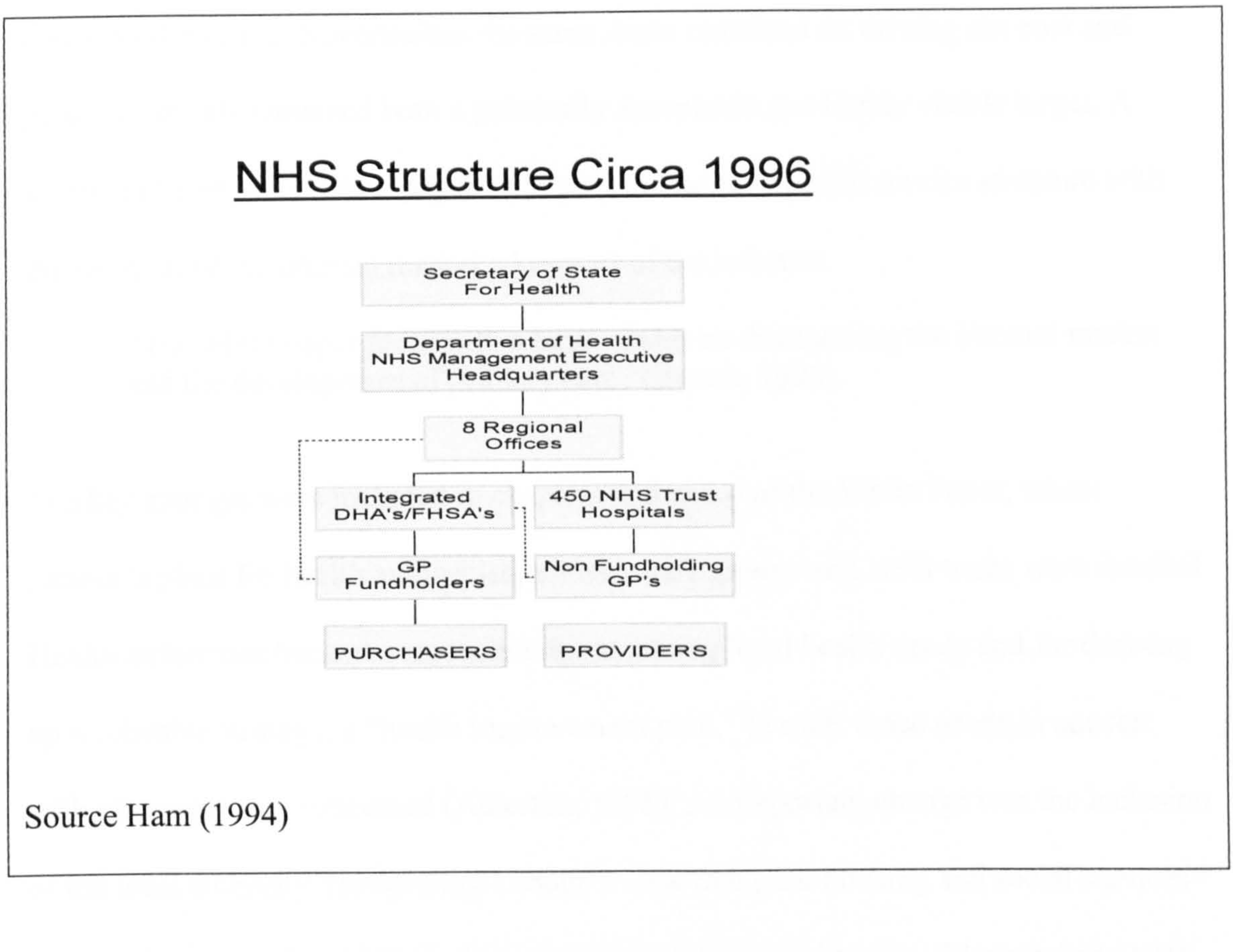
In conclusion, the Thatcher reforms injected a greater degree of measurement into the NHS, where managers now focused on taking cost out of the system and increasing value for money. The links between primary and secondary care were strengthened, building towards an integrated service where cost shifting from hospitals to GP practice would no longer be tolerated. Fund holders in turn had an incentive to adjust prescribing habits, for example to increase prescribing of anti-hypertensive or asthma preparations to reduce the cost of hospital admissions, or alternatively to cut prescribing costs through wholeheartedly embracing generic prescribing.

For the first time, active management of prescribing costs had been introduced across the NHS with managers specifically assigned to the task. Although the key influences upon GP prescribing were indirect factors designed to make practices aware of the cost of their prescribing relative to practices with a similar demographic profile, once awareness had been achieved, GP's incentives were introduced to encourage a change in behaviour.

> "Most of the current influences on GP prescribing patterns are indirect, such as the provision of prescription data to each GP and peer review of over and under prescribing doctors. Widespread use of PACT data has resulted in an increase in rational prescribing practice"(IMS, 1996p 28).

The structure of the NHS in 1996, the year before John Major's government lost to Tony Blair at the May General Election, is shown in figure 3.5

Figure 3.5 NHS Structure Circa 1996



Source Ham (1994)

3.5 The operating environment 1997 to 2002

Following their May General Election victory, the Labour Government took little time in introducing their plans for the NHS, which were announced in the White Paper "A New NHS" published in November 1997.

> "By grouping general practitioners and their patients as the basic building blocks of a renewed national service, the white paper sets out to provoke new thinking and to promote innovation in determining how to make a service suited for modern times. This is a fundamental change in which the voice of primary care professionals, particularly, general practitioners, has been deliberately amplified" (Parston *et al.*, 1998).

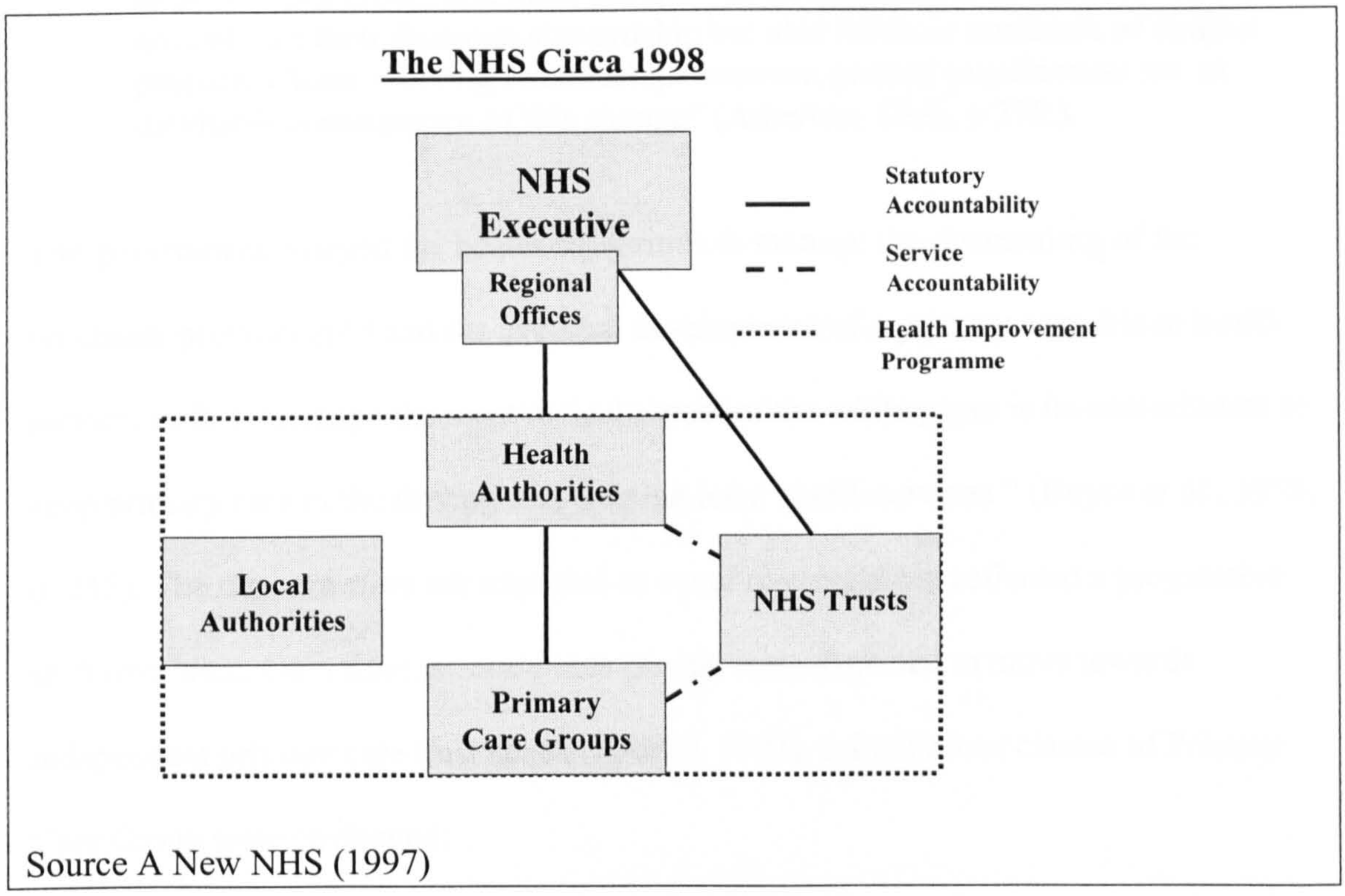
The basic thrust of Labour's proposals agreed with the Conservative approach by "committing the government to maintain a health service available to all on the basis of need, not ability to pay, and funded through general taxation" (Ham, 1998).A major

change, however, was the immediate scrapping of the fund holding scheme that Labour considered divisive. Nevertheless the same focus remained on driving out cost and pharmaceuticals remained both a politically acceptable and highly visible target. A significant part of the white paper addressed the issue of health service structure with the removal of the internal market a key part of the reforms:

> "The white paper focuses to a large extent on dismantling the internal market and the development of primary care" (Bunch, 1998).

The key changes were included in chapters 4, 5 and 6 of the White Paper, where Labour's plans for health authorities, primary care groups and NHS trusts were detailed. Health authorities became responsible for assessing local health needs and for drawing up a cohesive strategy, a "health improvement plan," to meet those needs in concert with other agencies concerned (Atherton, 1998). An important change was the inclusion of the local authority, recognising Labour's view that poor housing and social services impacted on a number of clinical conditions such as mental health. The resulting NHS structure is illustrated in figure 3.6.

Figure 3.6 The NHS Circa 1998



Source A New NHS (1997)

The internal market introduced by the Conservatives in 1991 was thus replaced with a new primary-care led integrated system, as illustrated in figure 3.6. Primary Care Groups replaced fund holding and were designed eventually to run along the lines of Trusts with total responsibility for commissioning healthcare for patient populations each in the order of 100,000 (HMSO, 1997).

> "From April 1999, 500 new primary care groups, typically serving populations of 100,000, will replace nearly 4000 existing commissioning organisations, including general practice fund holders" (Butler *et al.*, 1998, p 214).

A marked change was that, unlike fund holding, membership of primary care groups was not optional. Thus GPs that were used to working as independent contractors were now, for the first time, forced to work together within large, relatively formal, organisations.

> "Primary care groups are not optional: all general practitioners will be required to be within a group, and these groups will be answerable to health authorities not only for their financial stewardship but also for their standards of clinical practice. Closer working relationships between general practitioners are an inevitable consequence of this change" (Atherton, 1998, p 379.).

The government charged the health authorities to manage the dismantling of the purchaser provider split and the eventual development of a primary care driven health service; in fact "perhaps the most radical aspect of the white paper is its commitment to keep primary care in the driving seat shaping local health services " (Boyce *et al.*, 1998, p. 215). The changes were not expected to occur overnight but reflected a progressive shift over time. Over time, primary care groups were expected to move towards independent primary care trust status (HMSO, 1997). Initially four classes of Primary Care Group were envisaged:

> "The white paper outlines four progressive forms of primary care group: giving advice to health authorities on commissioning; managing devolved budgets; independent primary care trusts responsible for some devolved commissioning; and primary care trusts responsible for commissioning all primary and secondary care services with a fully integrated budget"(Butler *et al.*, 1998, p 214.).

These different forms of Primary Care Group reflected the different starting points of different GP practices with some having little experience of commissioning health care and others with previous responsibility for running total purchasing pilot schemes.

> "In time primary care groups will be responsible for purchasing almost 90% of hospital and community care, so proper accountability is crucial. Health Authorities will monitor their performance against targets set in health improvement programmes and will exercise some control through allocating resources and controlling the progress of groups up (and down) the four steps to complete autonomy" .(Boyce *et al.*, 1998, p 215)

Under this system, healthcare priorities were now driven within a national framework but locally adjusted within a three-year health improvement programme. For hospital

trusts, a major change was the development of clinical governance that placed a new emphasis on the quality of care. Cost containment remained a key element of the government's healthcare policy with cash limits being introduced on drug expenditure for the first time in the health service.

> "For the first time, primary care budgets will be fully cash limited, but the groups will be able to move money between different parts of the service to balance their books" (Butler *et al.*, 1998, p 214.).

A major problem facing Primary Care Groups, however, was how to discharge them from the budget deficit that they inherited from the Health Authorities. Instructions in force at that time stipulated that they must balance their budgets within three years. It is interesting to note in this context that the US concept of "managed care" requires that all elements of the health care system are brought together in one place so that budgetary trade offs can be made (Light, 1998):

> "The key to managed care is a single budget so that costs cannot be shifted to someone else's budget and savings can be reallocated elsewhere, including incentive pay and profits" (Light, 1998, p 217.).

Key effects upon the GP population were:

1. A loss of both individual and practice autonomy as GPs became part of a Primary Care Group that could encompass 50 to 100 GPs and more than 20 practices.

> "Within the PCTs, the main influence on prescribing tends to be the prescribing manager or advisor, who is usually a pharmacist. Doctors prescribe in accordance with a set formulary or prescribing guide and these may be used by a single PCT or a group of PCOs[5] in the same area...Cost is a major consideration in selection of drugs for a formulary as PCTs have capped budgets. There is generally close co-operation between PCT and hospital prescribing advisers, with joint prescribing

[5] PCO is an abbreviation for all forms of Primary Care Organization.

> guides commonly used across the primary care and hospital sectors" (IMS, 2003 p 25).

2. A much more stringent control on both budget and prescribing freedom as individual practices were initially brought into line. The old pressures of visits by the medical or pharmaceutical adviser from the Health Authority were increased through the actions of peer group pressure, the introduction of PCG formularies, clinical governance and more acute pressure on budgets.

> "The most recent survey shows that 50% of PCTs operate a prescribing formulary. This percentage looks set to rise markedly as a further 28% were developing a formulary towards the end of 2001… About three-quarters of PCTs use prescribing guidelines, usually linked to specific prescribing targets, such as generic prescribing, antibiotic prescribing or prescribing of statins " (IMS, 2003 p 25).

3. The introduction of unified budgets for GPs, who now had responsibility for commissioning total healthcare services for their local communities. This shifted the emphasis on to total treatment costs, although drug costs remained a highly visible and politically acceptable target.

4. The establishment of the National Institute for Clinical Excellence as the government's flagship for evidence based medicine.

> "The stated purpose of clinical guidelines from the United Kingdom's National Institute for Clinical Excellence (NICE) is to help healthcare professionals and patients make the right decisions about healthcare in specific clinical circumstances" (Wailoo *et al.*, 2004, p 536).

The refusal to grant Relenza, the Glaxo flu drug, a licence, rapidly brought NICE into the news. But it was less publicized that NICE also began to review the validity of established practice, such as the value of Proton Pump Inhibitors in the treatment of GORD (Gastro oesophageal reflux disease).

> "NICE is a national policy making body whose responsibility is clearly broader than the individual patient. This wider viewpoint is reflected in NICE's technology appraisal by the central role afforded to cost effectiveness" (Wailoo *et al.*, 2004, p. 536).

5. The government introduced a strategy to promote health and prevent disease focused upon cardiovascular disease, cancer and mental illness. "The main thrusts of the policy are, by 2010, to reduce mortality rates from heart disease by at least 40% and cancer by at least 20% in people under the age of 75" (IMS, 2003, p. 16,).

   Central to this strategy of health promotion were a number of major new, programmes:

   a) National Service Frameworks (NSFs) set out national standards for treating a range of diseases. NSFs were initially developed for cancer, cardiovascular disease, mental health, the elderly and diabetes.
   b) Health Improvement Programmes (HImPs) were developed at local level reflecting local conditions as well as targets of the NSFs. Asthma and obesity frequently featured in HImPs.

The pressures upon general practice to reduce cost and run more efficiently were now more acute than ever with principal measurements being provided by PACT (Prescribing Analysis and Cost) data. The introduction of global budgets under the new Primary Care Groups was seen by many GPs as an effective method of driving costs down and restricting demand. One GP described PCGs[6] to me as "a rationing mechanism for the government" (Bob Ingles, Chairman of Worcester LMC).

The 12% of the NHS budget spent on pharmaceuticals therefore remained a highly visible target for cost controls (IMS, 2003, p 10). A number of government funded

[6] Primary Care Groups

organizations were established to provide advice on prescribing and to evaluate the cost effectiveness of drugs focused on the drug bill. Among initiatives in place that impacted upon prescribing practices were:

1. Local prescribing committees that influenced which drugs are prescribed at community and hospital level.
2. The National Prescribing Centre, which was set up in 1996 to promote cost-effective prescribing. The role of the centre incorporated the earlier initiative of MeReC (Medicines Resource Centre) that produced regular bulletins on topical prescribing issues from 1991 onwards. The pricing comparison bar charts that these included added to the growing awareness of cost.
3. NICE, sometimes described as "the Fourth Hurdle" after gaining safety, efficacy and pricing approval, has demonstrated significant ability to influence the prospects of both established and new drugs within the UK.

> "At national level, the specific product recommendations and clinical guidelines issued by the National Institute of Clinical Excellence are a major influence on prescribing practice, especially now that PCOs (Primary Care Organisations) and health authorities have a legal obligation to make funding available to ensure that NICE guidance is implemented" (IMS, 2003, p 20).

The impact of such guidance on standardizing the prescribing choices within given therapeutic areas should not be under estimated:

> "Prescribing throughout the UK will become increasingly standardized as a result of the impact of NICE and other national guidelines and protocols, and as the PCTs merge to form larger organisations with prescribing policies covering extremely large patient populations" (IMS, 2003, p 20).

The establishment of NICE reinforced demand-side regulation of the market, where appraisal could significantly delay uptake of new products; for example Herceptin was not offered to patients for some time after launch because

physicians awaited NICE guidance (IMS, 2003, p. 21). A rejection or restricted recommendation from NICE could therefore mean that the potential of some new drugs was never realised. In contrast, a positive NICE recommendation virtually guaranteed rapid and widespread uptake of the medicine (IMS, 2003, p. 21). NICE recommendations, in effect, were designed to remove the "postcode lottery" that prevailed under the Conservatives, where individual health authorities decided whether to fund a particular treatment or not.

> "Recommendations made within a clinical guideline are graded according to the strength of the evidence on which they are based. The highest grades are afforded to recommendations based on meta-analysis of randomised controlled trials and the lowest grade to recommendations based on expert opinion, including the view of the development group. This classification also has the effect of reducing the impact of cost effectiveness considerations: health economic evidence is often sparse in established clinical areas and, where it does exist, is of variable quality" (Wailoo *et al.*, 2004, p 537).

Of the 44 appraisals conducted by NICE since it began work in 2000 until mid 2002, 31 were for pharmaceuticals and the remainder for diagnostics, devices and procedures (IMS, 2003, p. 21). Initially, critics saw NICE as a rationing machine aimed at primarily reducing costs, but the effect of NICE has frequently been to promote more widespread use of effective treatments.

> "When NICE was first established, critics considered that the institute had been set up to ration treatments in the NHS. However, most of NICE's recommendations have suggested partial or full use of technologies – 16 have been recommended for routine use (all of their licensed indications), 30 for selected use (in groups where evidence indicates they are most effective), and four for use in research settings only" (Mayor, 2002, p 924).

4. There is clear evidence that the national service frameworks are having a marked impact on prescribing, for example spending on prescribed drugs grew by 10% between 2001 and 2002, fuelled by a 25% increase in drugs in a number of particular categories (Macdonald, 2003, p 677).

"Spending on lipid regulating drugs, including statins, increased by 33%. The main reason for this, according to the Audit Commission, was the national service framework on coronary heart disease…The 18% increase in anti-hypertensives was also a result of the framework. Spending on drugs to treat diabetes rose by 23%. The report says this was due to the national service framework on diabetes, NICE guidance, and an increase in the number of diagnoses" (Macdonald, 2003, p 677).

"As a result of the NSFs, prescribing volume will increase for drugs to treat coronary heart disease, cancer, CNS disease, diabetes, and chronic conditions affecting the elderly" (IMS, 2003, p 20).

The Crown Report, "Review of Prescribing, Supply & Administration of Medicines," was published in March 1999. This recommended that a new group of "dependent prescribers" be established. These professionals could then review treatment of those patients who were clinically assessed by an independent prescriber. Such dependent prescribers could include specialized nurses or pharmacists carrying out reviews of a patient's medication (Crown, 1999). They would therefore have the power to limit the number of times that a repeatable prescription could be dispensed and would be able either to switch the patient to a cheaper alternative, such as a generic drug, or perhaps to persuade the patient to try an OTC[7] remedy, thus removing the treatment cost from the NHS arena. Such activities have some similarities with Pharmacy Benefit Managers, which significantly reduced costs to payers under managed care schemes in the USA.

Although members of the Labour government have mooted the possibility of legislation to require generic substitution, the increased level of generic prescribing and dispensing since 1997 is considered by some to obviate the need to legislate. However, the Department of Health believes that there is room to improve on the number of prescriptions written generically – currently around 60% of all GP prescribing. A level as high as 70% to 80% is considered achievable (IMS, 2003). Schemes to encourage

[7] OTC refers to an over the counter medicine that may be bought from a pharmacy without prescription.

more generic prescribing may be expected to continue to be a high priority within the Department's pharmacy and prescribing unit.

Within this scenario, the gatekeeper role of the GP in terms of access to drugs will be further enhanced in the Primary Care Group system in the future. With significantly increased budgetary responsibility, GPs will have more control over how healthcare funding is allocated in their area, including the drug budget. GPs who have not been in fund holding practice, which will include a significant number of dispensing doctors, will have to adapt to a new style of practice management in which cost control will be a key feature.

Traditional pharmaceutical customers are primarily GPs and hospital doctors, although with the emergence of Primary Care Groups the trend has been towards larger buying groups and committee decisions rather than individual prescribing choice. Under these circumstances, we may expect the number of customers to decrease as the desire to leverage administrative savings and achieve economies of scale encourages mergers to occur between Health Authorities, Primary Care Groups and Trusts.

Certainly, while numbers of GPs have increased slightly over the last few years, as illustrated in the table below, there has been tremendous concentration in buying and decision making power. Prior to the advent of the 1991 "Thatcher reforms" each GP acted independently. Effectively, purchasing of primary care pharmaceuticals, the key market driver, was in the hands of over 32,000 GPs. In contrast by 1995, as the Conservative reforms were in full swing, primary care purchasing came into the hands of approximately 4000 individual purchasers, encompassing multi funds, consortia,

fund holding and non-fund holding GPs. Under the Labour reforms, there were initially 500 primary care groups, responsible for primary care purchasing, a number that has been declining steadily through merger since. These changes have reinforced the focus upon driving out cost in pharmaceutical expenditure, standardizing prescribing habits and increasing the usage of generic drugs. However, even though the behaviour of GPs has altered in the face of changes in how the health service has been organised and attempts to influence prescribing behaviour, the number of actual primary care professionals interfacing with patients and the basic factors pertaining to regulation, pricing and distribution of pharmaceuticals has changed little during the period covered by this study. This is confirmed by the figures below.

3.6 The structure of the UK pharmaceutical Market, 1993 - 2002

The number of GPs in the UK has remained relatively stable during the ten year period 1992 to 2001, as illustrated in table 3.7. Given that patient prescriptions are the building blocks of the pharmaceutical market, this illustrates the point that it is changes in *prescribing behaviour* that have the potential to influence the pharmaceutical sales environment rather than structural change within the health service per se. Structural change acts to facilitate desired changes in physicians prescribing behaviour.

Table 3.2 The number of GPs in the UK 1992 – 2001

Year	England & Wales	Scotland	N Ireland	Total UK
1992	27,644	3,421	937	32,002
1993	27,991	3,456	950	32,397
1994	28,277	3,490	979	32,746
1995	28,421	3,524	994	32,939
1996	28,591	3,573	1,011	33,175
1997	28,852	3,625	1,026	33,503
1998	28,780	3,660	1,033	33,473
1999	28,471	3,697	1,039	33,207
2000	29,479	3,707	1,049	34,235
2001	29,628	3,755	1,054	34,437

Source: **(Yuen, 2002)** OHE Compendium of Statistics, 2002

The number of pharmacies in the UK, as with GPs, shows little difference over a ten year period, as illustrated in table 3.8.

Table 3.3 Number of Retail Chemists in the UK (1992-2001)

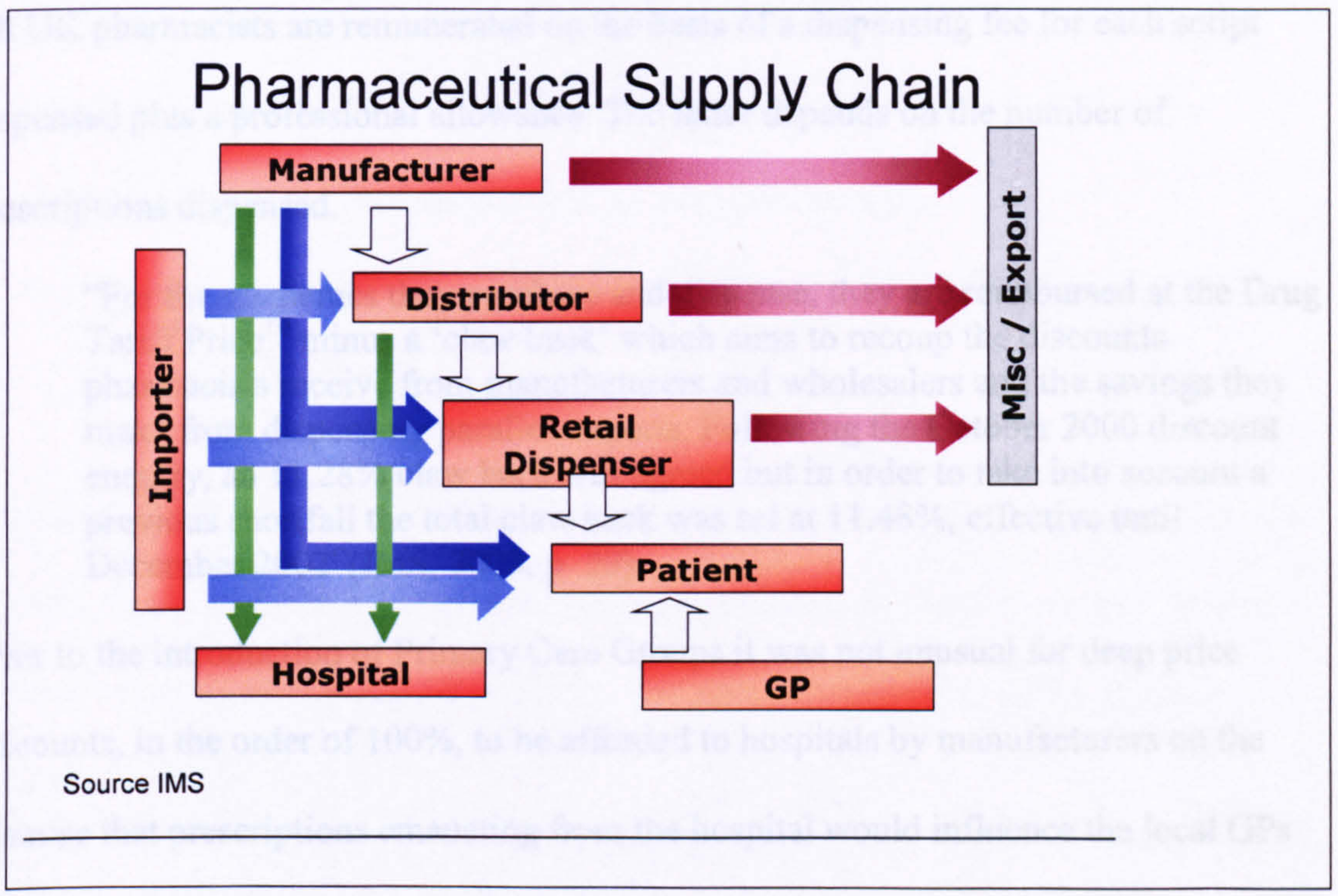
Year	England	Wales	Scotland	N. Ireland	UK
1992	9,947	712	1,137	509	12,305
1993	9,952	714	1,138	504	12,308
1994	9,954	721	1,136	507	12,318
1995	9,948	721	1,139	506	12,314
1996	9,779	715	1,142	504	12,137
1997	9,773	713	1,143	504	12,132
1998	9,791	714	1,145	508	12,156
1999	9,785	712	1,145	502	12,144
2000	9,775	711	1,144	504	12,134
2001	9,774	708	1,145	508	12,135

Source: (Yuen, 2002) OHE Compendium of Statistics, 2002

The basic unit of the pharmaceutical market remains the prescription. Prescriptions are generated by patients consulting a GP or hospital physician. The vast majority of

prescriptions are dispensed via the retail pharmacist, although dispensing practices and hospital pharmacies still also fill prescriptions. These "dispensers" obtain their supplies of drugs primarily via the drug wholesalers, who deliver daily or twice daily to pharmacies. Filled prescriptions are then submitted to the Prescription Pricing Authority (PPA) that prices the prescription and pays the pharmacist monthly, in arrears. The diagram below, Figure 3.7, presents a simplified overview of the supply chain.

Figure 3.7 Pharmaceutical Supply Chain



There are 14 full-line wholesalers operating in the UK, supplying drugs and related products to dispensing doctors and pharmacies. The three largest Pan European wholesalers are Alliance Unichem, AAH (owned by German wholesaler Gehe), and Phoenix. Together they account for over 80% of what is usually referred to as the

ethical pharmaceutical[8] supply market (IMS, 2003, p 69.), reflecting supply through GPs. While these three National wholesalers operate on a national basis, the remaining full-line wholesalers tend to cover regional territories. In addition, approximately 40 short-line wholesalers operate in the UK market, supplying limited ranges of cut price goods, mainly parallel imports[9], primarily to retail pharmacies. Wholesalers receive a fixed margin of 12.5% on branded medicines but margins can be 3 to 5% higher on generics, athough these products are therefore less profitable (IMS, 2003, p 39).

All UK pharmacists are remunerated on the basis of a dispensing fee for each script dispensed plus a professional allowance. The latter depends on the number of prescriptions dispensed.

> "For the medicines they purchase and dispense, they are reimbursed at the Drug Tariff Price[10] minus a 'claw back' which aims to recoup the discounts pharmacists receive from manufacturers and wholesalers and the savings they make from dispensing parallel imports. Following the October 2000 discount enquiry, an 11.28% claw back was agreed but in order to take into account a previous shortfall the total claw back was set at 11.48%, effective until December 2002"(IMS, 2003, p 39).

Prior to the introduction of Primary Care Groups it was not unusual for deep price discounts, in the order of 100%, to be afforded to hospitals by manufacturers on the premise that prescriptions emanating from the hospital would influence the local GPs and hence drive prescriptions in the community (IMS, 2003, p 39).

> "Hospital prescribing has a significant influence on the primary care drugs bill. Patients prescribed a product by a consultant are likely to continue with that product once their care has been passed back to the GP" (IMS, 1996, p 28).

---

[8] Ethical pharmaceuticals refer to those products which can only be obtained on prescription.
[9] The term 'Parallel imports' refers to supplies of products sourced from other countries in Europe where pharmaceuticals are available at lower prices. These parallel imports are typically sourced from Greece, Italy, Spain or France.
[10] Drug Tariff Price reflects the market price of a product. For a product which is still protected by patent, the drug tariff price is the same as the manufacturer's retail price, but for generic products a market price is calculated by averaging the current price across a small group of larger wholesalers and generic manufacturers.

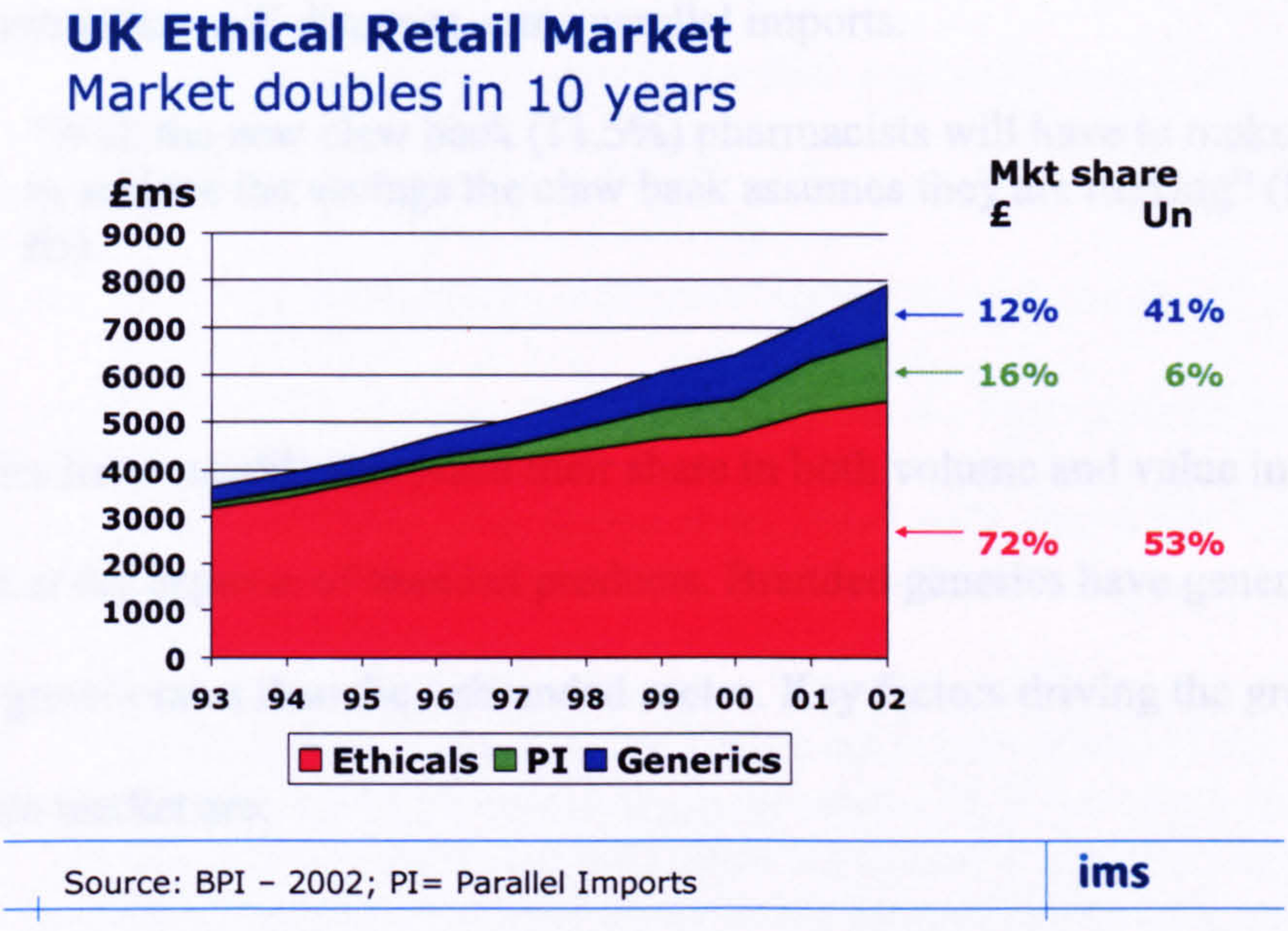
Available products consist of original brands, parallel imports, branded generics and unbranded or "commodity" generics.

Where:

1. Original brands are those marketed by an originating company that is the patent holder for the active ingredient.
2. Parallel imports are original brands sourced from other (normally European) countries where prices are lower.
3. Unbranded generics are commodity off-patent copies of drugs available at a fraction of the cost of the original brand. In the UK, unlike the US, these products are not identifiable back to the manufacturer.
4. Branded generics are improved generics with patented delivery systems or formulations.

A primary thrust of the NHS reforms has been to reduce the cost of medicines through actively encouraging switching from high price, branded products to cheaper generic alternatives or parallel imported products. The split between these major groups is illustrated in figure 3.8.

Figure 3.8 UK Ethical Retail Market



The importance of parallel imports should not be under estimated. Parallel imports represent a form of price competition to patent protected products which impacts different pharmaceutical companies in different ways. The impact depends upon the mix of products which the company markets and management's approach to European pricing.

> "The UK is the most popular European destination for parallel trade, followed by the Netherlands and Denmark…Leading companies and leading products are disproportionately affected by parallel trade. 50% of parallel imports are accounted for by 13 products, which include the five market leaders, and just four companies experience 57% of PI (Parallel Import) trade" (IMS, 2003, p 64).

Key factors driving parallel trade in the UK are the high degree of price sensitivity in the market. The parallel import trade is now a well established business, conducted by all the major wholesalers, and UK pharmacies have systems in place to track and obtain the best parallel import deals (IMS, 2003, p. 66). In fact, UK pharmacists have little

choice but to use parallel imports because the Department of Health claw back assumes that pharmacists will dispense some parallel imports.

> "With the new claw back (11.5%) pharmacists will have to make real efforts just to achieve the savings the claw back assumes they are making" (IMS, 2003, p 66).

Generics have steadily increased their share in both volume and value in the retail market at the expense of branded products. Branded generics have generally returned lower growth rates than the unbranded sector. Key factors driving the growth of the generics market are:

1. The focus on cost containment, which favours the cheaper generic alternatives as the government tries to curtail NHS expenditure. There is now a real culture of generic prescribing within the NHS.
2. Measures to promote generic prescribing, such as generic target incentives. Generic prescribing accounted for 74% of prescriptions in 2001 (IMS, 2003, p 27).
3. A number of "blockbuster" drugs came off patent during the study period, including omeprazole, enalapril, paroxetine, fluoxetine, and lisinopril.
4. The introduction of a unified budget managed by the PCOs has focused attention on drug prices as a major cost driver. Most PCTs have incentives in place actively to boost generic prescribing.

> "There are strong incentives to promote prescribing of generics. PCT prescribing software lists drugs by generic name and indicates generic alternatives to the GP. Trainee doctors are taught to prescribe generically" (IMS, 2003, p 27).

3.7 Pricing

The UK is one of the few major markets in which companies are free to set the launch price of new products (IMS, 2003, p 31). The others are the US, Germany and Switzerland. The UK government influences prices through control of profits made by the pharmaceutical industry on sales to the NHS via the Pharmaceutical Price Regulation Scheme (PPRS). This is one of the chief tools used in the UK to control expenditure on medicines.

> "Under the PPRS, companies are free to set launch prices of new products, provided that the total rate of return on capital (ROC) on their portfolio of products reimbursed by the NHS does not exceed a specified limit. Each company negotiates with the government for an allowed ROC, within the range of 17-21 per cent...Any excess is "repaid" either directly or through a price reduction "(Danzon, 1997, p 21).

The scheme, which is a "voluntary", non statutory, agreement between the government and the pharmaceutical industry covers all licensed branded prescription drugs sold to the NHS. These account for approximately 80% of the NHS drugs bill. Unbranded generic products and OTC medicines (other than those prescribed by doctors) are excluded from the scheme.

The PPRS controls the maximum profits a company can achieve on the capital it has invested in R & D and manufacturing for sales made to the NHS. For companies that undertake little or no manufacturing or research in the UK, profit targets are set in terms of return on sales (ROS). In 1999, the PPRS required companies to modulate their prices or pay a levy equivalent to a 4.5% reduction in turnover.

The PPRS also regulates company expenditure on promotional activity and provides incentives for R&D in the form of an allowance of 20% of NHS sales, plus an

additional 0.25% allowance for each additional in-patent molecule with annual sales in excess of £500, 000. These incentives may, in part, account for why the UK has traditionally been a favoured site for pharmaceutical R&D activity, representing a 10% share of world R&D. This is in stark contrast to only 3% of world sales (IMS, 2003, p. 54). However, despite these incentives, the number of new compounds introduced in the UK is falling, only 24 were introduced in 2000 as compared with 34 in 1996.

Unbranded generics have been excluded from the PPRS since 1986. Prices of all medicines are listed by generic name in the Drug Tariff, which is published monthly by the Prescription Pricing Authority. Changes to the Drug Tariff, which is negotiated between the DOH and the pharmacy body, the Pharmaceutical Services Negotiating Committee (PSNC), aim to reflect market changes but rarely keep pace with the high level of discounts obtained by pharmacists and dispensing doctors.

The Drug Tariff dictates the NHS reimbursement price for generics. Pharmacists and dispensing doctor reimbursement is based on the Drug Tariff price and additional professional fees for dispensing services. Discounts obtained on the Drug Tariff price can be retained, but part of this "excess profit" is "clawed back" by the government through the discount recovery system. The "claw back" is calculated on the basis of annual discount enquiries among a sample of pharmacists and dispensing doctors.

The system encourages pharmacists to dispense the cheapest available product and to retain the discounts that exceed the claw back. It has also stimulated generic price wars, which have negatively impacted on the generics sector.

In summary, by the end of 2002 a number of factors had come into play within the UK pharmaceutical industry that may have applied a differential impact to pharmaceutical companies operating within the UK pharmaceutical market. Firstly, the government's drive to reduce pharmaceutical expenditure through encouraging switching to cheaper alternatives has driven demand for both generic and parallel imported products. Companies with ageing product portfolios or whose pricing policies have established strong differentials across Europe appear most at risk. Secondly, NICE guidance has the potential to deliver market success to favoured new products yet consign others to obscurity. Thirdly, national service frameworks have focused the attention of primary care professionals on actively diagnosing and treating cardiovascular disease, diabetes and chronic conditions of the elderly. Thus companies that had the good fortune, or foresight, to research or licence products for these particular categories of illness have effectively been handed a financial windfall.

3.8 How to measure the effect of the NHS changes upon pharmaceutical companies

A key point about strategic groups is that because of the different nature of the mobility barriers which surround them, some groups will be more vulnerable to external environmental shocks and some more protected than others (Caves *et al.*, 1977); (for a full discussion see chapter 2). The issue here is how to measure the effect of such profound environmental change? This is not a question of measuring the reorganisation of the NHS, per se, or about numbers of types of hospitals, because regardless of how such units are organised their base functions and operating principles remain largely unchanged. The issue is about measuring changes in *behaviour* related to the procurement, choice and usage of pharmaceuticals. Since the NHS is virtually the sole purchaser of pharmaceuticals in the UK, then how NHS changes affect the choice and

use of pharmaceuticals should exert significant pressure on the operational strategies of pharmaceutical firms.

This environmental pressure in the study period should be considerable given that the Thatcher reforms introduced the most significant change to the NHS since its inception in 1948 (Ham, 1994, p. 10). Measuring the effect of change on the relative usage of pharmaceuticals becomes the key question. Many of the changes introduced in the NHS led to variation in the way in which different parts of the NHS were organised and related to one another. Here it is important to separate out the "noise" of reorganisation from the relatively few factors that directly impacted on pharmaceutical expenditure and the mechanism by which changes in pharmaceutical usage occurred.

3.9 Conclusions

In sum, the NHS changes from the late 1980s can in many ways be described in terms of efficiency, where the aim was to reduce variation in output and operating cost between similar health care providers. The aim was to drive out cost and increase value for money. Although pharmaceuticals represented only 12.3% of health care expenditure in 2001(IMS, 2003, p 10), it can be argued that pharmaceutical expenditure presented a valid target for efficiency gains for a number of reasons. Firstly, pharmaceutical expenditures are easily measured and the PACT system provided the means to track, compare and contrast pharmaceutical usage and expenditure between similar health care providers. Secondly, the pharmaceutical industry has frequently been cited as one of the world's most profitable industries (The Boston Consulting Group, 2000). Hence, it may be argued that reducing pharmaceutical profits, which some may regard as excessive, presented a more politically acceptable target than closing hospital

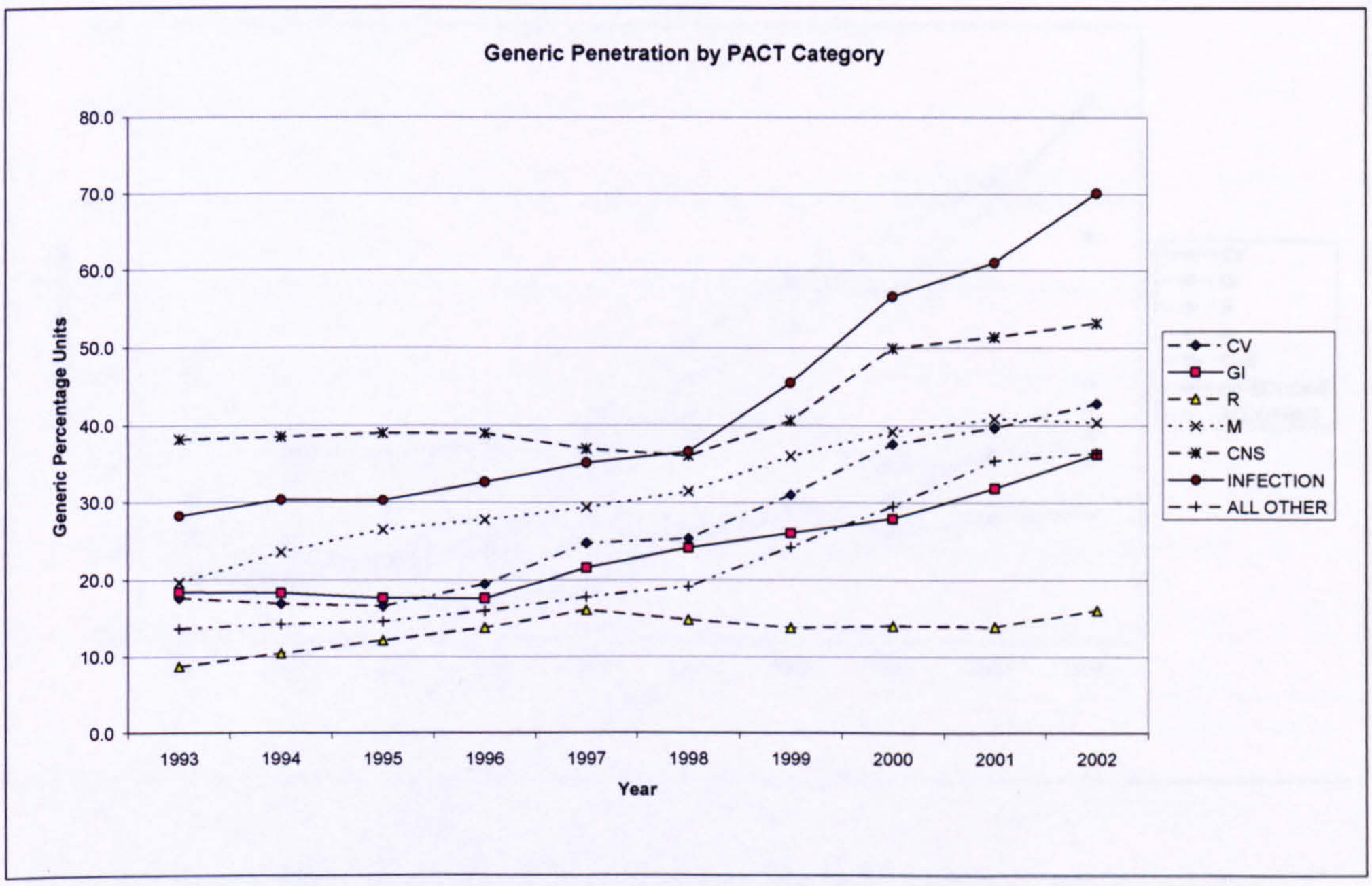
wards or postponing non-urgent operations. Thirdly, the availability of cheaper alternatives in the form of generic medicines and parallel imports meant that expenditure on pharmaceuticals could be significantly reduced without significant risk to health care provision.

Couched in these terms the principal changes to the NHS during the 1990s impacting on pharmaceuticals were not changes within the structure or the operating procedures of the various organs of the NHS, but rather in terms of those factors that changed the use of pharmaceuticals. It makes sense to consider how NHS managers measured the use of pharmaceuticals and the precise targets that NHS professionals were driven to achieve in terms of drug usage. These are targets can be broadly divided into two groups. Firstly, those related to achieving reductions in cost by direct cost shifting from higher priced products to lower cost alternatives within defined areas, as measured by PACT figures and generic percentages. Secondly, those incentives aimed at shifting focus to perceived higher priority health needs of the nation, such as the reduction of the burden of cardiovascular medicine through early diagnosis and treatment. The effects on pharmaceuticals in the first instance were to differentially penalise the sales of those companies operating in areas of high pharmaceutical expenditure and, in the second case,to actively grow the market for companies marketing products such as cholesterol lowering agents, for example Pfizer, Astra, MSD, Novartis and Bayer.

The former of these two categories is clearly measurable in terms of the penetration of generic products within defined therapeutic categories. The PACT categories effectively track the impact, as NHS managers focused on the big six therapeutic categories and the

uptake of generics. Figure 3.9 illustrates generic uptake across the seven PACT categories.

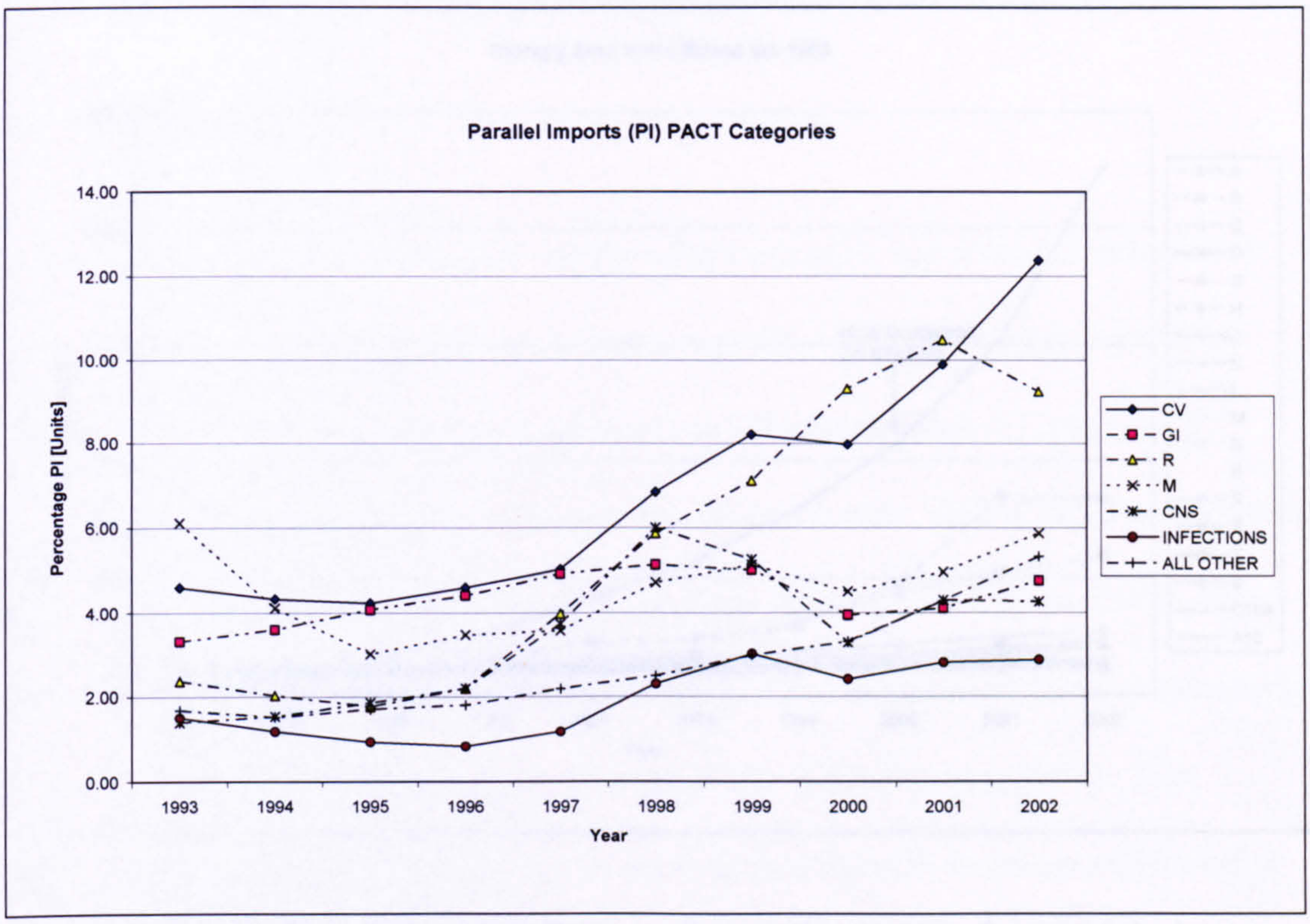
Figure 3.9 Generic Penetration by PACT Category



Here, the six main therapeutic categories; cardiovascular (CV), gastrointestinal (GI), respiratory (R), musculo-skeletal (M), central nervous system (CNS) and infection are shown together, with the remaining therapeutic areas summarized into an "all other" category.

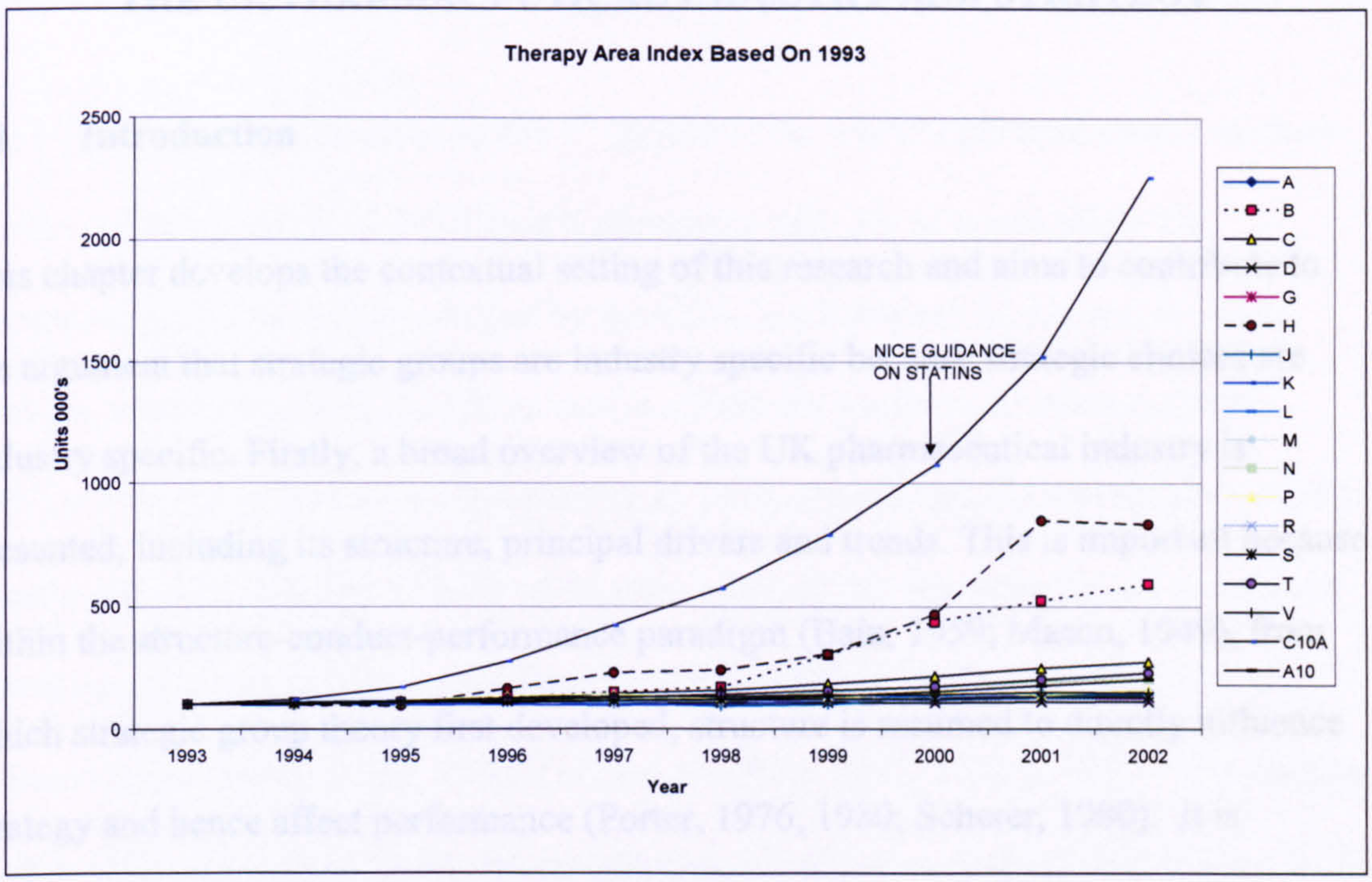
Similarly the uptake of parallel imports within these PACT groups is illustrated in figure 3.10.

Figure 3.10 Parallel Imports (PI) PACT Categories



To measure the effect of windfalls such as NICE guidance and the national service frameworks, sales in units of the relevant therapeutic category, for example Cardiovascular medicine, should provide a reasonably accurate picture of growth in prescriptions without skewing the result due to price differences. For example, note in figure 3.11 the tremendous relative growth of the statins (cholesterol lowering agents) sub-segment, which stands out from the rest of the therapeutic categories in the figure, all of which are indexed on 1993. The key to the right identifies the relevant therapeutic area but the key point of the graph is to highlight the huge increase in the use of cholesterol lowering drugs C10A.

Figure 3.11 Therapy Area Index Based on 1993



In the next section we shall explore the type of strategies that the pharmaceutical industry employed to capitalise upon the emerging opportunities within this turbulent environment.

CHAPTER 4

THE UK PHARMACEUTICAL INDUSTRY AND STRATEGY

4.1 Introduction

This chapter develops the contextual setting of this research and aims to contribute to the argument that strategic groups are industry specific because strategic choices are industry specific. Firstly, a broad overview of the UK pharmaceutical industry is presented, including its structure, principal drivers and trends. This is important because within the structure-conduct-performance paradigm (Bain, 1959; Mason, 1949), from which strategic group theory first developed, structure is assumed to directly influence strategy and hence affect performance (Porter, 1976, 1980; Scherer, 1980). It is important to note that, as discussed earlier (see chapter 2), both the theory of mobility barriers (Caves *et al.*, 1977) and the theory of intra-industry performance (Porter, 1979) derive from and build upon this premise. Secondly, strategy formulation within the pharmaceutical industry is discussed with particular emphasis on those operational aspects that may be considered country specific. As discussed in the previous chapter, while the healthcare systems of the developed world face a number of essentially common problems, the UK health service differs significantly in a number of ways from the operating environments which were the setting for previous pharmaceutical-based strategic group studies (Bogner, 1991; Cool, 1985; Cool *et al.*, 1987b; Guedri, 1998; Martens, 1988). Thirdly, a brief discussion of what is meant by strategy and alternative strategy frameworks is discussed to provide structure to the strategy dimensions identified. Finally, the chapter concludes with a discussion of the principal strategic choices that companies must choose between and a review of the principal mobility barriers that differentiate strategies in the UK pharmaceutical industry.

4.1 The UK Pharmaceutical Industry – Size, structure and principal drivers

The UK is generally described as the 6th largest of the world's pharmaceutical markets in terms of revenues (IMS, 2001) but it represents only 3% of world sales. The pharmaceutical market is dominated by the USA, the European Union and Japanese markets, where success in the US market is critical for commercial success (Porter, 1993, p 27.). Here, the balance has shifted. In 1995, the US and EU represented roughly equal markets at 33% and 32% of world sales respectively, but now the US dominates pharmaceutical strategy because it represents over 40% of world sales and 60% of pharmaceutical profits (IMS, 2001; Lehman Brothers, 2003; Pilling, 1999). The reasons for this shift are twofold. Firstly, as described in the previous chapter, healthcare systems across the world's developed countries face the common problems of rising demands for healthcare driven by an increasing elderly population and the rising costs of medical treatments. Secondly, the response to such pressures differs from country to country. Within Europe the approach has been towards control of drug expenditure and driving down the cost of pharmaceuticals. For example, in a recent article Sir Tom McKillop, Chief Executive of Astra Zeneca, stated that:

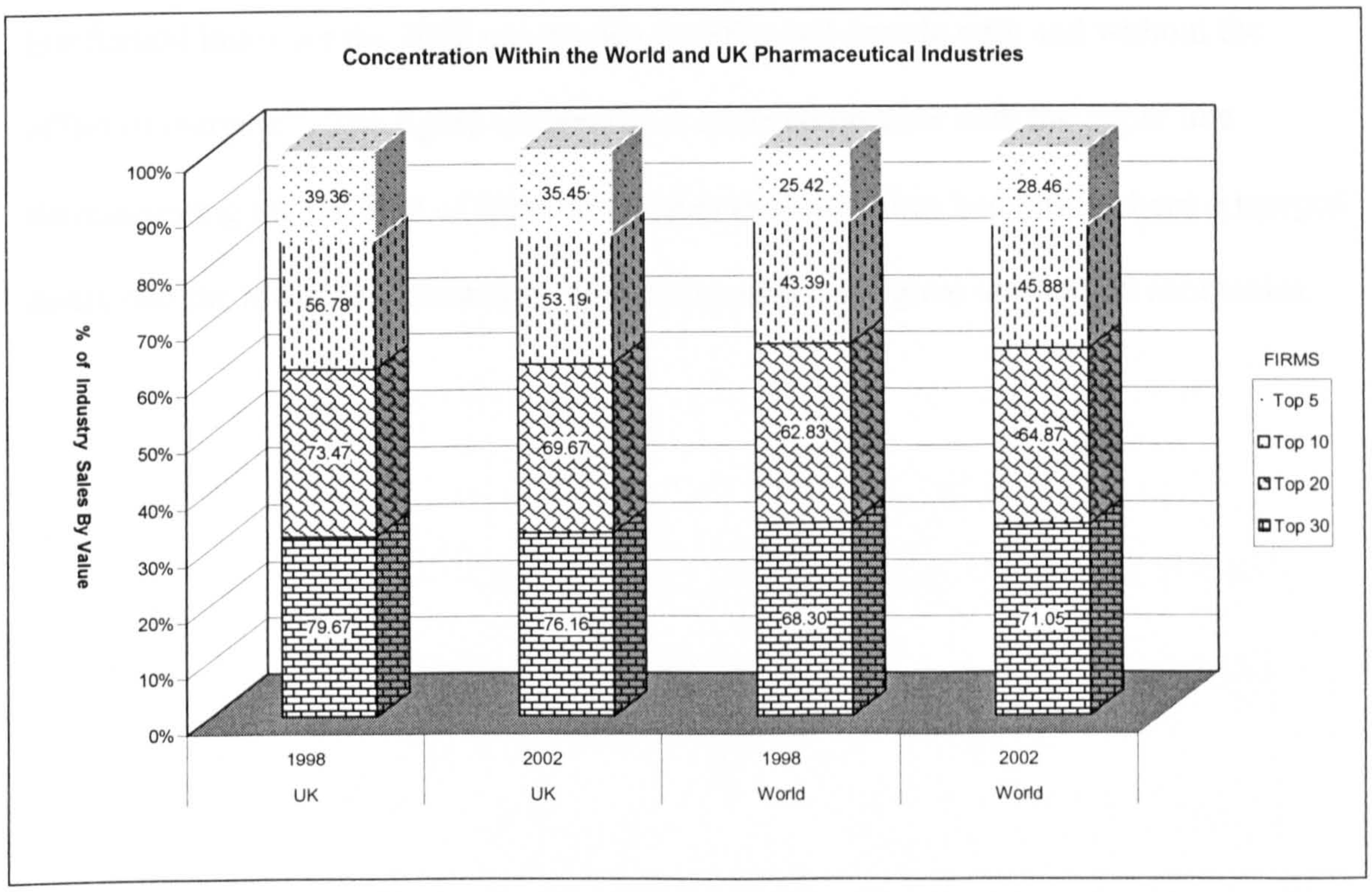
> "Europe has become a dog of a market with its downward spiralling of prices" (McKillop, 2004, p 50).

In contrast, within the US an opposite approach appears to dominate:

> "On the demand side, particularly in the US market place, we have seen a dramatic rise of managed care. One important effect has been a significant increase in the extent of insurance coverage for prescription drugs. This has been driven in part by a desire to substitute drugs for more costly medical interventions. Increased coverage for pharmaceuticals has been one of the main factors linked to the increased per capita expenditures on pharmaceuticals in the US in the 1990's" (Grabowski *et al.*, 2000, p 67).

The UK is therefore a market which has become progressively more price sensitive over the study period, which perhaps explains in part why market consolidation in the UK has declined in stark contrast to the trend in the US; see Figure 4.1.

Figure 4.1 Concentration within the world and UK pharmaceutical industries



A possible reason for this may be that UK companies experience a sharp decline in sales post patent expiry, typically in the order of 50% to 80% of sales in the first year. They also face slow market entry during due to the effect of entry barriers such as evaluation by bodies such as NICE,[11] which caused problems for Glaxo with Relenza, a treatment for flu. In the US higher prices are achievable and consumers may be influenced directly via direct to consumer advertising, which is illegal in the UK:

---

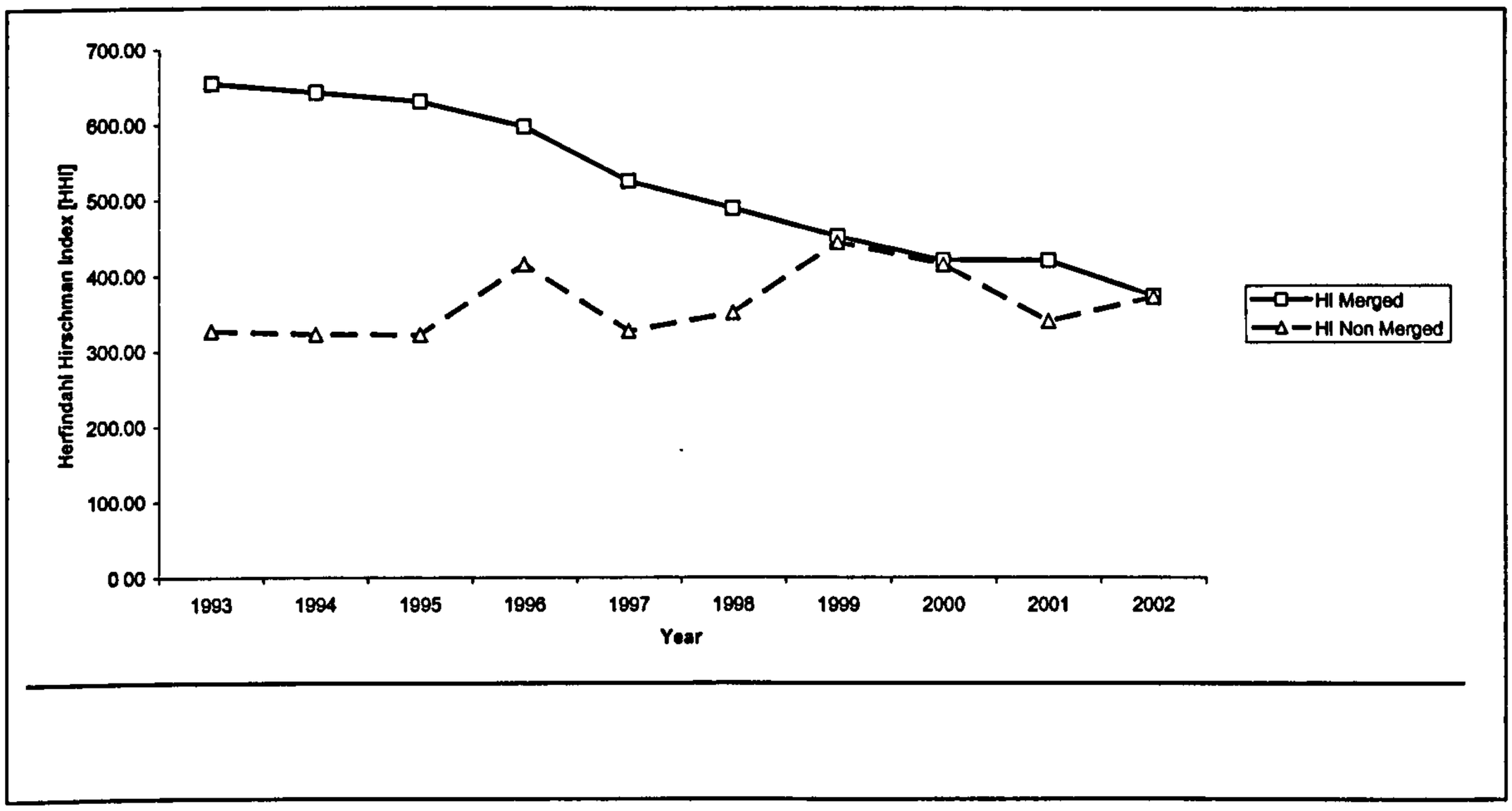
[11] NICE stands for the National Institute of Clinical Excellence a government body which evaluates the contribution of medicines to existing treatment. (See Chapter 3)

> "An ageing population, easy access to medical information, and the current scepticism about health care systems have increasingly made consumers – not the trusted family physician – the arbiters of what prescription medicine they take"(Aitken *et al.*, 2000). (Article discussing direct to consumer advertising in the US.)

The structure of the pharmaceutical industry has also been radically affected by mergers. Note the two merger waves, one in 1996 and a second between 1998 and 2000 that are prominent in the following figures 4.2 and 4.3. The first compares the Herfindahl Index for the 2002 companies over the last decade with and without the effect of mergers[12]. The figure compares the same companies with the upper line demonstrating the position of these companies assuming they had always been a merged entity and the lower line illustrates these companies as original un-merged companies.

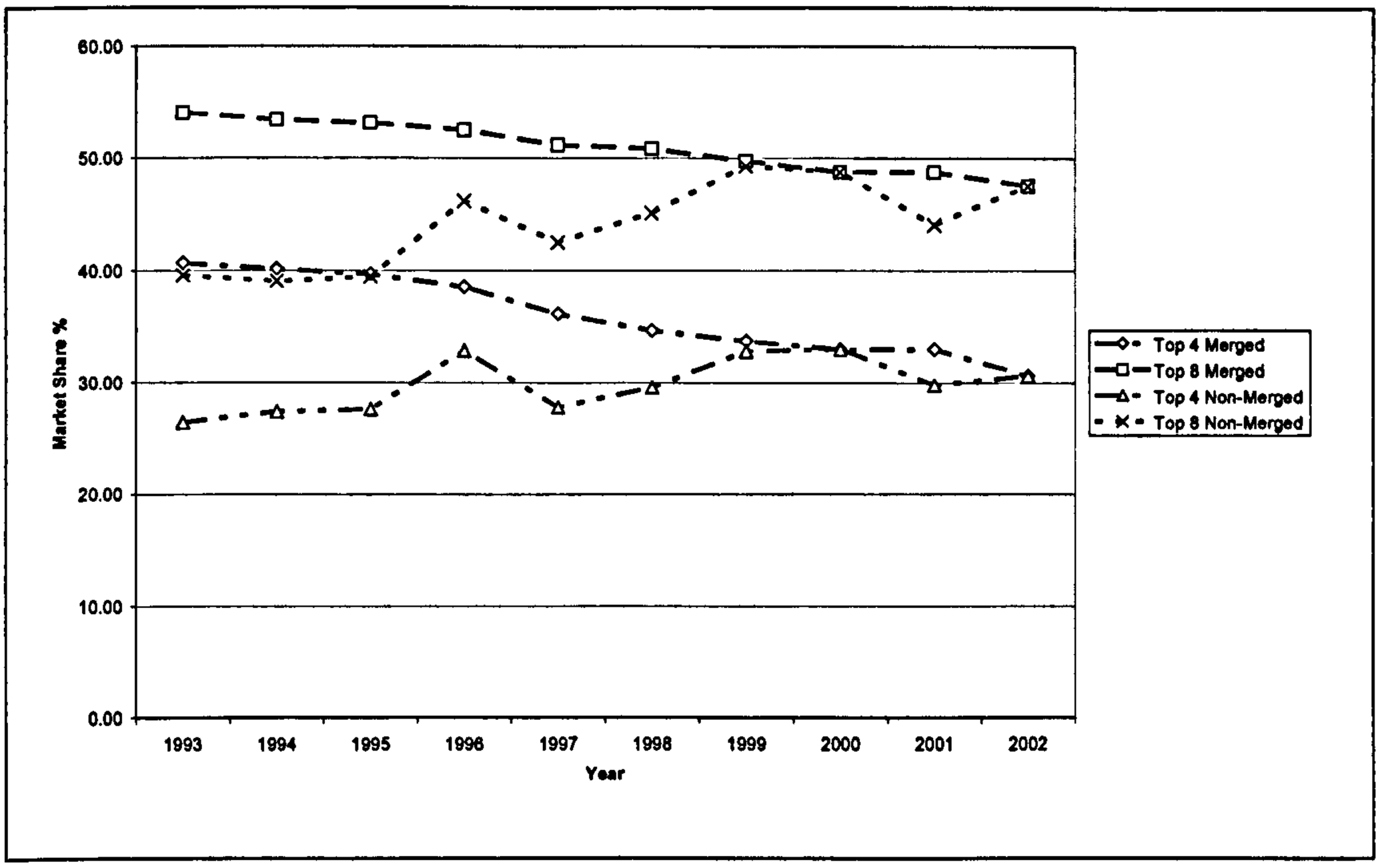
[12] The standard IMS database automatically incorporates merged companies and recalculates the companies' data assuming that a company had always had that asset combination.

Figure 4.2 The effect of mergers upon pharmaceutical industry concentration in the UK



Here, a Herfindahl-Hirschman (HHI) index of around 400 indicates strong rivalry (Oster, 1994, p 213.), while the US competitive authorities tend to view a HHI of under 1200 as indicating a competitive market structure. The degree of fragmentation in the UK pharmaceutical industry is clearly illustrated by figure 4.3, which compares the degree of the market held by the top 4, 8 and 20 companies respectively.

Figure 4.3 Concentration in the UK Pharmaceutical Industry



The importance of merger as a strategy in the pharmaceutical industry is clearly illustrated by the above two figures and it is worth noting that previous strategic group studies within the pharmaceutical industry do not address this (Bogner, 1991; Bogner *et al.*, 1996; Cool, 1985; Cool *et al.*, 1987b; Martens, 1988). According to industry sources, merger or acquisition is generally undertaken to gain cost synergies, to improve capabilities in research through acquisition of rare assets or critical mass, and to achieve marketing strength in critical markets such as the US (McNeil, 1996). These declared outcomes are, however, at variance with recent research, which indicates that mergers are primarily a response to anticipated patent expiry and weak product pipelines (Danzon *et al.*, 2004). This conclusion is supported in my data by the case of GlaxoSmithKline. If we compare the company's market position, as a combination of Glaxo, SmithKline Beecham and Wellcome, in 1993, the combined market share

represented 20.28%. But through patent expiry, notably of Augmentin, Zantac and Zovirax, the market share had dwindled to 10.97% by 2002.

Although the industry structure implies a relatively fragmented industry, competition does not occur openly between all firms. The degree of competition occurs at the level of substitution in the industry, therefore companies that engage in the marketing of alimentary or respiratory products, for example, do not necessarily actively compete. The locus of competition lies not at the therapy area level e.g. alimentary products – therapy class A – but at the sub-therapy level e.g. anti-ulcerant products – sub-therapy class A2B. This point is illustrated figures 4.4 and 4.5.

Figure 4.4 Competition between the Top 6 companies in the alimentary segment 2002[13]

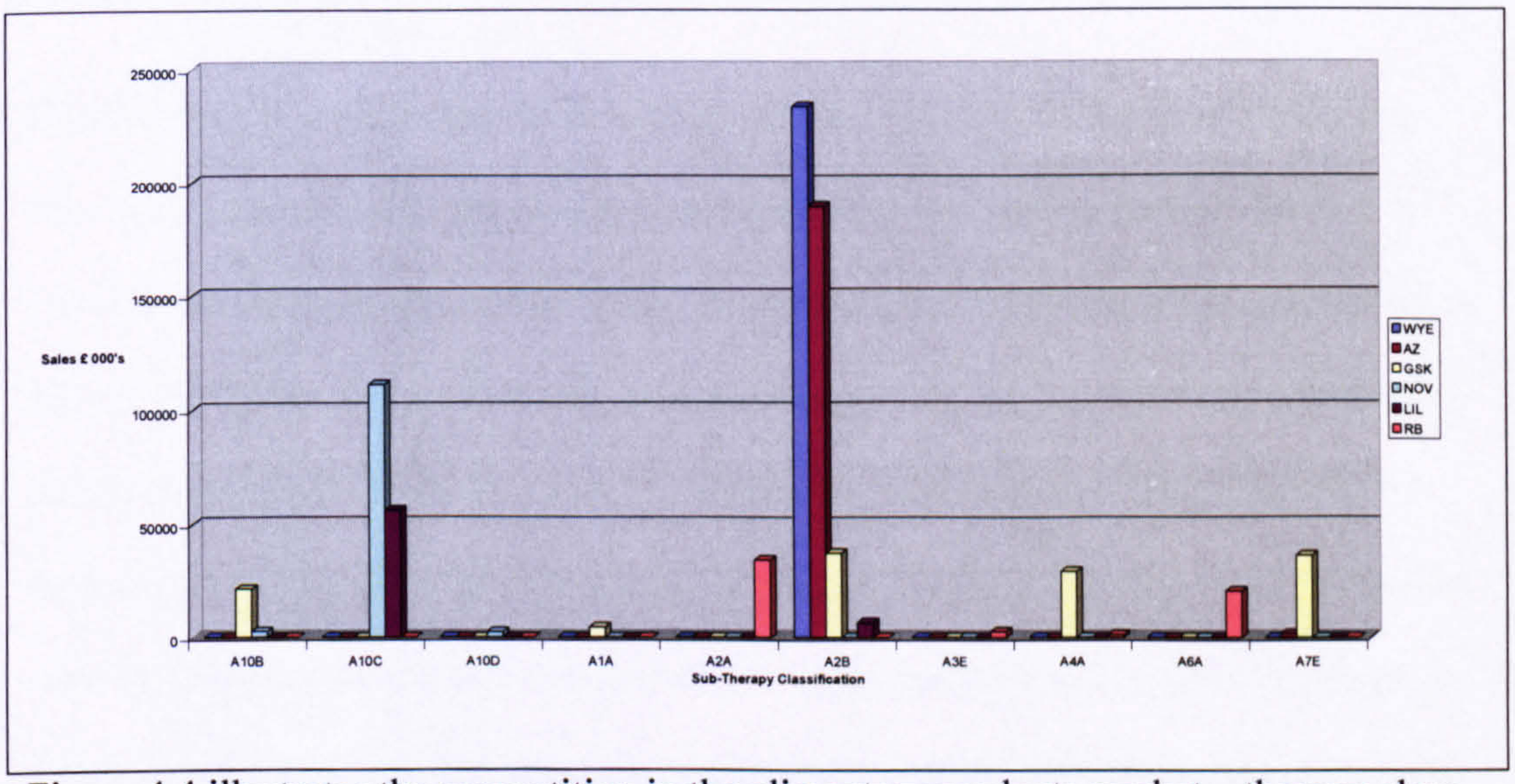


Figure 4.4 illustrates the competition in the alimentary products market – therapy class A. Here it can be clearly seen that the most important sub-therapy area is A2B – anti-ulcerants – where the market leader Wyeth [WYE]is in cut throat competition with

[13] In this graph the companies depicted are Wyeth [WYE], Astra Zeneca [AZ], Glaxo Smith Kline [GSK], Novo Nordisk [NOV], Eli Lilly [LIL] and Reckitt Benkisser [RB].

Astra Zeneca [AZ] each marketing their own brand of a Proton Pump Inhibitor. The next most important sub-therapy area is A10C where Novo Nordisk [NOV] and Eli Lilly [LIL] are in competition with equivalent products. The key point is that because of the nature of disease, the pharmaceutical market is effectively partitioned and companies active in one specialist area may not actively compete outside of their chosen segments. All companies do, however, compete for selling time in front of doctors, an increasingly scarce 'commodity', and promoting different but complementary products may provide additional strategic options through alliance, for example cross-selling arrangements.

Figure 4.5 Competition among the top 5 competitors in respiratory medicine 2002[14]

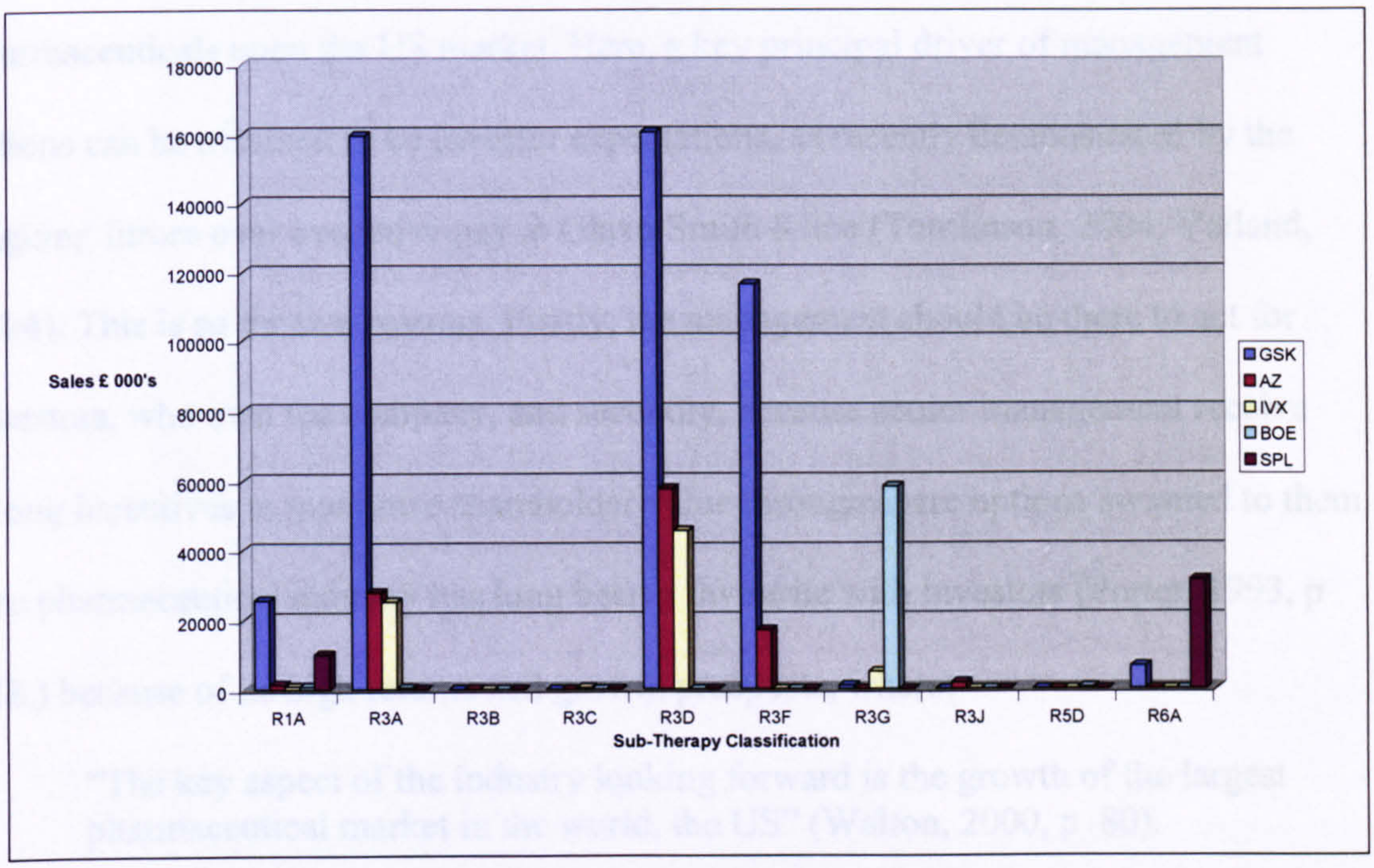


Figure 4.5 further illustrates the barriers to competition. Here AstraZeneca [AZ] and GlaxoSmithKline [GSK] are clearly direct competitors in R3D and R3F – inhaled steroids and beta-agonists, respectively. But Boehringer Ingelheim [BOE] and Schering Plough [SPL] can also market their products successfully in the respiratory market by concentrating their efforts in less actively contested sub-segments. This observation may in part explain why the pharmaceutical industry is able to produce such handsome returns. Competition is effectively reduced through companies choosing to compete in different market niches. This strategy is effectively negated through merger, where the combined company may find difficulty to maintain sufficient industry positions to sustain its size let alone allow continued growth.

---

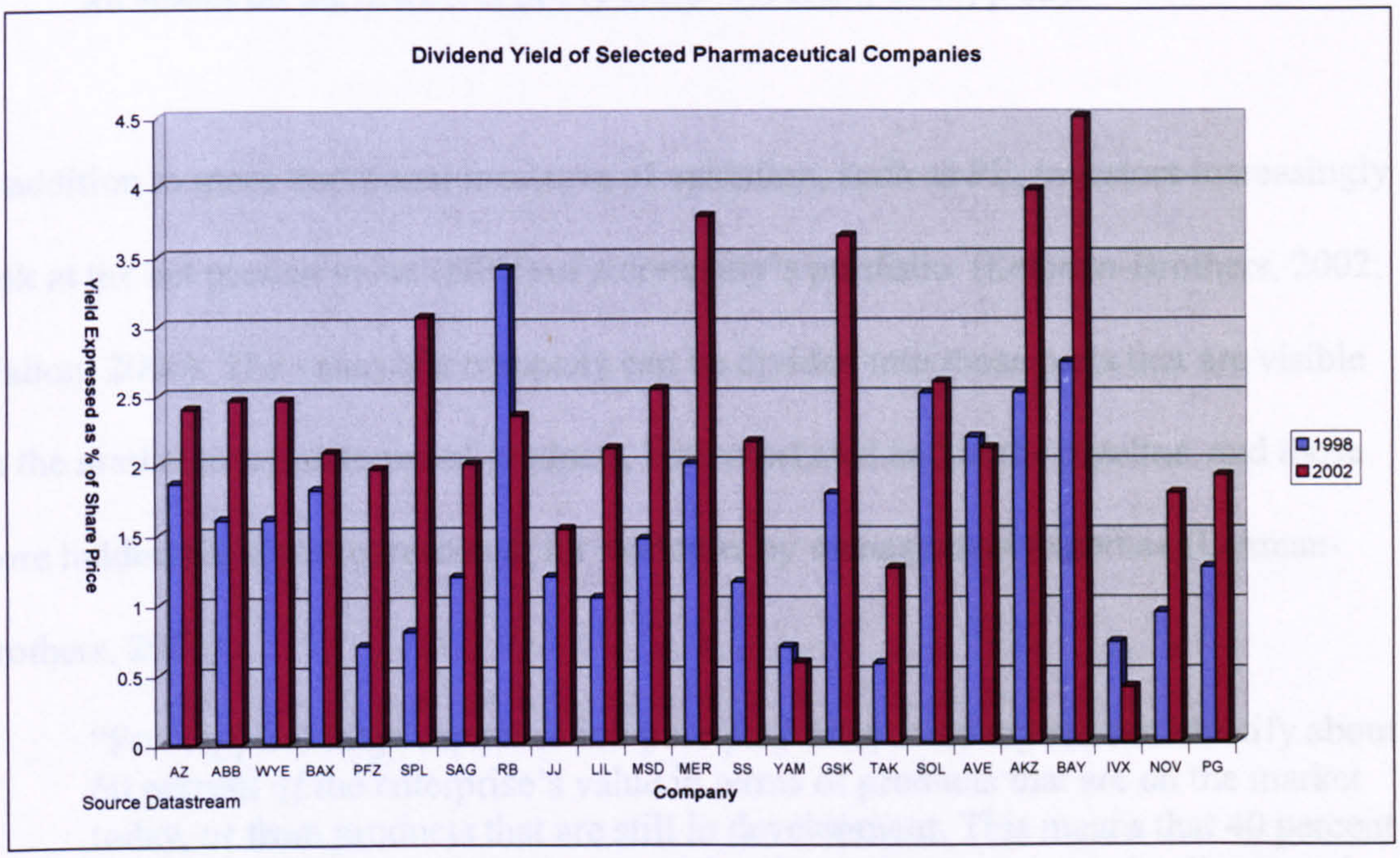
[14] Here the companies depicted are Glaxo Smith Kline [GSK], Astra Zeneca [AZ], Ivax Pharmaceuticals [IVX], Boehringer Ingelheim [BOE] and Schering Plough [SPL].

The increasing dominance of the US market, taken together with the risk and cost associated with new drug research and development, recently estimated at over $800m per new chemical entity, [NCE] (Hawthorne, 2003), act to focus strategy in modern pharmaceuticals upon the US market. Here, a key principal driver of management actions can be assumed to be investor expectations, as recently demonstrated by the ongoing furore over executive pay at Glaxo Smith Kline (Tomlinson, 2004; Yelland, 2004). This is so for two reasons. Firstly, the management should be there to act for investors, who own the company, and secondly, because senior management receive strong incentives to maximise shareholder value through share options awarded to them. The pharmaceutical industry has long been a favourite with investors (Porter, 1993, p 158.) because of its high returns and growth prospects, where:

> "The key aspect of the industry looking forward is the growth of the largest pharmaceutical market in the world, the US" (Walton, 2000, p 80).

It may be assumed that investors buy and hold shares on the assumption that the value of the shares will increase in line with previous growth. In general, pharmaceutical companies do not offer strong dividend payments, which during the study period generally averaged around 1% to 3% of the share price, a point further illustrated in figure 4.6.

Figure 4.6 Dividend Yield of Selected Pharmaceutical Companies



Key to figure 4.6 above.

ABBREV	COMPANY	ABBREV	COMPANY
AZ	Astra Zeneca	NOV	Novo
ABB	Abbott	PFZ	Pfizer
AVE	Aventis	PG	Procter & Gamble
AKZ	Akzo Nobel	RB	Reckitt Benkisser
BAX	Baxter Healthcare	SAG	Schering AG
BAY	Bayer	SS	Sanofi Synthelabo
GSK	Glaxo Smith Kline	SPL	Schering Plough
JJ	Johnson & Johnson	SOL	Solvay
IVX	Ivax	TAK	Takeda
LIL	Lilly	WYE	Wyeth
MER	E Merck	YAM	Yamanouchi
MSD	Merck Sharpe & Dohme		

It is because dividends do not represent a strong incentive to hold pharmaceutical company shares that sales growth can be taken as a proxy for share price appreciation, a point reinforced by Walton:

> "The correlation between sales growth and the relative performance of quoted pharmaceutical companies' price/earnings ratio (PE) compared with the PE of all stocks on the market is pretty close" (Walton, 2000, p 82).

In addition to more traditional measures of valuation, such as PE, investors increasingly look at the net present value (NPV) of a company's portfolio (Lehman-Brothers, 2002; Walton, 2000). The value of a company can be divided into those parts that are visible on the market today in terms of products, both marketed and in the pipeline, and those more hidden elements represented, for example, by management expertise (Lehman-Brothers, 2002):

> "For a typical large capitalisation pure play drug company we can identify about 60 percent of the enterprise's value in terms of products that are on the market today, or from products that are still in development. This means that 40 percent of that enterprise's value must be attributable to products yet to be discovered and to other areas of infrastructure such as sales forces" (Walton, 2000, p 101).

If we assume that the twin goals of maximising share price value and meeting shareholders' expectations drive managerial action, then the factors that would appear to drive strategic choice are those factors which contribute to sales growth and market success. Hence, the prime driver of company strategy may be assumed to be "the importance of developing a marketing presence, especially in the US " (Walton, 2000, p 97).

In the UK, the elements of success most likely to contribute to these over arching goals divide into pre and post market activities, where prior to product launch the factors that drive commercial success are about developing a strong cost effectiveness argument to submit to NICE. This contributes to the important wider goal of gaining rapid and full

marketing approval, especially if the UK has been chosen to act as "rapporteur" as part of the European "Mutual Recognition" Procedure.

Post product launch, the key aim is to maximise sales of the product prior to patent expiry. Speed of uptake into the market is important together with life cycle management in order to maximise revenues from the company's product portfolio. Walton states that "the most important driver of growth has been life cycle management" (Walton, 2000, p 86).

John Kay considers that within the pharmaceutical industry "most capital employed is actually uncompleted R&D" (Kay, 2000, p 10) and describes the structure of the industry as consisting of two different process parts:

> "There is a creative activity involved in origination. There is a delivery process of manufacture and distribution" (Kay, 2000, p 12).

The third factor, distribution, Kay considers important because:

> "..consumers are small; because consumers are ignorant; and because consumers are immobile" (Kay, 2000, p 13).

What sets the pharmaceutical industry apart from many other industries is, firstly, that the processes of origination, manufacture and delivery are nor clear cut but present "fuzzy boundaries", for example research, development, manufacture and marketing activities are` strongly intertwined. Secondly, because the retail function is performed by three different agents:

> "Governments (or in some countries intermediaries) try to negotiate better prices for consumers. Doctors do the product selection. Pharmacists bring the products closer to the patient" (Kay, 2000, p 14)

In the UK, strategy in the pharmaceutical sector therefore divides into strategic long – term activities, aimed at positioning the industry in the most profitable future market segments, and maximising long-term shareholder value and short-term operational strategy decisions, aimed at maximising UK sales profitability. The broad strategic decisions aim to address a changing world market where four key issues are presented by Walton (Walton, 2000, p 80):

1. Slowing market growth is driving industry consolidation. This factor is perceived as a more important driver than product pipeline gaps and a shortage of new chemical entities (NCEs).
2. Performance is diverging strongly between US and European companies. US based companies are showing stronger growth, perhaps due to "home advantage", which has long-term implications in terms of companies' ability to invest in future research or fund marketing programmes.
3. Costs are increasing sharply, which limits the amount that companies can afford to invest in research and the number of new products which companies' can afford to launch. McKinsey estimates that to launch a new product now costs in the order of US$400m (Bastianelli *et al.*, 2001); while Grabowski points out that R&D expenses have risen six-fold in the last two decades (Grabowski *et al.*, 2000, p 75).
4. A strong correlation exists between success and marketing effort, but beneficial scale effects are less evident in research and development activities.

In conclusion, the strategic factors that appear important in the broader industry setting are, firstly, factors related to scale. This is driven, in part, by the belief that research and

development is scale dependent (Cookson, 2000) and partly by the size of sales forces required to compete effectively in key markets, especially the US.

> Sir Richard Sykes, Glaxo Chairman, spelt out the rationale in characteristic language. "You can't discover drugs with a man and a dog. It requires really big expenditure to pull together a lot of knowledge coming from different areas. There are some things we want to do today but can't, even with a £1.2bn R&D budget"(Cookson, 2000).

A strategic response that has changed the industry has been considerable merger and acquisition activity, as commented upon earlier, which has generally been attributed to a need to build critical mass in research and marketing (Bastianelli *et al.*, 2001; Pursche, 1996{Walton, 2000 #778; Walton, 2000). Spreading of risk is also often cited as one of the key arguments in favour of building scale within pharmaceuticals.

> "The dynamics of innovation in pharmaceuticals, an industry in which R&D is extremely expensive, introduces substantial risk and takes place over a very long period of time. By means of consolidation and the development of oligopolistic industrial structures, firms have been able to work with these conditions" {Galambos, 2000 #783, p 23.}.

As explained earlier, merged companies were excluded from previous pharmaceutical industry based strategic group studies (Bogner, 1991; Bogner *et al.*, 1996; Cool, 1985; Cool *et al.*, 1987b; Martens, 1988). This is because earlier research chose to simplify the data set thus allowing the comparison of adjacent years to discover stable strategic time periods. The research presented in this thesis is unusual because merged companies are included.

In addition, a number of key scope decisions are important, although some decisions appear to be forced by the economics of the industry. For example, given that the cost of producing each new chemical entity is between US$700 and US$800m (Bastianelli *et al.*, 2001; Hawthorne, 2003) companies are forced to address the three major market

blocks, the US, the EU and Japan, in order to recoup their investment before patent expiry.

Costs of producing new products and the returns gained appear strongly skewed. Grabowski and Vernon, for example, found that the top 10% of products accounted for 48% of the overall net present value of the 64 products introduced between 1980 and 1984 (Grabowski *et al.*, 2000, p 63.). They concluded that, while the returns of research-intensive firms were positive, this result was highly dependent on a few new "blockbuster" products (Grabowski *et al.*, 2000, p 67). Grabowski and Vernon observed that:

> "When returns are highly skewed, considerable volatility in outcomes remains even if companies are investing in large numbers of projects as individual companies" (Grabowski *et al.*, 2000, p 67).

Earlier strategic group studies (Bogner, 1991; Cool, 1985; Cool *et al.*, 1987b). described an industry where new products were derived largely via the application of organic chemistry, in part in the manner described by Kay:

> "Historically my economic model of pharmaceutical research shows skilled and lucky people dipping into a very large pot that contained a very large number of coloured balls, hoping that one or two will turn out to have winning numbers on them" (Kay, 2000, p 14).

Application of knowledge later became the key to success, where biochemistry and enzymology began to reshape the industry through changing the innovation process (Galambos, 2000, p 21):

> "As enzyme inhibition became central to the process of drug discovery, scale and scope efficiencies in pharmaceutical R&D steadily became more important. The contest to be first or second to market became more intense, and the requirements of successful marketing and sales in now global markets began to

> drive merger and acquisition activity throughout the industry in the 1980's" (Galambos, 2000, p 21).

Despite this aim, however, the period prior to 1990 is marked by the introduction of numerous me-too products that frequently failed to recover their research, development and marketing costs. This situation Grabowski attributes to a desire to gain incremental revenues to set against sunk costs:

> "The R&D process in pharmaceuticals can be viewed as a sequential decision-making process under uncertainty. At each stage of the process, companies are in effect weighing the extra costs of going to the next stage against the expected revenues. The most likely explanation for bringing small revenue products to market is that, at the margin, by the time companies realise that these products are not going to be large sellers, the costs of carrying on and launching them are often relatively low compared to the money that has already been sunk. Therefore it is worth getting those incremental revenues since they still make a positive contribution to the bottom line" (Galambos, 2000, p 65).

More recently, enabling technologies, such as combinatorial chemistry and genomics, have built upon the scientific understanding of pharmaceutical chemistry and biochemistry and provided the means to identify larger numbers of potentially active compounds and to target sites of action more accurately. Huge chemical libraries have been built up, where new techniques such as high throughput screening provide a means to rapidly assess many thousands of compounds for chemical activity.

Despite this intense focus on the productivity of research activities, together with increasing resources being applied to research, there is still no evidence, however, that a doubling of a research budget produces a concomitant increase in productivity (McNeil, 1996, p 2.). In fact, companies that merge together in order to achieve scale [assuming a hypothetical doubling of size] need twice the level of sales from the combined R&D output simply to maintain the same growth rate.

In this context, research by Henderson and Cockburn indicates that far from improving research productivity, mergers may actively reduce it (Henderson, 2000; Henderson *et al.*, 1994). The argument is that some increase in size may benefit research through allowing specialisation, and some scale effects may accrue from the ability to spread expensive equipment costs or capabilities over more projects, for example an expensive staff of patent lawyers. But most companies have gained sufficient size to access these benefits prior to further merger(Henderson *et al.*, 1994). In fact, further size increases can produce diseconomies:

> "economies of scope were exhausted once the firm had more than six to seven major research programs – that indeed, beyond that level there were diseconomies of scope" (Henderson, 2000, p 10).

Henderson suggests that a far more compelling reason for merger activity could be either "the desire to compensate for serious "market failures" in the market for the discovery and development of new drugs (Henderson, 2000, p 11)" or the desire to benefit from economies of scale and scope in marketing and distribution.

> "Effective pharmaceutical marketing and distribution requires, in general, incurring very substantial fixed costs. These costs must be incurred whether one is selling one drug or ten, and are a classic source of scale economies" (Henderson, 2000, p 11).

Scale in marketing, aimed at improving sales presence in the critical world markets, particularly the US, together with scale in research aimed at seeking potential synergies in order to increase research output, therefore appear to be primary strategy drivers in the pharmaceutical industry. To achieve this strategy requires either stellar organic growth that must be driven by new product introduction (although the source of those products may not be in-house company research; witness the success of Wyeth through in-licensing successful compounds and marketing them aggressively e.g. *lansoprazole*).,

or, growth can be achieved through merger or acquisition. Both strategies require strong sales and marketing capability because to attract licensing opportunities the licensor invariably requires strong market reach and a proven sales track record. These capabilities are also required for merger or acquisition because to win the battle for investors' minds the lead firm must have, first, the paper wealth to afford the transaction, which invariably stems from a strong record of previous growth, second, the strategy to satisfy investors, analysts and management that the merger will create future value over and above the two firms' operating separately. As Henderson observes:

> "No one wishes to announce that they are merging with another firm because they have a weak pipeline and wish to combine assets; neither analysts nor employees are likely to welcome the news. Announcing that one is merging to gain economies of scale and scope in R&D has a positive, empowering, forward-sounding note to it. Unfortunately, the announcement alone is not conclusive proof that such economies exist" (Henderson, 2000, p 11).

Merger or acquisition strategy in the pharmaceutical industry, particularly for serial merger candidates, may therefore be interpreted as primarily an attempt to buy time with investors. This may be achieved through either the realisation of cost synergies and by a move away from weakness through the elimination of a poor performing operation, rather than building on strength.

> "Few investors think that Big Pharma can compensate for a deficit of new drugs by getting bigger. Some suspect that the converse is true: that size has made it sluggish. There is abundant evidence of a pipeline problem" (Gapper, 2004, p 21).

An alternative view is that building scale in critical markets will enable greater leverage to be gained from the existing product portfolio and a more attractive candidate profile achieved in the highly competitive market for in-licence product opportunities:

> "The hiatus has led the industry to try to squeeze more from those drugs that get to market. Companies such as Aventis have expanded their US sales forces in order to produce more billion-dollar blockbusters" (Gapper, 2004, p 21).

Mergers, therefore, represent the alternative strategic option for companies that cannot achieve their growth expectations organically with their current asset configuration. Large size is not, however, equally achievable by all companies. What strategic choices are open to the management of the mid-size companies that wish to remain independent and yet must achieve the growth expectations inherent in their share price? Alternative strategic options for these companies may include alliance or co-marketing, if they either cannot or will not merge with others. Here, the aim appears primarily to be maximization of the value of the company's product portfolio either through achieving some scale, for example marketing reach, via an alliance or alternatively through the use of in-licensed products to compensate for a dry pipeline. Mid-size companies by nature of their scale can specifically benefit from in-licensed products that would not have sufficient market potential to attract the big companies (Bastianelli *et al.*, 2001).

In conclusion, this section has discussed mergers at length, primarily because the time period encompassed by this study has been marked by successive waves of mergers. To exclude mergers, a strategy adopted by much previous research (Bogner, 1991; Cool, 1985; Martens, 1988), would therefore be both impractical and potentially misleading. The research reported in later chapters includes merged companies.

4.2 Strategy and alternative strategy frameworks

One of the difficulties apparent from a review of the literature on strategic groups (see Chapter 2) is that the number and type of variables used to operationalize strategy in previous strategic group studies has varied widely. In fact, one of the criticisms of strategic group studies is that they frequently do not attempt to delineate groups *a priori* (Thomas *et al.*, 1988) through the use, for example, of a generic template such as Porter's generic strategies (Porter, 1980) or Miles and Snow's strategic typology (Miles *et al.*, 1978).

This potential ambiguity also extends to the definition of strategy which many authors describe differently; for a detailed discussion see (Hofer *et al.*, 1978, p 18-19.) Porter defines strategy as;

> "a combination of the ends (goals) for which the firm is striving and the means (policies) by which it is seeking to get there" (Porter, 1980, p xvi).

Porter then links his definition of strategy to 13 dimensions (Porter, 1980, p 127-8.) (see Chapter 2 for a more detailed discussion). This idea of a matching between environment and actions by the firm is reinforced by Hofer and Schendel's definition of strategy:

> "The basic characteristics of the match an organisation achieves with its environment is called its strategy" (Hofer *et al.*, 1978, p 4).

They go on to further describe this as a:

> "fundamental pattern of present and planned resource deployments and environmental interactions that indicates how the organization will achieve its objectives" (Hofer *et al.*, 1978, p 25).

Hofer and Schendel then state that there are four components to any organization's strategy. These are: scope, resource deployments, competitive advantages, and synergy

(Hofer *et al.*, 1978). This definition of strategy suggests a pattern of scope and resource deployment choices from which the firm derives competitive advantage. This in turn fits the idea that strategy is invariably not a single decision and therefore is more accurately described in multivariate terms. Cool, in his study of the US pharmaceutical industry describes strategy first as:

> "a set of actions and the application of resources to this set of actions permitting an organisation to achieve its objectives while responding to the perceived opportunities and constraints in the environment"(Cool, 1985, p 83).

This definition is then refined by Cool as:

> "A strategy is a set of actions and the application of resources to this set of actions enabling an organisation to achieve positions of sustainable competitive advantage and permitting it to achieve its objectives" (Cool, 1985, p 85).

Cool then asks the question of what is strategic about strategic groups and suggests that:

> "If observed groupings really stem from differences in strategic management decision-making, then the concept of strategy should provide the basis for revealing differences in conduct between firms in any given industry" (Cool, 1985, p 87).

Cool then concludes that "strategy is minimally composed of two facets: actions (including scope choices) and resource allocations" (Cool, 1985, p 87- 88). These two components are derived from Hofer and Schendel's definition and Cool then suggests;

> "Given these two definitional components, it would only be natural to trace strategic conduct differences between firms in those terms. One may contend that unless both aspects of the strategy concept are included in the empirical design of the strategic group concept, no real strategic groups are identified within industries" (Cool, 1985, p 88).

This idea that strategy is incomplete without both choices with regard to domain (product and geographical market) and resource deployment, in effect challenges the traditional IO view (see Chapter 2) that strategy can be represented purely in univariate

terms namely as differences in relative scale. The issue then becomes not whether strategy is univariate or multivariate in terms of dimensions, but how many variables should be chosen to represent strategy and which dimensions should be chosen. In his study of strategic groups in the US pharmaceutical industry, Cool chose seven scope variables and seven resource deployment variables, together with a 15th variable representing size, to describe strategy within the industry and identify strategic groups (Cool, 1985, pp 301-303). Martens in his study of the pharmaceutical industry within five E.C. countries chose six variables to describe strategy, including a mix of scale (size), scope (in terms of therapeutic and geographical focus) and resource commitments (Martens, 1988, p 247).

Previous research within the pharmaceuticals industry therefore confirms the multi-dimensional nature of strategic choice within this industry, where the key business processes discussed earlier, namely research, sales and marketing, appear to build competitive advantage. Those processes which primarily contribute to shareholder returns are new product sourcing, either through in-house research or in-licensing activities, and the successful marketing and distribution of the company's products. In the pharmaceutical industry these two activities are intertwined because the average patent life of a product in the UK is probably in the order of 12 years post-launch. Prozac, for example, was introduced in 1988 and went off patent in 2000. Losec was introduced in 1989 and the UK patent expired in 2002 (IMS, 2002). Post-patent between 50% to 80% of branded product sales are captured by generic competition in the first year (Lehman Brothers, 2003). Therefore, in order to meet investors' growth expectations, companies must actively market their products up to patent expiry. The year prior to patent expiry typically marks the most important sales year for the product,

(Lehman-Brothers, 2002) and at the same time companies must make active provision for new products to be available for launch to replace the revenue lost post-patent expiry of their key brands. Thus R&D activities together with marketing resource commitments represent the key building blocks of sustainable competitive advantage, through differentiation, in the pharmaceutical industry.

Relevant to this discussion, it is important to realise that what we are measuring through strategic group analysis using, for example, cluster analysis is primarily the pattern of *past* strategic decisions. *Intended* strategy is not measured unless interviews are held, or other methods used, to canvas the future intentions of managers. This fact, together with the nature of the pattern of strategic choices, tends to limit the value of "generic strategy templates", such as those of Porter or Miles and Snow, for classifying strategic choice within the pharmaceutical industry.

The generic strategic dimensions offered by Porter are broad market or segment focus, versus differentiation or low cost (Porter, 1980). Low cost is not a commonly adopted alternative within the "ethical" research based companies, that are the subject of this study, although some companies notably Sanofi Synthelabo and Novartis do actively trade in commodity generics in addition to their research-based activities.

The principal business of a pharmaceutical company consists of two productive sets of activities, research and development of new drugs, on the one hand, and the active marketing of pharmaceuticals, on the other. Previous researchers have pointed out that the generics industry operates a different business model to ethical pharmaceutical companies (Bogner, 1991; Cool, 1985; Cool *et al.*, 1987b; Martens, 1988). Hence, they exclude "pure" generic companies from their strategic group research. The research

reported in this study also excludes pure generic companies, such as Generics UK, for two reasons. First, the profit model of these companies is not directly comparable with that of the research based industry. Second, within the UK generic products are not linked within the wholesalers records to the original manufacturer and therefore audits, such as those produced by IMS, and used in this study, cannot distinguish between companies. In Porter's terms this effectively excludes a low cost strategy, leaving the alternative broad strategic options of differentiation and focus, which, although perhaps useful as a broad classifier, lack the sensitivity to clearly differentiate patterns of strategic choices in UK pharmaceuticals.

The issue with the Miles and Snow classification is that it requires data of internal managers' attitudes and decisions within the firm, which are not represented by the data sets available in this study. The nature of strategy in the pharmaceutical industry suggests that a number of choices are important to deliver sustainable competitive advantage within this industry. These choices are discussed in the following section.

4.3 Strategic choice within the UK Pharmaceutical Industry

The previous discussion leads to the conclusion that barring low cost as a strategic option the various strategic choices within the pharmaceutical industry may be broadly nested within two of Porter's strategy choice dimensions i.e. the degree to which firms seek to differentiate their products from the competition and the breadth of market choices adopted by the firm. This is an observation congruent with that of Cool who chose a set of scope variables, that equate to the degree of focus, and resource variables, which largely reflect attempts to differentiate the firm's products from those of its competitors (Cool, 1985).

Previous research suggests that advertising and spending upon R&D, two of Cool's chosen variables, are complementary activities with respect to product differentiation (Lunn, 1989). Sales force actions are also a primary determinant of differentiation. They represent between 30% to 50% of pharmaceutical company operating costs and are therefore another important strategic variable.

The second of Porter's dimensions, the degree of focus, can be interpreted two ways. The first is in terms of geographical coverage, the choice between which markets to enter or not to participate in. This may have been an important choice variable in the 1960's and 1970's, when research productivity was higher, research costs were lower, and me-too products could still be successfully marketed. Cool, for example, included FOREIGN i.e. non-US sales as one of the variables in his study, but he restricted his study to US companies (Cool, 1985; Cool *et al.*, 1987b). The situation in the 1990's was very different, research productivity was declining, costs per NCE (New Chemical Entity) were spiralling and me-too products no longer recouped their research and development costs. (see Chapter 3) In addition, with research increasingly concentrated on fewer therapeutic targets, better access to information and use of techniques such as combinatorial chemistry, the exclusivity period from pioneer to first follower has steadily decreased, from years to months (Boston Consulting Group, 1996, p 42). Economics now dictate that promising compounds undergo a rapid launch in all of the world's key markets in order to recoup crippling research costs before patent expiry. Choice of geographies is no longer a valid strategic alternative and, even if it was, the quality of reporting and variance in the level of detail in accounts would make this

variable difficult to accurately operationalize for research purposes. It will not be included here.

In contrast, as mentioned earlier, choice of market area is critically important. In 1992, for example, top companies such as Glaxo, Pfizer, and Merck relied on the sales of only three drugs to generate over 50% of their pharmaceutical revenues (Boston Consulting Group, 1993, p 95.). The same situation persists today with a number of companies, notably Novo and Lundbeck, focused on a narrow range of therapeutic areas, while others like GlaxoSmithKline, Novartis, Pharmacia and Aventis are now active across a spectrum of therapeutic areas. Focus in terms of markets served is, therefore, an important variable and one included in the research.

Given the importance of patent expiry as a key driver of strategic activity, companies must seek to build strong product pipelines to incrementally grow future revenue streams. Product gaps may not be small, however, with a recent report predicting that the average large pharmaceutical company in 1997 should expect to lose 30% of its sales to generics within five years (Boston Consulting Group, 1999, p 39). New product sales are, therefore, an important strategy variable also included in previous research (Cool, 1985; Cool *et al.*, 1987b; Martens, 1988). They capture the product of both in-house research and in-licensing of new products.

Another important variable, strongly allied to R&D, is risk, where major costs representing 60% or more of the total occur at phase 3[15] in the research and development process. This is due primarily to the huge cost associated with recruiting

[15] Phase 3 trials are those where proof of therapeutic activity is established but large numbers of patients have now to be tested in trials to understand the side effect profile of the drug and its suitability for a broad range of patients.

and managing sufficient patients in large-scale clinical trials. The number of phase 3 projects provides both an opportunity to compare companies' different attitudes to the acceptance of risk and the ability of the company's pipeline to develop products to the point where they are eligible to seek marketing authorization[16].

4.4 Principal strategic choices in the Pharmaceutical Industry

As discussed earlier, there are really two key productive functions within pharmaceuticals. Firstly, to ensure a regular supply of viable products through research, development, and in-licensing of identified opportunities. Secondly, to effectively market those products in order to maximise returns before patent expiry. It is worth noting that patent expiry is not a significant issue in all markets, but it presents a problem in certain key markets, notably the US, Germany, Holland and the UK. In some European markets patent expiry is not an issue simply because the price attained for reimbursement is so low that a viable generic industry cannot develop. In these markets, notably France, Spain, Portugal, Greece and Italy, the product life cycle can be very long, in excess of 20 years, and revenues at a lower price will continue to accrue to the original patent holder for a prolonged period. A fuller discussion of this phenomenon is provided in chapter 3. It fuels the parallel import trade which effectively delivers "early generics" to the high priced European markets, including the UK.

Unlike consumer markets, price in the pharmaceutical market tends to be determined by two key factors, namely order of market entry and "acceptable" reimbursement price. In

---

[16] Marketing authorization in the UK means obtaining a licence to market the product and agreeing a price which the NHS will pay for it. This requires satisfying the Medical Control Agency (MCA) in terms of the efficacy, safety and value of the product.

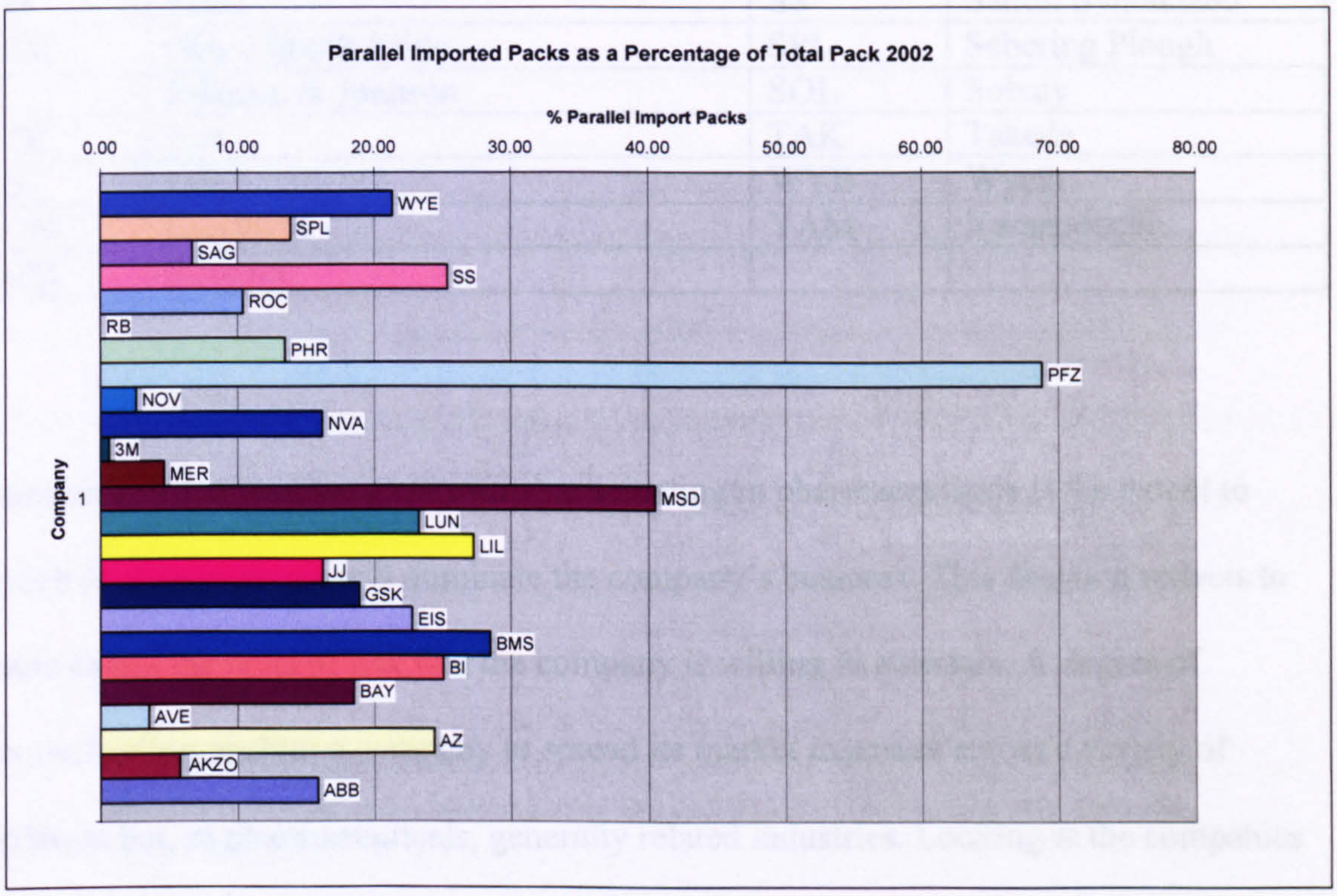
the UK, if you are first to market you have the opportunity to "set the standard" and can price at what the market will bear. Late-entrants then have two choices, to price at parity, e.g. as in the case of the UK anti-depressant market, or to price at a discount, e.g. as in the case of the UK proton pump inhibitor market. As discussed in Chapter 3, from 1991 with the introduction of the Thatcher reforms, the UK pharmaceutical market became increasingly price sensitive. The opportunity to premium price late entrant, me-too, products on the basis of relatively minor dosage or delivery advantages, which had prevailed in the 1980's, effectively eroded away. The second factor, the acceptable reimbursement price, was determined by the host government, where in the UK any product that represents a significant additional cost to the health service is carefully scrutinised by bodies like the MCA and NICE. (See Chapter 3 for a more detailed discussion of the effect of NICE on new product entry and market acceptance). The company effectively enters into negotiations and trades relative price with the government in exchange for breadth of licensed indications and ease of market entry. A green light effectively means any GP can prescribe the product without restriction, an amber light means that the product is limited to specific therapeutic indications or may only be prescribed by a hospital consultant. An amber light has the effect of significantly slowing diffusion into the market and reducing product usage thus significantly reducing market potential. A red light means that the product must not be prescribed or only under very strict circumstances.

Measuring relative market price is difficult, however, primarily because of a lack of transparency regarding discounts given to dispensing doctors or through hospital contracts. Another difficulty relates to the problem of determining the equivalent dose of competitor products. However, to measure the effect of pricing decisions on branded

products, use can be made of parallel import sales, which give an indication of the UK price relative to the price of the product in lower-priced European countries.

The effect of parallel imports can differ significantly between companies. This point is illustrated in Figure 4.7 where, for example, Pfizer [PFZ] loses almost 70% of UK pack sales[17] to cheaper European imports.

Figure 4.7 Parallel Imported Packs as a Percentage of Total Pack 2002



[17] Pack sales refer to the unit sales for the standard pack size for that product. Generally pharmaceuticals are packaged in units containing 28 days supply.

Key to figure 4.7 above.

ABBREV	COMPANY	ABBREV	COMPANY
3M	Minnesota Mining & Manufacturing	MSD	Merck Sharpe & Dohme
AZ	Astra Zeneca	NOV	Novo
ABB	Abbott	NVA	Novartis
AVE	Aventis	PFZ	Pfizer
AKZ	Akzo Nobel	PG	Procter & Gamble
BAX	Baxter Healthcare	PHA	Pharmacia
BAY	Bayer	RB	Reckitt Benkisser
BI	Boehringer Ingelheim	ROC	Roche
BMS	Bristol Myers Squibb	SAG	Schering AG
EIS	Eisai	SS	Sanofi Synthelabo
GSK	Glaxo Smith Kline	SPL	Schering Plough
JJ	Johnson & Johnson	SOL	Solvay
IVX	Ivax	TAK	Takeda
LIL	Lilly	WYE	Wyeth
LUN	Lundbeck	YAM	Yamanouchi
MER	E Merck		

Another key decision for a company participating in pharmaceuticals is the extent to which pharmaceuticals will dominate the company's business. This decision reflects to some extent the level of risk that the company is willing to entertain. A degree of diversification enables a company to spread its market exposure across a variety of different but, in pharmaceuticals, generally related industries. Looking at the companies included within the study in this thesis, there is clearly a spectrum of activities, from a quite broad range of different industries within the large industrial chemical or manufacturing companies such 3M, Akzo, Bayer, or Solvay, through to a more narrowly defined focus within companies such as Pfizer or MSD. A trend is frequently identifiable over time with some companies, such as Astra Zeneca, Aventis, Novartis and Pharmacia, divesting their lower return businesses, for example agrochemicals, to concentrate more upon pharmaceuticals.

It is because of the risk and costs of bringing pharmaceuticals to market, recently estimated by Bain & Co at US$1.7 billion (Gapper, 2004), and the fact that the most important world markets, such as the US, have a limited span of potentially high sales years, that the industry must continue to invest heavily in both R&D and marketing.

Choice of what research areas to invest in is a critical strategic decision and one that has become more important over time for three principal reasons. Firstly, the number of areas open to research, that satisfy the requirements of both a high unmet medical need and a large patient population, are declining with each subsequent key discovery. For example, in the five years prior to the period encompassed by this research, Selective Serotonin Re-uptake Inhibitors (SSRIs) for depression, Proton Pump Inhibitors for gastro-oesophageal reflux, and Statins for the lowering of cholesterol levels were all brought to market. Companies are therefore chasing similar markets in crowded categories, which makes new discovery all the more hazardous.

> "Bain estimates that overall return in investment in new drugs has fallen to 5 per cent. Every drug class has become crowded, and most companies are chasing similar diseases" (Gapper, 2004, p 21).

Secondly, many of the areas left for research are either fragmented, e.g. cancers, or present problems of accurate measurement, necessitating the development of suitable surrogate markers[18] and large expensive clinical trials to prove a benefit, for example as in the case of Alzheimer's disease. This difficulty has also to some extent been compounded by the lack of products emanating from the Human Genome project:

[18] Surrogate markers are measurements taken as a proxy for a response which is difficult or impossible to measure directly. These are frequently used in clinical trials involving brain disorders and similar conditions where improvement can be difficult to quantify.

> "To some extent, Big Pharma is suffering from a backlash from the exaggerated expectations that followed the mapping of the human genome in 2000. This produced a plethora of possible new targets for therapies, which drugs companies hoped to be able to crunch through rapidly using new research techniques such as high-throughput screening. Turning the new molecules produced by these techniques into usable medicines has proved a more difficult matter" (Gapper, 2004, p 21).

Thirdly, pharmaceutical companies in the 1960's, 1970's and 1980's could rely upon the marketing of me-too products, where justification for higher priced new products frequently hinged upon minor dosage or delivery improvements. Such me-too's provided much needed revenues to contribute towards and ameliorate crippling research costs. This opportunity has now all but disappeared. Strongly organised health-care buying groups control the choice of pharmaceuticals through formulary management and second, or later entrants, are forced to settle for a lower price and frequently an insignificant market share. This makes recovery of sunk R&D and marketing costs virtually impossible. For example, in 1999 the market shares of the top four Proton Pump Inhibitors were Losec 64.4% (Astra), Zoton 30.7% (Wyeth), Protium 3.7% (Knoll – later acquired by Abbott), and Pariet 1.5% (Eisai) (IMS, 1999). This illustrates a common phenomenon within the UK market, namely that the first entrant sets the price and captures the lion's share of prescriptions, the follower product marketed at a discount to the market leader – in this case 15% - achieves a reasonable market share, leaving little opportunity for late entrants. Thus, it is not enough to have a good product – Protium was market leader in Germany at the time – it is equally or more important to be first or second to market. This places further risk and expense upon research, where dual tracking of development processes on promising compounds, for example *ranitidine* by Glaxo, is becoming commonplace. This ratchets up cost and risk simultaneously.

Each research therapy area, e.g. respiratory, represents significant cost to develop and staff a facility capable of leading edge research work. The addition of new research areas also offers little in the way of synergy (Henderson *et al.*, 1994). Clearly certain scale effects exist, for example a staff of patent lawyers can work across therapeutic boundaries, but the fact remains that each new active research area adds significantly to the cost and risk that the company must manage.

The problem of research continuity is another, related issue. The decision to stop research in an area, both signals a significant failure to the investment community and effectively closes a door because the time to assemble the right research team and catch up with the competition represents a very significant barrier to future market entry. This problem of continuity is increased by the lack of market acceptance of me-too products, which places the onus upon the company to deliver a string of breakthrough products or so called "blockbusters":

> "A move away from the blockbuster model could help. Instead of placing bets in many therapeutic areas in the hope of striking it lucky, companies could focus more on particular areas of expertise. That would help them build enough knowhow to make better choices among research leads" (Gapper, 2004, p 21).

Typically, however, even large companies are unlikely to come up with more than one or two significant products in a decade of research:

> "To match past levels of productivity, given their huge research and development budgets, big companies should be producing three or four new drugs a year. Instead, most now struggle to produce one" (Gapper, 2004, p 21).

This dearth of new products from in-house research and declining research productivity places further importance on the development of market franchises from a nucleus of

product areas. This is because if the company cannot produce the products that it needs to refresh its portfolio from in-house research then it must seek licensing opportunities. With intense and increasing competition for promising new molecules, the winner in negotiation will increasingly need to demonstrate not only complementary research and development skills, particularly development, but a proven market presence in the therapy area, with superior access to key investigators, opinion leaders, high prescribing physicians and a strong marketing presence in all key markets. These capabilities cannot be built overnight. A company assumes significant risk both through entering a new research area, that may dilute current research and marketing priorities, and by abandoning one.

The increasing importance of certain world markets, notably the US, has also placed a premium upon previous launch success and having visible marketing muscle in place to compete effectively with the increasing promotional noise in the marketplace. The building of scale in marketing in key markets is, therefore, an additional argument put forward for mergers and acquisitions to achieve critical mass, enabling the company to tackle world markets and leverage full potential from the product portfolio before patent expiry cuts in.

4.5 Mobility barriers in the Pharmaceutical Industry

If, as argued earlier, investor expectations are a primary driver of pharmaceutical strategy, then a key element of sustaining a superior market position will be the presence of one or more strong mobility barriers to protect and sustain superior market returns. Porter, for example, argues that the factors that affect a firm's profitability are (Porter, 1980, p 142.):

1. The height of mobility barriers protecting the firm's strategic group.
2. The bargaining power of the firm's strategic group with customers and suppliers.
3. The vulnerability of the firm's strategic group to substitute products, e.g. in the case of pharmaceuticals this would reflect parallel imports, generics or equivalent products.
4. The exposure of the firm's strategic group to rivalry from other groups.

To this list Porter adds the firm's implementation ability, recognising that;

> "Not all firms pursuing the same strategy (thus in the same strategic group) will necessarily be equally profitable even if the other conditions – as listed above – are identical" (Porter, 1980, p 144.).

Thus, Porter makes it clear that mobility barriers and strategic groups are intertwined.

This is discussed in more detail in chapter 2. Strategic groups cannot persist without mobility barriers there to protect them. Therefore, he argues that the best strategic variables to identify strategic groups are those "that determine the key mobility barriers in the industry" (Porter, 1980, p 152.).

In the remainder of this section the mobility barriers that separate strategic groups within the UK pharmaceutical industry are discussed. Table 4.1 lists the various mobility barriers, the nature of the barrier, source of advantage and relative strength.

Table 4.1 Mobility barriers in the UK pharmaceutical industry

Mobility Barrier	Description	Source of Advantage	Relative Height
Research	The ability to conduct leading-edge research and generate breakthrough molecules.	Proprietary knowledge. Tacit research skills. Reputation assists in recruitment. Access to leading edge platform technologies e.g. genomics.	Very high but specific to therapy area.
Development	Formulation and production skills. The ability to recruit and manage clinical trial networks.	Proprietary knowledge. Reputation with investigators. Process skills.	High but generally development skills are more transferable between companies than research skills. Some clinical trial expertise available via outsourcing
Sales force size	Sufficient numbers to hit required call and frequency targets.	Superior training. Displacement skills. Access to physicians. Market knowledge. Reputation.	Medium. Numbers can be raised easily by outsourcing but quality relationships are difficult to replace

Sales force reputation	Known presence in a given therapy area.	Access to the right doctors. Knowledge of how the market network operates and how to influence it. Tacit skills.	Medium to high Explains why new entrants to an area, despite success elsewhere, may fail e.g. Ciba-Geigy with *fomoterol.* Can gain access via co-marketing
Advertising	Ability to be heard above the market noise	Creative skills reside with agency but company strategy, especially positioning, will impact on results	Low to medium Barriers based on advertising can be overcome by clout i.e. outspending your rival
New Product Launch	Gaining the right early trajectory into the market to maximise future sales potential	Effective pre-marketing, especially the recognition of the right clinical trials to conduct. Access to the right products. Tacit launch skills. Access to key opinion leaders. Clinical trials conducted in the right centres. Hard wired access to the market through previous success e.g. Glaxo respiratory franchise	High. A good proportion of good products fail to achieve their market potential. Key benchmark for investors along with new product supply.
In-licensing	Increasingly important source of pipeline "gap filling". The ability to strike successful deals and attract the right partners	Market reputation, especially a strong existing, complementary franchise. Scale in marketing and skills in development, particularly formulation and clinical trial management. Active network to ensure access to projects early on	High. Dependent upon a combination of tacit skills such as networking, negotiation and relationship building

Co-marketing	The ability to overcome market problems by working proactively with a partner. Can be a gap in product supply, seasonal products, excess marketing capacity. Alternatively the ability to recognise when in-house skills are not sufficient to maximise the potential of an opportunity	Access to interesting, high potential, products or the "right partner". Ability to spot synergies and develop trust. Networking skills.	Medium to high.

In summary, strategic choices in the pharmaceutical industry can be measured by a number of key dimensions, including the following:

1. Sales force capability measured by the number of sales calls made within a given period.
2. Media advertising, but excluding direct to consumer advertising which is illegal in the UK, as measured in previous research (Cool, 1985; Cool *et al.*, 1987b).
3. Research spend – this cannot, however, be taken as a proxy for R&D effectiveness only strategic intent. Effective output is really determined not by the number of INDs [investigational new drugs] or by the number of candidate drugs at a given stage but by the actual sales achieved by new products launched.
4. Research effectiveness, as measured by number of projects entering phase 3 trials.
5. Research focus, i.e spend/number of therapy areas
6. New product sales, where the conventionally reported figures [available from IMS] are for sales achieved in the two years post launch.
7. Therapeutic scope, i.e. the number of product areas actively marketed. Although compounds in research could be taken as proxy for therapeutic focus, the

number of compounds in a given area gives little indication of sales potential. In previous research opinions vary as to what number of therapeutic areas which are important. Cool, for example, chose to measure the sales contribution from companies' top three therapeutic areas (Cool, 1985; Cool *et al.*, 1987b), while Martens measured contribution from the top two (Martens, 1988).

8. Merger status. Whether a company has achieved its current market position through organic growth, e.g. Eli Lilly or Merck, or via one merger, e.g. Novartis or Astra Zeneca, or serial merger activity, e.g. GlaxoSmithKline or Aventis.
9. Business focus i.e. the sales contribution that ethical pharmaceutical sales make to the total company sales.
10. Licensing activity.
11. Co-marketing activity.
12. Chronic versus acute therapy, where cardiovascular sales have been used in previous research as a proxy for chronic vs. acute focus (Bogner *et al.*, 1996).

The way in which these variables can be effectively sourced and incorporated into the experimental design will be addressed in the next chapter, which deals with the choice of research method and methodology.

4.6 Conclusion

Contrary to the predictions of early IO researchers, the pharmaceutical industry does not offer merely one way to compete, with returns predicated solely by the relative application of scale. (see chapter 2 for a fuller discussion). The presence of strategic groups in the pharmaceutical industry makes it clear that there are many different kinds of potentially profitable strategies. Strategies, which, as Porter points out, can be based on a wide variety of mobility barriers or approaches to dealing with competitive forces (Porter, 1980 , p 144.).

Factors shaping these different strategic choices include, the general decline of the European market as compared to the US, the effects of shareholder expectation on management actions, and the industry's declining research productivity reflected in the number of new chemical entities introduced each year.

This shift hinges on two key changes. The first the differential impact of industry regulation. In Europe regulation is concentrated in the hands of, increasingly powerful, purchasing authorities, focused on reducing the cost of pharmaceuticals. In contrast, within the US greater choice to consumers were reflected in higher prices as "Pharmacy benefit", is increasingly seen by employers as an important element in employee benefits.

The impact of regulatory change within the UK was severe; A highly price sensitive market ensued with late entrants regularly offered at a discount to market leaders. An active generics market for off-patent pharmaceuticals and a strongly increasing parallel trade fuelled by government clawbacks forced pharmacists actively to seek cheaper

alternatives to fill prescriptions for patent protected products. (see chapter 3 for further details). This trade in parallel imports differentially impacted on firms, with some, like Pfizer and MSD drastically affected, with up to 70% of their total UK pack sales comprised of parallel imports. The concomitant introduction of primary care formularies forced GP practices to rationalize prescribing choice, often on cost grounds. In addition to increasing relative price sensitivity the adoption of these formularies also effectively resulted in a market more hostile to me-too products. This removed the option of a strategy of introducing new me-too products, differentiated solely on minor improvements, to the market. This strategy had been common in the preceding three decades.

The second major change has been the steady decline in research productivity. Without me-too products to support their research activities companies have increasingly been forced to fish in the same declining, but increasingly competitive, research areas for new products. A new opportunity for research drying up with each new blockbuster discovered. Thus research productivity progressively declined despite the building of huge chemical libraries, facilitated by the advent of combinatorial chemistry techniques, and a sharp increase in the number of compounds tested annually by companies. The new product pipelines remain sparse and the much heralded "genomic revolution" has failed, to date, to fulfil its promise.

Faced with declining research productivity and the increasing costs of competing in European markets, companies have increasingly concentrated upon the still lucrative, US market. Here, building scale is important and this rather than the achievement of cost synergies, or the need to build research capability, has driven the waves of

consolidation that hit the industry in the 1990s. There were eighteen mergers between pharmaceutical companies in the ten years reported in this research.

Despite this consolidation, competition in the industry remains high but increasingly success hinges on two sets of decisions. In the long-term where to compete, in terms of markets, and in the short-term how to compete. Market choice is a critical strategic decision that determines both the research focus of the firm and the nature of the market competition which it faces. In pharmaceuticals, competition is effectively reduced by product substitution occurring at the at the sub-therapy level. This creates a myriad of market choice opportunities but the larger more lucrative segments, such as statins or anti-ulcerants, are strongly contested. In the short-term operational decisions increasingly reflect the dearth of new products. Speed to market is key, and life cycle management together with achieving scale in key markets are increasingly important determinants of success.

In conclusion, the UK pharmaceutical market is caught between two sets of tensions. International factors determine market choices and research priorities, while local factors such as the regulatory environment affect pricing and other key marketing decisions. To accurately identify firms' strategies, and classify them within strategic groups, in this environment, requires a mix of measurement variables reflecting each of these key strategic choices. Later in the thesis a number of variables are used to capture these choices.

CHAPTER 5

METHODOLOGY, METHOD AND DATA

5.1 Introduction

In the previous three chapters we have reviewed the literature relevant to strategic group research and described both the UK operating environment and the strategic options that pharmaceutical companies may choose to reach their objectives. This chapter describes the epistemological stance of this research before addressing the choice of methods used to identify strategic and competitive groups within the UK pharmaceutical industry and to statistically test for salient differences between them.

Choice of method is critical to strategic group research because the nature of the firms included in the study and the variables selected to represent strategy will determine to a large extent the results of the analysis. These two factors may, as argued in the earlier chapters, explain to a large degree the variation between studies even within a common industry [see chapter two for further details]. The two preceding chapters are important first to determine the environmental factors that may impact upon strategic choice and second, to identify the variables that represent the valid strategic choices within the UK pharmaceutical industry.

The benchmark for this study is Cool's study of the US pharmaceutical industry from 1963 to 1982 (Cool, 1985; Cool *et al.*, 1987b). This study was selected for two reasons. First, because it represents the first comprehensive and detailed longitudinal study of strategic groups within the pharmaceutical industry. Second, because Cool's study is the main comparator and reference used in more recent strategic group studies of the

pharmaceutical industry (Bogner, 1991; Bogner *et al.*, 1996; Guedri, 1998; Martens, 1988). This thesis aims to utilize Cool's method to identify strategic groups in the UK pharmaceutical industry and to attempt to build on Cool's method and subsequent research.

Strategic groups are, as discussed earlier [see chapter 2], a method of classifying firms according to their pattern of strategic choices. This chapter therefore begins with a discussion of what is meant by classification, the different types of classification system and the epistemological framework within which this research fits. Next the choice of variables used to describe strategy in the UK pharmaceutical industry are discussed and compared to previous research. A discussion of the environmental variables then follows, together with a review of the methods used in previous research to identify stable strategic time periods (SSTPs). The fourth section of this chapter explores the different methods that can be used to identify meaningful strategic and competitive groups within our data set, which is followed by a selective review of the statistical methods available to measure between, and within, group differences. It is important to note that a detailed discussion of each statistical method is beyond the scope of this research. The aim here is to acquaint the reader with the salient features of each method, a discussion of their relevant strengths and limitations, together with the assumptions that underlie each technique.

The chapter concludes with a summary of the method used in this research and the salient similarities and differences to previous strategic group studies of the pharmaceutical industry.

5.2 Methodology

This section aims to place the research reported in this thesis in perspective. Firstly, by exploring the extant theory to which this research relates, and upon which it seeks to build. Secondly, to explain the choice of methodology and the underlying assumptions that underpin it. Thirdly, to describe the paradigm or view of the world within which both the theory and the methodology employed here are situated.

Bryman (2001) distinguishes between two forms of theory. Grand theory that operates at any abstract level and which therefore provides little in the way of either direct research guidance or clear corroboration. This takes the form of detailed case specific accounts, that provide little opportunity for generalisation, and middle range theory that lies intermediate between the abstract and the case specific. This research builds upon existing strategic group theory, which under Bryman's classification would fall within the middle range.

This choice of middle range theory is itself dictated by three practicalities. First, by the need to provide a clear contribution to knowledge, traditionally illustrated by reference to extant work. Second, by the requirement to embed research within a conceptual framework built within the context of the existing literature. Third by, recognition of what is practical and achievable within the permitted time period of the research.

The origins of strategic group research lie within the realm of economics. A discipline that traditionally employs a highly quantitative approach to the pursuit of knowledge. This choice of method falls emphatically within the positivist paradigm, which makes a number of assumptions about the nature of the world and the valid methods of gathering

information and carrying out research. An approach which previous research, on which this research seeks to build, adopted (Bogner, 1991; Cool, 1985; Martens, 1988).

Listed within the positivist paradigm are the following basic beliefs (Bryman, 2001. p 12).

1. Only phenomena and hence knowledge confirmed by the senses can genuinely be warranted as knowledge. This constitutes the principle of phenomenalism.
2. That the purpose of theory is to generate hypotheses that can be tested and that will thereby allow explanations of laws to be assessed. This constitutes the principle of deductivism.
3. That knowledge itself is derived through the gathering of facts which provide the basis for laws and observations. This represents the principle of inductivism.
4. That scientific enquiry must be free from value judgements and be solely objective, i.e. that the observation should be separated from the observer. In effect, this means that the researcher can suspend any emotion, preconception or value judgement from the observation and record it as an impassionate, objective observer.
5. That scientific statements not normative statements are the domain of the scientist because the truth or otherwise of a normative statement cannot be confirmed by the senses.

Concomitant with these basic beliefs is the view that the researcher should focus upon facts, where observation represents the only true data. Here, search for causality has led to an attempt to construct fundamental laws and reduce phenomena to their simplest elements. This is encompassed within the deductive approach to theory construction, namely the formulation of hypotheses followed by rigorous testing. This approach

requires that concepts under consideration are operationalized so that effective measurements can be made. It frequently necessitates the taking of large samples in order to achieve statistical significance and hence support claims for generalisability. Such generalisations are facilitated through comparing observations from samples taken from different populations.

Positivism, however, does have its critics and this approach to research is made all the more difficult because of a lack of unity across the positivist school as to exactly which features constitute a positivist viewpoint.

Relevant issues that relate directly to this research include that it is virtually impossible to make any observation without allowing some preconception to influence judgement. It is human nature to make comparisons. Comparisons are based upon previous experience, the product of environment, education and those who have influenced our opinions.

Also, the benefits of direct observation are skewed because: "facts and data are produced and make sense only in the context of a particular framework that allows and guides us to see certain things and neglect others"(Alvesson *et al.*, 2000.p63) It is, therefore, difficult to accept the positivist claim that research techniques can be purely objective. Positivist methodology favours the employment of parametric statistics and associated quantitative methods, where subjectivity is clearly illustrated by the decision to choose the 1%, 5% or 10% level, of significance to test hypotheses. Why not 2% or 11% ? It is commonly overlooked that statistical significance is itself largely a function of sample size. Finally, in its strictest sense positivism may not attach meaning to social

observation and hence in some circumstances may not really add to an understanding. For example it is possible to observe tangible aspects of human society such as speech or specific patterns of behaviour but such observation excludes the intangible aspects – the internal interpretation or motivation of those external factors (Fisher, 2004).

So, when considering a quantitative, positivist stance what other alternatives exist? The first serious challenge to the dominance of the positivist paradigm was provided by Dilthey (circa 1880), who believed that physical science concerned the study of largely inanimate phenomena. These are subjects largely independent from human beings, where in contrast social science was a product of human construction. Dilthey proposed an opposing interpretative/hermeneutical approach, positing that social studies should not use methods designed for the physical scientists due to a fundamental difference in subject and form of the matter under investigation. Believing that objective reality was unlikely in research, Dilthey reasoned that meaning was context specific, and that understanding would depend upon interpretation that varies according to the viewpoint or history of the interpreter. Thus, Dilthey put forward an alternative world-view to that of the positivists. This approach has attracted the criticism that if there are several alternative viewpoints, which is the right one?

My preference is to view these conflicting paradigms not as two distinct positions but as different positions on a research continuum. Indeed, all the various dichotomies used to separate the positivist from the non-positivist paradigms may, in some researchers' opinion, be viewed as ends of a continuum. For example, quantitative vs. qualitative, hard vs. soft, or deductive vs.inductive. It is my contention that the practical choice of where on such a continuum to site specific research depends primarily upon its aims, the

availability of data and other practical consideration. A view congruent with that of Miles and Huberman (2001) who concluded that, "epistemological purity doesn't get research done."

In conclusion, the subject of the research in this thesis is the UK Pharmaceutical Industry. Where pertinent, links are built with previous longitudinal studies on strategic groups within the US Pharmaceutical Industry. This research provides both a blueprint for methodology and an opportunity to validate these previous findings and explore the general application of their research in the UK market.

This previous research work adopted a primarily positivist methodology, which indeed underpins much of the previous strategic group work. Strategic group theory originated from disciplines with a strong positivist tradition. The previous studies by Cool (1985), Martens (1988) and Bogner (1991) all include the hallmarks normally associated with positivism. Clear hypotheses were proposed and research was carried out at an arm's length utilising available databases, implying an objective perspective. In other words, the methodology of previous studies demonstrates a natural science tradition through the adoption of a clear experimental design and the stated aim to prove or disprove a set of hypotheses. The choice of a range of quantitative, largely parametric, statistical methods, such as analysis of variance, also supports this epistemological position.

My choice on embarking on this research was whether to endorse this choice or to conduct research underpinned by an essentially different methodological assumption. From a purely practical viewpoint I was encouraged to pursue this research work in the same vein as the previous studies, which places my work strongly within the positivist

paradigm. I did not, however, wish to restrict my options and endorsed the concepts of triangulation and the idea that methods should not be paradigm specific but chosen to advance the research task undertaken.

In conclusion, research presented in this thesis adopts a positivist approach based upon the principles of natural science. The reasons for this epistemological stance are first, that it is congruent with previous research approaches with which this study seeks to be comparable (Bogner, 1991; Bogner *et al.*, 1996; Cool, 1985; Cool *et al.*, 1987b; Guedri, 1998; Martens, 1988). Second, the nature of this research, based upon numerical analysis of primarily secondary data, falls naturally within this epistemological research paradigm.

5.3 Method

5.3.1 Introduction

The rest of this chapter deals with what strategic groups are and how they are identified. Strategic groups classify firms according to the strategy which they adopt. They are therefore a classification system based primarily upon observed or calculated differences in the way such strategic decisions are implemented. As discussed in chapter 2 the measures used to separate strategic groups are based upon *realized* not intended strategy. The key decisions at this stage are to identify the sample of firms to include within the study and the variables that best represent strategic choice in the given industry.

The second stage of the analysis is then to decide how the data is to be handled and the method or methods to be employed in order to reliably and accurately identify the strategic groups present within the sample. A criticism of strategic group theory is that such groups are an artifact of method (Barney *et al.*, 1990) therefore choice of method and how we may have confidence in the results obtained are important issues. These important considerations are addressed below.

5.3.2 What classification means and different approaches to classification.

Gordon defines classification as "concerned with the investigation of sets of objects in order to establish if they can validly be summarized in terms of a small number of classes of similar objects"(Gordon, 1999, ix). In this research, strategic groups represent the classes identified and firms the set of similar objects included

within a common class. Such classes are invariably mutually exclusive and hierarchically nested (Gordon, 1999).

> "In classification, in the sense in which the word is used in this [research], the classes are not known at the start of the investigation: the number of classes, their defining characteristics and their constituent objects [firms] all require to be determined" (Gordon, 1999, 3).

The word classification has also been used in a different sense, meaning the assignment of objects to one of a set of pre-determined classes (Gordon, 1999). This latter meaning does not apply to this research, which is concerned with the identification of strategic groups and not the assignment of firms to a pre-determined set of groups. Two main aims of classification are identified by Gordon: data simplification and prediction. The aim of this research is to classify firms operating within the UK pharmaceutical industry according to their strategy, so that meaningful comparisons can be made between them. The aim, therefore, is data simplification.

> "The methodology of classification enables such data sets to be summarized and can help to determine important relationships and structure within the data set" (Gordon, 1999, 5)

Gordon states that the end result of a classification study is (often) a partition of the set of objects into a set of disjoint classes, such that objects in the same class are similar to one another. An additional requirement for a partition, noted by Gordon, "is that classes should be well-separated, i.e. that objects be not only similar to other objects in the same class, but also markedly different from objects in other classes" (Gordon, 1999, 3)

.

McKelvey is primarily in accord with Gordon and describes classification as;

> "The actual construction of a classification scheme and the identification and assignment of organizational forms to formally designated classes" (McKelvey, 1982, p 13)

Classification systems are divided by McKelvey into two basic types: special classifications and general classifications (McKelvey, 1982). Special classifications use only a small, selected number of attributes of particular interest to classify objects and have the advantage, according to McKelvey, of high predictive validity. "Such a classification is very useful for practical and scientific purposes, but only if one is narrowly interested in the one attribute" (McKelvey, 1982, p 15). The major weakness of special classifications that McKelvey identifies are their lack of general comparability. The early IO studies that focus on group identification through relative size could perhaps be viewed in this light.

In contrast, a general classification system attempts to be all encompassing and to group objects according to all or at least many of their attributes, but some may be weighted more highly than others (McKelvey, 1982). As a consequence of this, groups identified reflect the combined effects of many attributes, not just a very selective few, and the members of a group have roughly similar behaviour with regard to many different attributes.

> "Since many-usually all-known attributes are taken into consideration, a general classification allows scientists to make broad predictions about the total behaviour of the members of a given class" (McKelvey, 1982, p 16)

McKelvey points out that such a general classification is not as sharply predictive as a special classification with regard to any specific attribute, but this compromise is necessary if the effects of many attributes are to be included within the classification.

> "Because a general classification is broadly predictive of the total behaviour of the members of its classes, it serves as a good method of organizing functional studies. And because it reflects total behaviour rather than specific attributes, it acts as a broadly inclusive and thus very useful information-retrieval system for scientific findings. It often will include many special classifications within it. Such a scheme is a way of organizing all findings about organizations on the basis of total behaviour rather than only certain attributes" (McKelvey, 1982, p 16).

Chrisman states that a general classification is more important and useful than a special classification, largely because of the ability to make broad predictions about behaviour of members and because "without a general classification system, researchers are forced to pick and choose and/or derive schemes that appear to best fit their data" (Chrisman *et al.*, 1988, 417).

A general classification system would play several important roles (McKelvey, 1982, p 17).

1. Offer a basis for explanation, prediction, and scientific understanding through identifying homogeneous populations of organizations allowing the formulation and testing of hypotheses.
2. Provide a conceptual framework that describes the diversity of existing organizational populations thus facilitating understanding.
3. Through parsimonious organization of classes, information from functional studies can be collated and organized thus aiding information retrieval.
4. Allow the substitution of a few broad classification variables for a large number of specific attributes.

5. Provide a classification system useful to other areas of organization research, for example performance studies.

A number of theories of classification are described by McKelvey. Essentialism is the classic classification approach, used for example by Linneaus for the classification of flora and fauna (Linnaeus, 1756). This starts with the premise that "every entity has a hidden reality which generates observable properties that differentiates it from others and can thus be defined" (Sjorstrom, 1994, 150). "Essentialist classification concentrates on relatively few characters. For example, of all the characters that might be chosen to describe a species, essentialists might base the definition on a few" (McKelvey, 1982, p 38). "Classifications are therefore only as good as the homologies of the characters on which they are based" (Sokal *et al.*, 1963, 23). Sjorstrom suggests that some of the early IO strategic group studies, such as those of Newman and Porter, employed an essentialist approach.

Nominalism is the second central strand of general classification, which argues that only individual objects truly exist. There is no difference between classifying living and inanimate objects and therefore all groupings of objects represent artifacts of the human mind.

> "Nominalists held that the construction of classes was an activity of reason which served the purposes of classifiers in particular and of scientists in general" (McKelvey, 1982, p 41)

The strength of this approach is the recognition that researchers carrying out functional studies require homogeneous groups upon which to base theory or apply inductive reasoning. The principal weakness is that the experience of seeing different types of

birds flying overhead or fish swimming in a stream makes it difficult to accept that natural groupings or types of organisms do not occur in nature. It was because of this weakness that nominalism was never taken too seriously (McKelvey, 1982). As discussed earlier [see chapter 2], one of the key criticisms leveled against strategic group research was the assertion that strategic groups did not exist but were merely an analytical convenience or artifact of method (Barney *et al.*, 1990; Hatten *et al.*, 1987). These researchers may, therefore, be seen to be adopting a nominalist stance.

McKelvey's third theory of general classification is "empiricism" or numerical taxonomy. Here, in contrast to nominalism, the fundamental premise of empiricism is that "groupings of plants and animals did occur in nature and that a classification should follow as closely as possible the naturally occurring groupings"(McKelvey, 1982, p 43). Empiricists place their emphasis on observed similarity and attempt to keep their observations as free as possible from prior theory about the origin of groups or which variables might form the underlying essential pattern. Thus issues of classification and origin are kept separate. The aim is to let the facts decide and an important consequence of this is the equal emphasis on variables and an attempt to include as many characteristics as possible. The following summary of principles underpins the empiricist approach (McKelvey, 1982, p 44).

1. The greater the content of information included in the classification and the more variables on which it is based, the better a given classification will be.
2. A priori, each variable is of equal weight in creating natural groups.
3. Overall similarity between any two firms is a function of their individual similarities in each of the characters by which they are being compared.

4. Distinct groups may be recognized because the correlations of characters will differ between groups. In effect,each natural strategic group should demonstrate a different pattern of resource commitments.
5. Taxonomy is both viewed and practiced empirically.
6. Classifications are based upon similarity.

The principal strengths of the empirical approach are that such classifications are generally based upon substantial samples thus employing a stronger empirical base. Second, empirical taxonomy, although not perfect, offers substantial improvements over alternative classification approaches in the objective and replicable treatment of data (McKelvey, 1982). Third, empirical classification is more comprehensive, taking into account all available characters, therefore the overall similarity of members within groups is broadly based. This broad base also means that the resulting classification is less subject to bias, including the inadvertent omission of a character or the subsequent discovery of a new one.

The empirical approach is not, however, devoid of weaknesses. Inclusion of many characters, usually of equal weighting, means that by indiscriminant measurement of all known or available characters some attributes may be inadvertently given more weight than others. For example, through the inclusion of eight characters that reflect one fundamental attribute but only two characters that describe another. Second, critics of numerical taxonomy argue that there is no way to distinguish trivial differences from significant ones. Third, empirical methods are not as truly objective as frequently claimed.

> "Buried within the multivariate methods are numerous choice points that call for decisions by an investigator which are often arbitrary, subjective, and

> sometimes not widely accepted by knowledgeable colleagues. In factor analysis the choice of the number of factors to rotate, which is indeterminate, directly affects the number of factors in the solution and thus the number of cells in the classification. In cluster analysis the choice of clustering algorithm directly affects the final configuration (McKelvey, 1982, p 48).

Fourth, the quality of outcome achieved depends upon how well the industry is defined and the firms chosen to represent it. Finally, taxonomists have questioned whether empiricism can in fact be successfully pursued without recourse to prior theory because such critical decisions as sector definition, variables chosen to represent firm strategy and the choice of firms to include in the sample, all rest to some degree on prior theory.

The fourth and final theory of general classification discussed by McKelvey is that of evolution, and phyletics. Phyletics shares the assumption with essentialism and empiricism that natural groupings exist but argues that character similarity alone is not enough to prove a relationship. For example, animals within a common *genus* may share a number of superficial similarities but phyletics argues that classification within a common grouping implies more than mere similarity. Consider the case of the green tree boa of South America and the Asian green tree python, both snakes live in trees feeding on birds and essentially exploit the same ecological niche. In superficial resemblance, the two species are difficult to distinguish but they each belong to different genus. Pythons lay eggs but boas give birth to live young. Phyletics is the only theory that attempts to explain how groups arose in addition to attempting to classify them. This attempt to explain natural groupings is an attractive idea, particularly because such a classification is based upon natural evolutionary links and not contrived. The major weakness of the evolutionary approach, which is almost solely associated with biology, is that "often poor data are used in making judgments about phyletic descent, even where there is a strong fossil record" (McKelvey, 1982, p 51).

Other weaknesses cited by McKelvey are the frequent use of small data sets, in stark contrast to empiricism, and that the results are susceptible to the personal bias of the investigator (McKelvey, 1982).

The classification approach taken in this research is that of McKelvey's third grouping – empiricism or numerical taxonomy, employing a broad selection of variables to describe strategic choice in the UK pharmaceutical industry. This approach has a number of distinct advantages over alternative approaches as discussed above, together with the benefit of strong antecedent research, notably the studies of Cool (1985), Martens (1988) and Bogner (1991).

McKelvey also notes five main principles of enquiry employed in classification studies. First, the idea of a reductive principle, where the researcher seeks to find an explanation for the behaviour of an object through studying the behaviour of the object's constituent parts. Second, through application of a holistic principle, where the researcher rejects the idea that the behaviour of the whole can be explained solely through an analysis of an object's constituent parts. The focus is on the pattern of relationships between the constituent parts themselves and between the parts and the whole. Third, the use of a rational principle, where the researcher seeks to explain the behaviour of an object by looking at the environment in which it is embedded. This approach is taken by the organizational ecologists in strategic management research, for example Hannan and Freeman [see chapter 2 for further detail], which draw on this principle by emphasizing an organization's ties with its environment. Fourth, the adoption of an anti-principle, where researchers avoid acceptance of any theory or hypothesis but let the facts decide;

and finally primitive principle where the researcher lets the existence of a practical problem or norm be the guide for scientific enquiry.

It is clear that the original IO studies (Hunt, 1972; Porter, 1973) of strategic groups adopted a reductionist approach and used size as a proxy to describe firms' behaviour and to identify strategic groups across a varieties of industries. In contrast, the organizational ecologists explored the perspective that environmental factors affect strategic change. (see Chapter 2 and 3 above). "Implicit in this view is the idea that environments will support a mosaic of macro-niches, in each of which lives a population of organizations of more or less similar characteristics [strategic groups]"(McKelvey, 1982, p 100). The research in this thesis adopts the holistic principle and argues that strategy cannot be effectively reduced to a single element but consists of a number of strategic choices determined in part by the internal resources of the firm and in part by the opportunities identified within the firm's environment. Strategic choice implies a matching process between each firm and its environment and to be useful a strategic group classification should accurately reflect these choices and aid comparison between firms.

5.4 Choice of Variables, Data Sources and Sample

This section examines the types of variables used to represent strategy in previous studies of the pharmaceutical industry. It is important to note that the aim here is not to represent strategy for some narrowly defined purpose or to build a special classification (for a discussion on the distinction between special and general classifications, see previous section of this chapter). The objective of this research is first to provide a

comprehensive review of the strategy choices in the UK pharmaceutical industry and to select the variables most appropriate to represent these choices. Second the aim is to build a link to previous research, thus enabling some comparison to be drawn from earlier studies of strategic groups in the pharmaceutical industry. Table 5.1 lists the variables used in previous strategic group studies that focused solely on the pharmaceutical industry. The studies included in this comparison are those that measure strategic groups, not cognitive groups, that concentrate solely upon the pharmaceutical industry, and which attempt to measure strategic groups over more than one year. In sum, these studies are those dedicated to the pharmaceutical industry that broadly employ methods comparable to the research in this thesis. Further papers reporting the original research are not included to avoid duplication and the studies of Osbourne (1996), and Voyer (1993) are excluded because they do not meet the above criteria.

Table 5.1 Variables Used in Previous Pharmaceutical Strategic Group Studies

Cool (1985)	
Strategy Dimension	Measure
FOCUS	Rx sales in 3 largest therapeutic categories/[Total Domestic Rx Sales]
DRUGST [Retail]	% Drug store sales in total domestic drug sales
SIZE [Scale]	Ln [Total domestic drug sales]
BRANGEN Branded drugs	% Branded Generic Sales in total domestic Rx sales
PROFPROM Medical Promotion	[Total Domestic Professional Promotion]/[Total Rx Sales
RDINTENT Current R&D Spend	[Total firm R&D]/[Worldwide Health Sales]
RDCAP R&D Capital Stock	[Cum No of NDAs submitted]/[Cum No of INDs submitted
RDORIENT	[Cumulative number of NCEs approved]/Cumulative number of NDAs submitted
PRODSTR	[Cumulative number of NCEs introduced]/[Cumulative number of all products introduced
CONSADV - Advertising to the consumer	[Total domestic PTY drug adv]/Total domestic RxSales
FOREIGN	% Total firm sales generated abroad
COMMGEN	% Commodity generic Rx sales in total domestic Rx sales
DISTR Distribution Strategy	% of total domestic drug sales shipped directly to drug stores and hospitals
Commitment to the maintenance drug market	% drugs for chronic use vs. those for acute use
Commitment to the Ethical Drug Market Rx	% Rx sales in total domestic drug sales
Martens (1988)	
Strategy Dimension	Measure
THERAPEUTIC FOCUS	Rx sales in 2 largest therapeutic categories/[Total Firm Sales]
GEOGRAPHICAL FOCUS	Max of sales of firm in one of the five countries studied/[Total Firm Sales]
INNOVATIVENESS	Firm sales of products less than 2 years old/[Total Firm Sales]
PROMOTION	Total promotion/Number of products introduced during the last two years
LOYALTY	Ln [Total firm sales]
MARKET PROXIMITY	Rank order of cluster derived from % of sales in each of 12 therapy areas
WEIGHTED MARKET SHARE	Sum of [% of firm sales/total firm sales]x [firm sales/total market]
	NB: All Marten's variables are based on totals for the preceding 4 years.

Fiegenbaum, Sudharsan & Thomas (1990)	
Strategy Dimension	Measure
ASS [Asset]	Gross book value of fixed assets.
SLS [Sales]	Firms total sales.
ADV [Advertising]	Firms total advertising expenditure.
RD [R&D]	Firms total R&D expenditure.
INV [Inventory]	Firms total inventory level.
CR [Current Ratio]	Current assets over current liabilities.
QR [Quick Ratio]	Cash and short term receivables over current liability.
DP [Dividend Payout Ratio]	Preferred and common dividends over income before extraordinary items and discontinued operations.
TIE [Times Interest Earned]	Operating income before depreciation over interest expense.
DE [Debt-Equity Ratio]	Debt over equity.
CI [Capital Intensity]	Invested capital dollars over sales dollars.
RDI [R&D Intensity – Production]	20% of R&D dollars over sales dollars.
INVI [Inventory Intensity]	Inventory dollars over sales dollars.
CE [Cost Efficiency]	Cost of goods sold over sales.
RSI [Receivables Intensity]	Receivable dollars over sales dollars.
ADI [Advertising Intensity]	Advertising dollars over sales dollars.
RDI2 [R&D Intensity – Marketing]	80% of R&D dollars over sales dollars.
Bogner (1991)	
Strategy Dimension	Measure
ABSOLUTE R & D	Number of drug related patents granted in that year for particular firm
RELATIVE R &D	No of drug related patents granted in that year for that firm/No of new products approved in past 7 years
SCOPE of R &D	Concentration of R &D by therapy area in each year for each firm
RELPROD	Firms new products as a percentage of industry total
HOSP [Hospital Sales]	Product codes 04, 09, 10 & 11
CHRN [Maintainance Sales]	Number of new cardiovascular drugs introduced over the past 7 years/total number of new drugs
HMK	Concentration of drugs by therapeutic category in each year for each firm
Guedri 1998	
Strategy Dimension	Measure
AT [Total Assets]	Total of current assets, net property, plant, equipment and other non-current assets
TEMP [Total Employees]	Number of employees reported by the company at fiscal year-end.
SALE [Total Net Sales]	Net sales or revenues during the accounting period
XRD [R&D Expenditures]	All direct costs related to the creation and development of new processes, techniques,

	applications and products.
RMKG [Marketing Expenditures]	Rank of each firm based on selling & administration expenditures
TFSALEP [Spatial Reach]	Proportion of sales generated from operations in foreign countries to total firm sales.
THCLASS [Range of market segments]	Number of therapeutic classes in which the corporation is active
DIVERS [Product/Industry Diversification]	Sales generated from operations within the pharmaceutical industry divided by firm total sales.
SEGM [Segmentation]	Indicates how many industry segments are available for each firm.
RDINT [R&D Intensity]	R&D expenditures over sales.
RDOR [R&D Orientation]	Number of new drugs approved by the FDA in each year.
CAPINT [Capital Intensity]	Capital expenditures over sales

Key to abbreviations used in the above table.

Rx Prescription

NDA New Drug Application

IND Investigational New Drug

NCE New Chemical Entity

PTY Over the counter medicine

Ln Natural logarithm

FDA Federal Drug Administration

Comparing these five studies, it is important to note that all use a number of variables, ranging from 7 to 17, to represent strategic choice in the pharmaceutical industry. All encompass scale, scope and resource commitments or scope and resource commitments, after Hofer & Schendel (1978). Each, however, measures a different set of strategic choices and where choices coincide they are sometimes operationalized differently. Cool (1985) for example, chooses to measure market focus as represented by the proportion of revenue derived from each firms's top three therapeutic segments, whereas Martens (1988) utilizes the top two therapeutic segments. A common theme

across these studies is size as measured by firm sales. This features in four out of the five studies, although both Cool and Martens convert this measurement to its natural logarithm.

> "Size has an important influence on the ability to allocate sizeable amounts of resources to R&D and marketing. When R&D to sales ratios and promotion to sales ratios are employed without taking the size factor into account, this scale element is overlooked. Therefore a final resource deployment variable was defined: the natural logarithm of total domestic drug sales (i.e. drug stores and hospitals sales combined). The logarithm rather than the absolute amount of sales was taken to reflect the differential difficulty of adding equal absolute amounts of resources in different size classes" (Cool, 1985, 310).

Other common themes include some measurement of research expenditure, promotional choices and the measurement of new product sales, which are generally defined as sales from products less than two years old. The study by Bogner places more emphasis on research and market focus, each with three out of seven variables respectively. The studies by Fiegenbaum (1990) and Guedri (1988) place a greater emphasis on financial variables than the other three studies.

> "Some of these Compustat variables which partially reflect elements of realized strategy can, however, provide useful proxies for key strategic variables associated with scope and resource commitment" (Fiegenbaum *et al.*, 1990, p 138).

Thus, some variables chosen reflect a trade-off between precision and availability.

Differences in data availability provide, in part, an explanation for the use of different sets of variables between studies, to describe what appear to be similar choices within a common industry. Cool, for example, states that he would have liked to have included a more comprehensive data set within his study.

> "In total, 15 variables are used in this study to measure the competitive strategy of each firm in the pharmaceutical industry. Although it would be desirable, to consider more variables than the ones discussed data availability prevents a more detailed analysis" (Cool, 1985, 310)

Bogner (1991) reiterates this point and refers to the particular difficulty of obtaining a comprehensive data set for longitudinal studies. The common data sources used in strategic group studies within the pharmaceutical industry are (1) those of IMS [Intercontinental Medical Statistics], employed in this research and in the studies by Bogner, Cool and Martens, and (2) Compustat[19] used by Fiegenbaum, Thomas and Sudharshan. A reason for choosing IMS data is that it is the industry standard, available in all major countries and widely used by the pharmaceutical industry.

> "Practically, researchers are constrained by data availability when measures of managerial decisions and performance are sought. Variable selection is done in large part based upon the availability of data from Compustat and other packaged data sources. The availability of data from these sources often pre-selects out all but a few potential measures. This problem is amplified when multiple year studies are used. Even if a good variable is available for one period of time, it may be difficult to find that variable for all the years needed" (Bogner, 1991, 105-106)

Variable choice is a critical decision that affects the outcome and comparability of the study and it is this point, rather than any other, that makes comparisons between previous research studies difficult, particularly because those variables which accurately reflect strategy in one country may not accurately reflect strategy in another. (see table 5.4 below for specific detail on this point.)

> "Whether the objective is exploratory or confirmatory, the researcher has effectively constrained the possible results by the variables selected for use" (Hair *et al.*, 1998. p 481).
>
> "The choice of variables to be used with cluster analysis is one of the most critical steps in the research process" (Aldenderfer *et al.*, 1984. p 19).
>
> "Variables which are largely the same for all data units have little discriminatory power whereas those manifesting consistent differences from one subgroup to

---

[19] Compustat provides extensive longitudinal information on financial statement variables broken down in some instances into line-of-business data (Fiegenbaum *et al.*, 1990, 138).

> another can induce strong distinctions. When a relevant discriminating variable is left out of the analysis some clusters may merge into an amorphous and confusing mass...On the other hand, inclusion of strong discriminators not particularly relevant to the purpose at hand can mask the sought-for clusters and give misleading results" (Anderberg, 1973. p 12).

A further difficulty of making valid comparisons between studies arises because key decisions like the geographical focus and the firms included in the research, differ between studies. The exclusions made within studies also present a significant difficulty when comparing between studies, for example, Cool excluded non-US, merged and generic companies from his study.

> "To decide which drug firms would be included in the sample for empirical analysis, a number of issues related to sampling methodology and data availability were taken into account. First, it was necessary to exclude foreign drug firms because of a lack of reliable data on various strategy (geographical scope, patent data, R&D outlays) and performance (profitability) dimensions.. A second criterion imposed on the sample selection was that firms needed to exist as separate legal entities over most of the 1963-1982 period. This criterion was adopted to ensure that a changing sample composition would not bias the results. Third, all firms participating exclusively in the commodity generic drug segments were not included...The primary reason for their exclusion is ...that a comparison of their operations with those of the established ethical drug companies is not meaningful because of the totally different bases on which each function" (Cool, 1985, 337-338)

These points are illustrated are table 5.2.

Table 5.2 Comparison of Previous Pharmaceutical Strategic Group Studies

	Cool 1985	Martens 1988	Fiegenbaum et al 1990	Bogner 1991	Guedri 1998
Industry Focus	US	5 E.C. Countries	Global	US	Global
Time Period	1963-1982	1978-1985	1974-1981	1969-1988	1995-1997
No of Firms	22	42	22	41	42
Major Exclusions	Non US, Merged & Generic Companies	Some Private Companies	None listed	Some Non-US excluded from performance analysis	Japanese Companies
Data Source	IMS Annual Reports	IMS Annual Reports	Compustat	IMS Annual Reports	Annual Reports

Data for this research was drawn from a number of sources. The primary data is derived from IMS statistics, which are the leading suppliers of quantitative pharmaceutical sales and marketing data in the UK and indeed in most, if not all of the world's principal pharmaceutical markets. Company annual reports and Datastream[20] were used to obtain details of companies' geographical focus, R&D expenditure and degree of diversification. These data sources were supplemented by access to PharmaPipelines[21] and industry specific publications, for example Pharmaceutical Companies Analysis.

As in previous research (Bogner, 1991; Cool, 1985; Guedri, 1998; Martens, 1988), some companies were excluded from the research. The reason for exclusion was data availability, either because the company did not disclose the required information or because the company had not traded publicly for the entire period of analysis.

---

[20] Datastream is a subscription only service that provides access to on line financial data derived primarily from annual reports, together with share price information.

[21] PharmaPipelines is a database produced by Lehman Brothers that provides data on the net present value of all major pharmaceutical companies, their research portfolio, licensing arrangements, launch schedule, current marketed products and portfolio age profile.

Table 5.3 details the companies included in the analysis and abbreviations of their names, used for brevity, in some subsequent tables. Company selection included 33 of the leading pharmaceutical companies, ranked in terms of UK sales in 2002. At the end of 2002 these companies represented 76.6% of the UK pharmaceutical market (IMS BPI and HPAI 2002)[22]. This sample is clearly biased in the sense that it ignores smaller companies. That fact cannot be ignored and is considered when interpreting the results.

> "The researcher must realize that cluster analysis is only as good as the representativeness of the sample"(Hair *et al.*, 1998. p 490-491).

The primary reason for restricting the analysis to the larger companies was availability of data. In fact, several companies ranked in the top 40 in terms of sales could not be included because they are privately owned. Privately-owned companies do not publish information such as annual research expenditure, although their market performance is captured within the IMS data base. Examples of companies excluded from the research include Mundi Pharma, Ferring, Leo Pharmaceuticals, Servier, Elan Pharmaceuticals, Gilead and Goldshield.

Cool's study included 22 companies, limited to US based companies that had not participated in any merger activity during the study period and which did not engage in significant trading in generic pharmaceuticals (Cool, 1985; Cool *et al.*, 1987b). If the research reported in this thesis were to have excluded merged companies, eight of the top 10 UK companies would have been omitted, i.e. Glaxo Smith Kline, Pfizer, Astra Zeneca, Wyeth, Pharmacia, Novartis, Aventis and Sanofi Synthelabo (IMS, 1996). Therefore, merged companies are included. This does, however, present a problem, because as Cool points out, mergers have the effect of introducing considerable

---

[22] BPI is the British Pharmaceutical Index which measures sales from wholesalers to retail pharmacies and dispensing doctors. HPAI is the Hospital Pharmacy Audit Index which measures sales from wholesalers and direct from manufacturers into hospitals.

disruption to the sample over time. To resolve this problem, two approaches were taken here. First, the sample was constructed as though mergers had never happened and each company is as it was in 2002 throughout the analysis. This is the normal format in the IMS database, which is recalculated for the preceding ten year period whenever mergers occur. But this does introduce a problem for certain figures such as research expenditure, and geographical and business focus. These figures were gleaned from annual reports, Datastream and industry reports, converted to common currency at the appropriate date and then combined. Second, the analysis was rerun with the original company structures. This provided the opportunity to explore the effect of merger as a strategy upon strategic groups and to ascertain if companies generally merged within or across strategic groups.

The study does, however, concur with Cool's in excluding "pure generic" companies, such as Ranbaxy or Kent Pharmaceuticals, because they operate in essentially very different markets, supplying commodity products primarily to wholesalers and chains of retail pharmacies.

Table 5.3 List of Companies included in the Analysis and Abbreviations used in subsequent tables

ABBREVIATION	COMPANY
3M	Minnesota Mining and Manufacturing
ABB	Abbott Laboratories
AKZO	Akzo Nobel
AVE	Aventis
AZ	Astra Zeneca
BAX	Baxter
BAY	Bayer
BI	Boehringer Ingelheim
BMS	Bristol Myers Squibb
CELL	Celltech
EIS	Eisai
GSK	Glaxo Smith Kline
IVX	Ivax
JJ	Johnson & Johnson
LIL	Lilly
LUN	Lundbeck
MER	E Merck
MSD	Merck Sharpe and Dohme
NOV	Novo
NVA	Novartis
PFZ	Pfizer
PG	Proctor & Gamble
PHR	Pharmacia
RB	Reckitt Benkisser
ROC	Roche
SAG	Schering AG
SHI	Shire Pharmaceuticals
SOL	Solvay
SPL	Schering Plough
SS	Sanofi Synthelabo
TAK	Takeda
WYE	Wyeth
YAM	Yamanouchi

My research uses Cool's (1985) original study as a benchmark, but aside from the problems of company sample outlined earlier, a major difficulty occurs with the variables used by Cool to represent strategy. This problem relates to the country specific way in which health care in general and pharmaceuticals in particular are administered.

A major strategic thrust in the US, for example, is direct to consumer (DTC) advertising.

> "Between 1996 and 1999, AstraZeneca, Pfizer, and Schering-Plough increased their DTC spending by at least $100 million each, and Merck added $50 million. In a few cases, DTC represents the lion's share of the marketing mix. Estimates suggest that at least half of the marketing expenditures of three drugs—not only Claritin but also Prilosec, which relieves gastrointestinal distress, and the hair loss treatment Propecia—are directed at consumers rather than professional health care providers. As much as 83 percent of Propecia's budget, and 69 percent of Claritin's, may be allocated to consumer advertising" (Aitken *et al.*, 2000, 84).

The UK does not permit direct to consumer advertising of prescription drugs, but this does not mean that this channel is unimportant. Access to the internet is now commonplace in our society, therefore, for consumers interested in their health, a myriad of opportunities to research the relative benefits of products are available. Expenditure by pharmaceutical companies on internet promotion may therefore be expected to influence a proportion of consumers today, but neither the IMS databases nor the other data sources available for this research provide the opportunity to measure this phenomenon. Fortunately, this is unlikely to be a significant weakness of the study because for much of the time period included, there was little internet use.

> "As online advertising develops, advertisers will discover that the Internet is the only medium that can deliver certain types of message, such as multisensory and interactive ads. These new forms will allow advertisers to achieve several objectives—some of them unattainable via conventional media—simultaneously" (Cartellieri *et al.*, 1997, p 51).

> "... many senior pharmaceutical executives believe that drug companies can find dramatic new sources of value through DTC marketing, which (in addition to TV and radio commercials) includes print advertising, promotional efforts, public relations, and Internet communications. There is a powerful logic to this optimistic view. An aging population, easy access to medical information, and the current skepticism about health care systems have increasingly made consumers—not the trusted family physician—the arbiters of what prescription medications they take. This trend will probably gain momentum. Drug makers are likely to find the consumer increasingly at the center of their strategic thinking as they search harder and harder for blockbuster drugs that can generate

> the revenues needed to sustain their high market multiples" (Aitken *et al.*, 2000, p 84).

Thus direct consumer advertising represents one of a number of significant differences between the UK and US operating environments. As a result of these differences not all of Cool's original variables are applicable to this research. This point is illustrated in table 5.4.

Table 5.4 Comparison Of Variables Used In This Study With Those Of Cool (1985)

US Strategic Group Variables Cool (1985)		UK Strategic Group Variables	
	At the company level		At the company level
PHARMA	% prescription sales in total domestic drug sales	PHARMA	Pharmaceutical sales / total world sales
DRUGST	% drug store sales in total domestic drug sales	DRUGST	UK retail chemist sales/Total UK sales of pharmaceuticals
BRANGEN	% branded generic Prescription sales in total domestic Prescription sales	BRANGEN	This represents the availability of cheaper substitutes best represented in the UK by parallel import sales/total UK sales[23]
COMMGEN	% commodity generic sales in total domestic Prescription sales	Not used	In the UK commodity generics sales are not distinguishable by manufacturer
MAINT	% maintenance drug sales in total domestic Prescription sales	MAINT	This variable distinguishes chronic (long-term) from acute (short-term) therapy. Chronic therapy sales/Total UK sales
FOCUS	(Prescription sales in 3 largest therapeutic categories)/(total domestic Prescription sales)	FOCUS	(Prescription sales in 3 largest therapeutic categories)/(total UK Prescription sales)
FOREIGN	% total firm sales generated abroad [Cool's analysis was restricted to US based firms which all complied with the same accounting procedures and distinguished home from foreign sales.]	FOREIGN	A very problematic variable. Annual reports differ significantly in terms of how geographical sales are reported which makes accurate comparison difficult.
RDS	(total firm R&D)/(Worldwide health care sales)	RDI	(total firm R&D) /(worldwide health care sales)

[23] When total sales is used as a denominator it refers to total UK pharmaceutical sales, unless otherwise stated.

RDEFFS	(No of New drug applications submitted)/(No of Investigational New Drugs)	Not used	This data attempts to measure the movement of product submission through the regulatory body and is not available in the UK, where frequently a European wide application is often sought with a different country as rapporteur.
RDORIENT	(NCEs approved / NCEs submitted)	Not used	As above
PRODSTR	(No of NCEs) / (Total No of New Products)	PRODSTR	Sales of products less than 2 years old
PROFPROM	(total domestic professional promotion) / (total domestic Prescription sales)	PROFPROM	(Total UK professional promotion) / (Total UK Prescription sales)
CONSADV	(total domestic consumer promotion) / (total domestic Prescription sales)	N/A	Direct to consumer advertising of prescription products is not allowed in the UK
DISTR	% of total domestic drug sales shipped directly to drug stores and hospitals	N/A	In the UK national pharmaceutical wholesalers offer twice daily delivery therefore virtually all distribution is via wholesaler for retail and hospital customers
SIZE	LN (Total domestic drug sales)	SIZE	LN (Total domestic drug sales)

The above table illustrates that, although Cool employed a relatively comprehensive set of variables to represent strategy in the US pharmaceutical industry, some of these variables are not easily, nor directly transferable to the UK. This is because first, accounting procedures differ between countries and company annual reports vary considerably in how they treat sales by geographical area, which makes accurate

comparisons based on geographical scope extremely difficult. Second, country specific differences relating to the legal, regulatory environment and the ways in which health care is administered and pharmaceuticals delivered to the end user, differ between countries. This may reflect to some extent that with measurement of strategy we are attempting to measure two things, first broad strategic choices about where to invest time and money, such as research focus, degree of diversification and markets to enter, and second local implementation choices reflecting the pattern of local priorities. In effect, the difference between strategic and operational decisions reflect choices of effectiveness and efficiency respectively (Sjorstrom, 1994). Thus, variables used to identify strategic groups in the pharmaceutical industry should reflect local (operational) and international (strategic) choices. The variables used to represent strategy in the research in this thesis are listed below in table 5.5. They are divided into those concerned with strategic and operational decisions, respectively.

Table 5.5 Strategy variables used to identify strategic groups

Strategic Variable	Measurement
Business Focus [DIV]	Pharmaceutical sales/Total sales
Research Intensity [RINT]	Research spend/Total Sales
Research Focus [RFOC]	Research spend/Number of Therapeutic Areas
Promotional Intensity [PINT]	All promotional costs/Total Sales
Merger Status [MERG]	A categorical variable 1 indicates companies that have not merged during the period of this study, 2 indicates that the company by the end of 2002 was the product of one merger and 3 indicates a serial merger strategy where the company has engaged in more than one merger during the study period.
Size [SIZE]	Natural log of total sales
Operational Variable	
Market focus [MFOC]	GP (community sales)/Total sales
Therapy focus [TFOC]	Top 3 therapy area sales/Total sales
Maintenance therapy [MAINT]	Chronic therapy sales/Total sales
New products [NEWPRO]	New product sales/Total sales
Price exposure [PIEXP]	Parallel import sales/Total sales
Sales force [SFORCE]	Sales force costs/Total sales
Advertising [ADVERT]	Advertising costs/Total sales
Licensing activity [LIC]	Number of in-licensed products
Co-marketing activity [COMARK]	Sales of co-marketed products/Total sales

The six strategic variables included in this research each measure either specific resource decisions or access to resources. *Business focus* measures the degree of diversification and measures the strategy dimension between those firms, such as MSD (Merck Sharpe & Dohme) or Eli Lilly, that operate solely in pharmaceuticals, and industry conglomerates such as 3M or Akzo with a broad portfolio of business interests, where pharmaceuticals represent a relatively small element of their turnover. *Research intensity* measures each company's commitment to innovation versus imitation and distinguishes firms such as GSK (Glaxo Smith Kline), MSD or Pfizer, that spend a large

proportion of income on innovation from those such as Ivax or Solvay which invest less. *Research focus* measures the distinction between firms that invest actively in research across a broad spectrum of therapeutic areas in search of the next blockbuster, for example Pfizer or GSK, versus firms such as Novo that are specialists in a narrow field of research. It is important to note that research is a strategic not operational variable because of the huge financial risks incurred (for a fuller discussion on this point see chapter 4). *Promotional intensity* along with research intensity, represent firms' ability to differentiate their products. By taking total promotion as the numerator, local differences are effectively removed, as whether the focus is on sales force, advertising, or direct to consumer, this variable provides a general measure of each firm's position with regard to promotion.

There have been a number of waves of merger activity in the pharmaceutical industry, (for further details please see chapter 4) and merger to capture rare assets, gain critical mass in specific markets or to meet investor profit expectations, is an important strategic option. The categorical variable '*merger*' distinguishes firms that have chosen to grow organically, for example Eli Lilly or MSD, from those that have chosen to grow through acquisition or merger. It is important to note that this variable only refers to horizontal mergers and specifically excludes the acquisition of pharmacy benefit managers[24] (PBMs) in the early 1990's, which was a phenomenon solely limited to the US market. *Size* is included because it measures access to resources and ability to sustain a strategic position. Larger firms generally have deeper pockets and greater market power than smaller ones.

---

[24] Pharmacy Benefit Managers (PBM) are an almost exclusively US phenomenon. In the early 1990's a number of pharmaceutical firms purchased PBMs in order to gain greater control over their distribution channels in the US market. All of these acquisition decisions were subsequently reversed.

The nine operational variables represent specific market decisions that are determined locally. *Market focus* [MFOC] measures the split between general practice (community) sales and hospital sales. This distinguishes between firms that concentrate almost solely upon GP products, for example Takeda or Wyeth, from those with a strong range of hospital products, such as Pharmacia or Roche. *Therapy focus* [TFOC] measures the relative importance of the top three therapy areas to total company sales and distinguishes those companies that concentrate upon a narrow section of the market, for example Lundbeck or Novo, from those companies with a broad portfolio of products, like Novartis. *Chronic therapy* products are those which the patient has to take regularly for a long period of time, as compared to products that are used to treat an illness of short duration, for example antibiotic treatment of a respiratory condition.

> "A similar proxy was constructed in order to measure the chronic care/acute care split in the product line of each firm. Chronic care drugs hold high potential for profits because patients often refill the same prescription, perhaps for life, and physicians are reluctant to change a prescription after the patient begins using a particular product. Here the proxy attempts to measure the extent to which products approved by the FDA are targeted for long-term patient consumption" (Bogner *et al.*, 1996) pp. 93-94.

Cardiovascular products have been taken as a proxy for maintenance therapy (Bogner, 1991). More recently a broader based alternative using the combined sales of anti-arthritics, cardiovascular, sedative and tranquilizer drugs has been suggested (Bogner *et al.*, 1996 p. 91), which is employed here for the variable [MAINT].

Post-patent erosion may account for significant sales loss (see chapter 4 for further details), therefore, the ability to periodically refresh the product portfolio is necessary to meet shareholder expectations. This important variable is measured by the *proportion of sales from products less than two years old* [NEWPRO].

In the UK parallel imported products from lower priced countries within the European Union (EU) have become increasingly important, but not all companies are affected equally (for a detailed discussion of parallel imports please see chapter 4). Parallel imports effectively are discounted versions of patent protected products and represent a form of price competition measured by [PIEXP]. This variable reflects price decisions both locally in the UK and with reference to the EU countries.

The most widely employed means of product differentiation in UK pharmaceuticals is the use of a direct sales force to call on doctors and related professionals in order to convince them to use the company's products (see chapters 3 and 4 for further details). The cost of UK sales force calls are represented by the variable [SFORCE]. The companion variable to [SFORCE] is [ADVERT] which measures media advertising to doctors, and related professions, in support of prescription only products. These two variables are strongly correlated both to themselves and to *promotional intensity* [PINT], but provide some flexibility to examine companies that appear outliers or to run confirmatory analysis. They are included here for reasons of completeness.

Not all companies are successful in researching their own products and some companies rely heavily on marketing other companies' products. This strategic variable is measured by [LIC], which represents the *sales from in licensed products* that the company has in their product portfolio.

Similarly, some companies recognize that they either have a gap in their promotional priorities that provides some slack sales force time or alternatively the management recognizes that they lack either the experience or the critical mass to succeed in a given

therapeutic area. The variable [COMARK] measures the *proportion of sales due to co-marketing activity* between firms.

Use of total sales as a common denominator for many of the above variables has the advantage of making the majority of variables directly comparable across firms of different sizes. The above division into strategic and operational variables may aid comparison with other studies because strategic variables should be generally applicable to a number of countries while operational variables reflect adaptation to local operating conditions.

Strategic groups measured by the above set of strategic variables group firms in terms of *how* they compete in the market. The classification of firms into competitive groups denotes *where* firms compete, which market segments they occupy and their relative importance. For a fuller discussion of the distinction between strategic groups and competitive groups, see chapter 2. The variables used to separate companies into their competitive groups in order to identify where firms compete, or the product areas they compete in, are the respective company's sales across the 16 IMS therapeutic categories listed in table 5.6. Competitive groups are important because as Porter pointed out, choice of markets, (represented here by competitive groups) together with the strategy chosen to compete,

(strategic groups) are important determinants of profitability (Porter, 1976; Porter, 1979).

Table 5.6 Variables used to separate companies into competitive groups

IMS THERAPEUTIC CATEGORY
A ALIMENTARY TR+METABOLISM
B BLOOD + B.FORMING ORGANS
C CARDIOVASCULAR SYSTEM
D DERMATOLOGICALS
G G.U.SYSTEM+ SEX HORMONES
H SYSTEMIC HORMONES
J SYSTEMIC ANTI-INFECTIVES
K HOSPITAL SOLUTIONS
L ANTINEOPLAST+IMMUNOMODUL
M MUSCULO-SKELETAL SYSTEM
N CENTRAL NERVOUS SYSTEM
P PARASITOLOGY
R RESPIRATORY SYSTEM
S SENSORY ORGANS
T DIAGNOSTIC AGENTS
V VARIOUS

The next section starts by isolating the key environmental variables used in the research to represent environmental change, before discussing the methods used to isolate 'stable strategic time periods' (SSTPs) (for a discussion on the use of stable strategic time periods in strategic group research, see Chapter 2).

5.4 Environmental variables and establishment of stable strategic time periods.

The concept of strategic groups is inextricably linked with the idea of mobility barriers, which act as barriers, partly structural or of exogenous origin, and partly endogenous between groups (Caves *et al.*, 1977). Thus, for groups to persist and competitive advantage to exist between groups it is necessary for strategic actions to be underpinned by a unique asset or skill.

> "If the strategy is not supported by a unique asset or skill then it can be easily duplicated because mobility barriers and competitive advantage will be lacking" (Mascarenhas *et al.*, 1989. p 476).

Mobility barriers are necessary for strategic groups to exist and for profitability differences to exist between groups (Caves *et al.*, 1977).

> "Group-specific entry barriers not only give differential protection against new firms coming into an industry. They also protect the members of one group against entry by a member of another group (intergroup mobility).... Indeed without intergroup immobility it would be hard to explain persistent differences in profit rates among groups within an industry. If the strategy embodied in one group's traits is more profitable than any other, why do not all other sellers in the industry clamber into that group?" (Caves *et al.*, 1977. p 254).

Therefore it is argued that strategic groups are a relatively stable and persistent intra-industry phenomenon.

> "A natural concern about any grouping is whether substantial mobility is observed between groups. If there is substantial mobility one can question whether mobility barriers exist between groups, and whether strategic groups have in fact been identified" (Mascarenhas *et al.*, 1989. p 476).

The idea of stable strategic time periods builds on the premise that strategic groups are the product of stable sets of strategic investments by firms that do not change frequently. Change may be prompted however, either in response to a new opportunity that may necessitate moving to another strategic group or to exogenous shocks brought about by environmental change. Strategic groups are predicted to be differentially affected by such shocks.

> " Because of their structural similarity, group members are likely to respond in the same way to disturbances from inside or outside the group, recognizing their independence closely and anticipating their reactions to one another's moves quite accurately" (Caves *et al.*, 1977. p 251).

Cool (1985) argued that changes in firms' strategy relative to other industry members could be reliably used to determine stable strategic time periods and to identify the breaks between such periods.

> "It is postulated that at any point in time, the covariance structure of a given firm's strategic variable set with the sets of the other industry members gives an adequate view of the position that firm occupies in its industry. By tracing inter-temporal changes in this covariance structure it can be discerned whether and when a firm is repositioning itself vis-à-vis its competitors" (Cool, 1985 p. 121-122).

Cool measured each year's covariance structure consisting of an n x p matrix with n companies and p variables. Significant changes between years were identified by use of the Box M test of homogeneity of matrices. The precise procedure was as follows.

First, a covariance matrix for year 1 was compared to year 2. If no significant differences were found between these two years, the two years were pooled and compared against the third year. The reverse operation was also performed by comparing the pooled results for years 2 and 3 with year 1.

$$H_0 \qquad \sum_1 = \sum_2$$

$$H_1 \qquad \sum_1 \neq \sum_2$$

Where $\sum$ represents the variance/covariance matrix between the strategic variables for a specific period. When for a chosen significance level,[25] the null hypothesis is not rejected (meaning that no change has occurred between the two periods), the two periods are pooled together. Then, the third period is introduced as

$$H_0 \qquad \sum_{12} = \sum_3$$

$$H_1 \qquad \sum_{12} \neq \sum_3$$

and

$$H_0 \qquad \sum_1 = \sum_{23}$$

---

[25] Cool chose 5% and Bogner 10%. Bogner chose a larger significance because of the power available from his larger sample.

$$H_1 \qquad \sum_1 \neq \sum_{23}$$

Where $\sum_{12}$ and $\sum_{23}$ denote the variance covariance matrices of the data pooled over the first two periods and the last two periods respectively. This dual check between years was used because, even if the variance covariance matrix did not differ for the first two periods, it is possible that a significant strategic change might occur over the last two periods.

This procedure was repeated until a significant difference was found between years, indicating that a strategy discontinuity had been identified. Significant differences between years were taken to indicate that the firms within the industry had shifted their strategy at the end of a stable strategic time period.

> "When firms alter their strategy vis-à-vis each other, the covariances between the strategy variables should change. By determining at what point in time the covariance structure for all firms considered simultaneously, has changed from previous periods, it is possible to establish breakpoints where significant dissimilarities occur. These breakpoints indicate the existence of distinct sub-periods with different strategic group structures" (Cool, 1985. p 122).

The next stage of Cool's method is then to identify the strategic groups present within each discrete, stable, strategic time period. A similar method was also employed by two subsequent longitudinal strategic group studies of the pharmaceutical industry (Bogner, 1991; Martens, 1988). It is a requirement of this methodology that the number and identity of the firms involved remains constant throughout (Bogner, 1991). Therefore, in order to include merged companies in the longitudinal research in this thesis, the firms had to be assumed to have always been together.

The two statistical tests here are quite specialized tests so a short explanation of them both is included, although a full explanation is outside the scope of the research. (for a fuller description see Tabachnick & Fidell (2001) or Stevens (2002))

Hotelling's T^2 test is appropriate when;

> "the independent variable has only two groups and there are several dependent variables... It is not legitimate to use separate t tests for each dependent variable to look for differences between groups because that inflates Type I error due to unnecessary multiple significance tests with (likely) correlated dependent variables. Instead Hotellings T^2 is used to see if groups differ on the two dependent variables combined. The researcher asks if there are reliable differences in the centroids (average on the combined dependent variables) for the two groups" (Tabachnick *et al.*, 2001. 20).

Box's M test is used to test the assumption that the variance covariance matrices in the research are equal.

> "Box (1949) has developed a test, which is a generalization of the Bartlett univariate homogeneity of variance test, for determining whether the covariance matrices are equal. The test uses the generalized variances, that is, the determinants of the within-covariance matrices" (Stevens, 2002. 271).

The Box M test is very sensitive, especially to the presence of non-normal variables. A significance test of 0.01 or less is used as an adjustment for the sensitivity of the statistic (Hair *et al.*, 1998).

In concluding this section of the chapter, it is important to isolate stable strategic time periods in a longitudinal study as a precursor to identifying the strategic groups contained within them. In this research Cool's procedure (1985) was adopted.

1. Identify stable strategic time periods by comparing the variance covariance matrices (n firms x p strategy variables) between adjacent years.

Confirmation of stable strategic time periods through comparison of the mean values of strategic variables between adjacent years, as used by Fiegenbaum et al (1990), was not used. This was because the normality of the data set, although suitable for the Box M test which relies upon central tendency was not considered sufficiently robust across all variables to use Hotelling's T, which requires accurate determination of confidence limits.

In the next section we shall review the choice of methods to cluster individual firms within their strategic groups and how to identify the most appropriate group structure.

5.5 Clustering methods and identification of group structures.

The aim of a cluster analysis is to sort the objects of analysis, in this case firms, into groups based upon their similarities in terms of the respective variables included within the data set. This is done so that the differences within groups are minimized, i.e. firms with similar patterns of investment in particular strategies are grouped together, and differences between groups are maximized, i.e. firms within groups compete in essentially different ways.

> "Cluster analysis techniques are concerned with exploring data sets to assess whether or not they can be summarized meaningfully in terms of a relatively small number of groups or clusters of objects which resemble each other and which are different in some respects from the objects in other clusters" (Brian S. Everitt *et al.*, 2001. p 10).

The approach used by Cool (1985), provides a good general model of the approach used in subsequent longitudinal studies investigating strategic groups within the pharmaceutical industry (Bogner, 1991; Cool *et al.*, 1987b; Martens, 1988). This model provides the basis for the approach adopted in this thesis.

Figure 5.1 Flow of analysis and overview of methods applied in the study of strategic groups

	ANALYSIS	METHODS
Step 1	Identification of stable strategic time periods	Box M test of equality of variance covariance matrices.
Step 2	Identification of strategic groups in each SSTP	Cluster Analysis Combination of methods
Step 3	Inter-strategic group performance differences • Market share • Weighted Market Share • Market Rank	ANOVA[26] MANOVA[27] Kruskal Wallis[28]
Step 4	Intra-strategic group performance differences • Market share • Weighted Market Share • Market Rank	ANOVA MANOVA Kruskal Wallis

The first step was discussed in the previous section of the chapter. For the identification of competitive groups, step 2 is repeated but instead of strategic variables the groups are clustered using each company's sales for the 16 IMS therapeutic categories (see table 5.6).

The choice of clustering algorithm may have a marked effect upon the results and the use of more than one method is recommended to both strengthen and validate the results:

---

[26] ANOVA stands for Analysis of Variance
[27] MANOVA stands for Multivariate Analysis of Variance
[28] The Kruskal Wallis test is the non-parametric equivalent to the Analysis of Variance test.

"What is important to remember when faced with the difficult choice of which clustering method to use is that the method must be compatible with the desired nature of the classification, the variables to be used, and the similarity measure used to estimate the resemblance between cases" (Aldenderfer *et al.*, 1984. p 35).

"The various cluster analysis methods...differ in important respects. It seems possible that the unique characteristics of these methods could complement each other so that a comprehensive analysis might involve the use of several methods, each sensitive to special features of the data set" (Anderberg, 1973. p 188).

> "In many applications it might be reasonable to apply a number of clustering methods. If all produce very similar solutions, the investigator might, justifiably perhaps, have more confidence that the results are worthy of further investigation. Widely different solutions might be taken as evidence against any clear-cut cluster structure" (Brian S. Everitt *et al.*, 2001. 177).

Although, as Alderberg remarks

> "If the clusters are well separated then almost any method will succeed in finding them" (Anderberg, 1973. 210).

Cool (1985) used two different algorithms, Ward's method and Complete Linkage, to separate his data set. Both of these are agglomerative hierarchical algorithms, which means that they start with each firm as a separate cluster and then successively combine the most similar clusters until all firms are combined within one cluster. It is up to the investigator to decide on the right cluster solution, i.e. the number of groups. This is a common problem with clustering methods. The second problem with agglomerative techniques is that once combined within a group, that position is set in stone even if, later in the analysis, moving the firm from say cluster 'a' to cluster 'b' would make more sense.

"A hierarchical method suffers from the defect that it can never repair what was done in previous steps. Indeed, once an agglomerative algorithm has joined two objects they cannot be separated any more...The rigidity of hierarchical methods is both the key to their success (because it leads to small computation times) and their main disadvantage (the inability to correct erroneous decisions)" (Kaufman *et al.*, 1990. 44-45).

"A partition of data units obtained at a chosen stage in a hierarchical classification can be refined using the nearest centroid sorting methods. The

> partitions generated by hierarchical methods are not necessarily optimal with regard to the chosen clustering criterion because early merges cannot be undone to improve the partition at later stages. However, hierarchical methods usually give very good partitions which require only modest modifications to achieve a local optimum. Thus, the results from a hierarchical method can provide an excellent initial partition from which the nearest centroid methods can converge rapidly" (Anderberg, 1973. p 190).

The use of Ward's method to separate groups is a common denominator between each of the previous longitudinal studies of strategic groups in the pharmaceutical industry (Bogner, 1991; Cool, 1985; Martens, 1988). Ward's method is also known as the minimum sum of squares technique, which assumes points can be represented in Euclidean space for geometrical interpretation (Brian S. Everitt *et al.*, 2001). Distance between clusters is defined as the increase in sum of squares within clusters, after fusion, summed over all variables (Brian S. Everitt *et al.*, 2001).

> ".the method of Ward … is intended for interval scaled measurements and makes use of Euclidean distances. The dissimilarity between two clusters is again based on the Euclidean distance between their centroids" (Kaufman *et al.*, 1990. p 230).

> "This method is designed to optimize the minimum variance within clusters. This objective function is also known as the within-groups sum of squares or the error sum of squares (ESS). The formula for the error sum of squares is

$$\mathrm{ESS} = x_i^2 - 1/n\left(\sum x_i\right)^2$$

> where x_i is the score of the i^{th} case. At the first step of the clustering process, when each case is in its own cluster, the ESS is 0. The method works by joining those groups or cases that result in the minimum increase in the ESS" (Aldenderfer *et al.*, 1984. p 43).

Ward's method is widely used in many of the social sciences (Aldenderfer *et al.*, 1984) but tends to find same size, spherical clusters and is sensitive to outliers (Brian S. Everitt *et al.*, 2001).

> "Outliers are likely to show up as clusters consisting of only one or two data units. Such atypical features of the data tend to distort the functioning of many clustering algorithms.They should be examined carefully with a view to finding a rational explanation for the deviant score profile. Outliers may provide a hint of a relevant category in the population which is poorly represented in the data set" (Anderberg, 1973. p 183).

> "More troublesome are single-member clusters, which may be outliers not detected in earlier analyses. If a single-member cluster (or one of very small size compared with other clusters) appears, the researcher must decide if it represents a valid structural component in the sample or if it should be deleted as unrepresentative. If any observations are deleted, especially when hierarchical solutions are employed, the researcher should rerun the cluster analysis and start the process of defining clusters anew" (Hair *et al.*, 1998. p 499).

Outliers are a feature of Cool's study where Marion, for example, formed a singleton group, i.e. a group consisting of only one member, in stable strategic time periods 1 and 2 and Lederle in period 4. Outliers are potentially important because a significant outlier may distort the cluster solution when hierarchical methods like Ward's or the Complete Linkage method are used. Despite these limitations, however, Wards method has been shown to provide superior recovery of a known cluster structure and to outperform most other clustering methods in conditions of cluster overlap (Aldenderfer *et al.*, 1984). Ward's method will therefore be used in this research both for its strengths and to aid comparison with previous pharmaceutical-based strategic group studies (Bogner, 1991; Cool, 1985; Guedri, 1998; Martens, 1988). The strength of the clustering solution found by Ward's technique will also be assessed in this research through use of a Banner plot. This utilizes the same information depicted in a Dendogram[29] but provides a better overall insight into cluster structure and data quality (Kaufman *et al.*, 1990).

> "The overall width of the banner is very important because it gives an idea of the amount of structure that has been found by the algorithm. Indeed, when the data possess a clear cluster solution, the between-cluster dissimilarities (and hence the highest level) will become much larger than the within-cluster dissimilarities, and as a consequence the black lines in the banner become longer" (Kaufman *et al.*, 1990. p 211).

This measure is provided by means of an agglomerative coefficient

---

[29] A dendrogram is a tree diagram that provides a visual representation of the sequence of mergers between clusters.

$AC = \frac{1}{n}\sum_{i=1}^{n} l(i)$ which can be compared with the silhouette coefficient (SC) (see later in this chapter). The AC simply describes the strength of the clustering structure that has been found.

> "When the AC.or SC are very small, the corresponding method has not found a natural structure, which can be expressed by saying that no clusters have been found, or rather that the data consists of one big cluster. On the other hand, a value of AC ...or SC close to 1 means that a very clear clustering structure has been identified" (Kaufman *et al.*, 1990 p 213) .

It is important to recognize the property of the algorithms used because each will to a certain extent tend to impose their own structure on the data (Kaufman *et al.*, 1990). The use of more than one algorithm is therefore recommended to negate the bias of any particular method and to confirm results. Anderberg for example recommends an iterative process.

> "A distinctive cluster which is well separated from the remainder of the data set is likely to be apparent in the first clustering cycle and continue to appear regularly in subsequent portions of the analysis. Rather than continuing to recover the same information time after time, it is appropriate to extract such clear cut features of the data set and focus attention on the more confused residue...The absence of the removed cluster should have no substantial effect on the identifiability of the remaining clusters" (Anderberg, 1973. p 183-184).

Several authorities recommend a combination of hierarchical and non-hierarchical methods to gain the benefits of each, which is the method that is employed in this research.

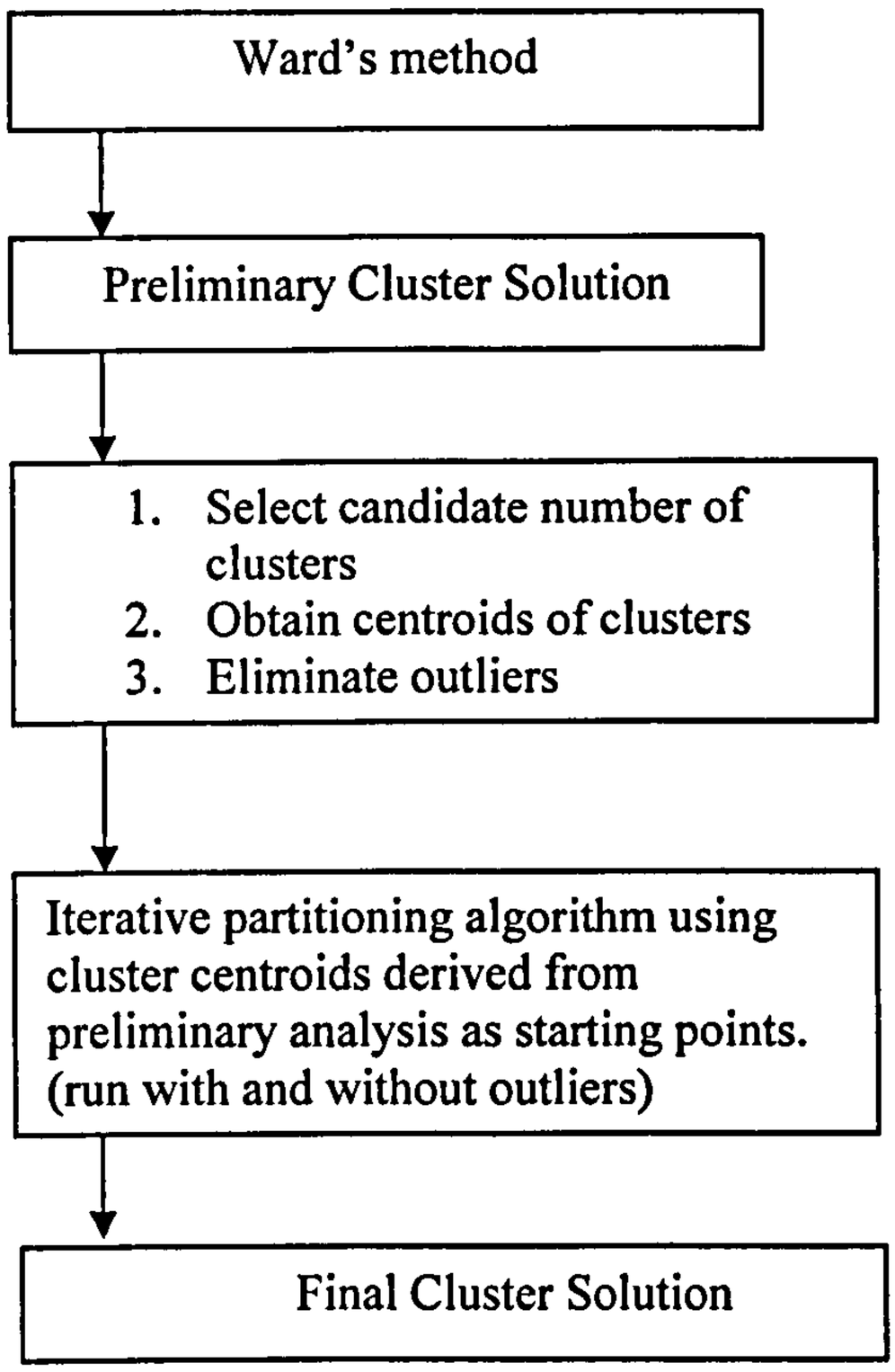
> "First, a hierarchical technique can establish the number of clusters, profile the cluster centres, and identify any obvious outliers. After outliers are eliminated, the remaining observations can then by clustered by a nonhierarchical method with the cluster centres from the hierarchical results as initial seed points. In this way, the advantages of the hierarchical methods are complemented by the ability of the nonhierarchical methods to "fine-tune" the results by allowing for the switching of cluster membership"(Hair *et al.*, 1998. p 498).

> "A solution advocated by many experts is to use a two-stage procedure where a hierarchical algorithm is used to define the number of clusters and cluster centroids; these results then serve as the starting points for subsequent nonhierarchical clustering...Research has shown that this procedure increases

> validity of solutions…Thus, in summary the best solutions may be those obtained by using hierarchical and nonhierarchical methods in tandem" (Ketchen *et al.*, 1996. p 446).

In their review of clustering procedures, Punj and Stewart (1983) recommend the two step process suggesting that average linkage or Ward's method should be used first, followed by an iterative partitioning (non-hierarchical) algorithm. This step wise process is adopted in the research in this thesis. The process is summarized below.

Figure 5.2 The two-step procedure for identification of strategic groups.



The other key decisions, aside from *the choice of algorithm*, are whether to weight or standardize the data, which similarity measure to employ, and how to identify the appropriate number of clusters. These points are discussed below.

Cool (1985) afforded all his variables equal weight in his analysis. This assumes that each strategic choice variable is of equal importance.

The argument with regard to standardization is more subjective. Cool standardized all his variables to z scores.

> "Careful use of cluster analysis requires a transformation of all variables to a single index at similarity before starting any cluster analysis. To that end scale conversion techniques may be applied. A procedure that is often suggested in the literature is to transform all variables to their standardized form (zero mean and unit variance). In this way a scale-free set of variables, independent of the

> measurement units used, is obtained. This procedure will be followed in this study" (Cool, 1985. p 163-164).

It is the opinion of Kaufman and Rousseeuw (1990) that the choice of standardization, really comes down to how much weight you wish to apply to a given variable. If the measurement scales are meaningful in their own right then it is best not to standardize and leave the inherent weights within the variable. But if the variables are assumed to have equal importance, then standardization of variables is recommended.

> "by standardizing one attempts to give all variables an equal weight, in the hope of achieving objectivity. As such, it may be used by a practitioner who possesses no prior knowledge" (Kaufman *et al.*, 1990. p 11).

This argument stems back to the point made by Kaufman and Rousseeuw (1990) that if the variables are meaningful then standardization may reduce the ability of variables to act as effective differentiators. The same basic argument, one of relative weighting, applies equally to multicollinearity and standardization, which both have the effect of altering the relative weight of the individual variables within the analysis. It is recommended by some researchers that analyses be done both with and without standardization, for this reason:

> "Because results may differ solely based on standardization, we suggest that analyses be done both using and not using standardization" (Ketchen *et al.*, 1996. p 444).

This is the approach taken in this research, for two reasons. First, because it is recommended but, second because the variables are not equal, although specifically assigning weights to them would be subjective. This is because as explained earlier, mobility barriers differ (see chapter 4 for a fuller discussion) in their characteristics, i.e. relative degree of difficulty of achieving scale, and some strategic choices may be expected to accrue together. For example, if a company has an active flow of new products it is more likely to put considerable emphasis upon advertising and sales force

activity investments, which work in concert, for example to raise awareness. In this case, removing one of these variables is contrary to the strategic intent of the company which strategic group analysis is seeking to capture. Therefore, relatedness between some variables is a natural phenomenon to be expected.

> "Interdependencies among variables may exist by design or, more often, are the unexpected result of the research design. Careful selection of variables may reduce unwanted interdependencies but the problem is likely to remain even in the best of circumstances….the effect of which is to weight more heavily certain dimensions along which clustering will be carried out. When this is desirable for some theoretical or practical purpose, correcting for interdependencies is inappropriate"(Punj *et al.*, 1983. p 144) .

> "When the researcher desires that all dimensions or attributes be given equal weight in the clustering process, it is necessary to correct for interdependencies…Correction may be achieved by completing a preliminary principal components analysis with orthogonal rotation. Component scores may then be used as input for the computation of a similarity or distance measure" (Punj *et al.*, 1983. p 144).

Thus a similar problem related to the issue of weight is correlation between variables. If multicollinearity[30] occurs within the variable set then, in effect, some variables are represented more strongly because strongly correlated variables will exert a concerted effect:

> "in cluster analysis.those variables that are multicollinear are implicitly weighted more heavily…Multicollinearity acts as a weighting process not apparent to the observer but affecting the analysis nonetheless"(Hair *et al.*, 1998. p 491).

Approaches suggested to overcome this are either to split the variable set and run two separate analyses as a cross check each with one set of uncorrelated variables (Hair *et al.*, 1998) or to reduce the variable set to its uncorrelated principle components, using principle component analysis, and cluster the factor scores. This latter approach is used

---

[30] "Extent to which a variable can be explained by the other variables in the analysis. As multicollinearity increases , it complicates the interpretation of the variables because it is more difficult to ascertain the effect of any single variable, owing to the variables' interrelationships"(Hair *et al.*, 1998. p 471).

to identify strategic groups in the pharmaceutical industry by Guedri (1998). Criticisms have, however, been made about the use of factor score:

> "There is debate over the use of factor scores in cluster analysis, as some research has shown that the variables that truly discriminate among the underlying groups are not well represented in most factor solutions. Thus, when factor scores are used, it is quite possible that a poor representation of the true structure of the data will be obtained" (Hair *et al.*, 1998. p 491).

> "However, this technique is controversial because researchers often drop all values with low eigenvalues [a statistic representing the amount of variance explained by a factor]. The excluded factors may represent unique, important information" (Ketchen *et al.*, 1996. p 444), explanation in parenthesis added).

The principal criticism of factor scores is that by including only the first few factor scores in the analysis, a significant proportion of variance may be lost, which may include variables that differentiate significantly between groups. The same argument can also be extended to the twin group solution. By splitting the data set its full explanatory power is also potentially reduced.

It is recommended by Ketchen and Shook (1996) that because both methods of correcting for multicollinearity have drawbacks, an attempt should be made to assess the impact of the technique used.

> "We suggest that the ideal approach is to perform a cluster analysis multiple times changing only the method of addressing multicollinearity. Consistent group assignments despite different methods would be evidence of stability whereas inconsistent assignments would suggest a tenuous cluster solution" (Ketchen *et al.*, 1996. p 444).

The approach taken in the research in this thesis is to triangulate results through conducting the analysis first without correcting for interrelationships, second by using the split sample method, and finally using factor component scores. In this way three alternatives methods are used, allowing the resulting solutions to be compared. An

advantage of utilizing factor scores is the simplicity that it brings to the analysis through reducing the pattern of strategic investments to their core elements.

> "Even though some information will be lost, there is a major advantage in reducing the dimensionality through principal components. With two dimensions we can plot the data and with three dimensions we could build a physical model. This would give managers a much better feel for how objects were clustered together" (Morrison, 1967. p 776-7).

The final critical decision in the cluster analysis process is how to choose the appropriate number of groups. Here there are traditionally two methods, the first is to examine the Dendrogram, a graph of the order that firms join clusters and the similarity between combined clusters. The length of lines along the edge of the Dendrogram measure the relative distance between successive fusions and the researcher looks for a natural break.

> "Heuristic procedures are by far the most commonly used methods. At the most basic level, a hierarchical tree is "cut" by the subjective inspection of the different levels of the tree...This procedure is hardly satisfactory because it is generally biased by the needs and opinions of the researcher as to the "correct" structure of the data" (Aldenderfer *et al.*, 1984. p 54).

The second commonly used method is to examine the fusion or amalgamation coefficient (see glossary), which is the numerical value where each cluster joins together, and look for a sharp increase in value that indicates the joining together of two dissimilar clusters.

> "A large increase implies that dissimilar clusters have been merged; thus, the number of clusters prior to the merger is most appropriate. A major limitation with this approach is that there may be no large jumps in the coefficient, indicating that there may not be any natural groups in the data. In some cases, there may be several large jumps; this would be evidence for more than one natural set of clusters" (Ketchen *et al.*, 1996. p 446).

Alternatively, a variant of the "scree test" (see glossary) used in factor analysis is employed by graphing the fusion coefficient on the y axis against the number of clusters on the x axis.

> "A marked flattening of the graph suggests that the clusters being combined are very dissimilar, thus the appropriate number of clusters is found at the 'elbow' of the graph. Interpreting a graph, however, may be difficult; for example, the elbow may not be pronounced, indicating that there may not be any natural groups in the data. Alternatively, the graph may have more than one elbow, indicating that more than one natural set of clusters fit the data" (Ketchen *et al.*, 1996. p 446).

Cool utilized the first of these methods as the stopping rule.[31]

> "A heuristic which is often applied relates to the behaviour of the criterion function at any step in the cluster procedure. It is suggested that a "large" increase in the criterion value points to a merging of very dissimilar clusters. When there is a large increase in the "diameter" or in the within group error sum of squares, this heuristic suggests that the existing clusters should not be merged and that the "natural groupings" are described by the clusters identified at the previous stage. Although this decision criterion is rather subjective, it will be applied in this study for lack of a decidedly better criterion" (Cool, 1985. p 169-170).

Despite the above concerns expressed regarding the subjectivity traditionally associated with the selection of the "right" group structure, which may have contributed to some of the concerns expressed by critiques of strategic group analysis, such Barney and Hoskisson (1990) (for further detail see chapter 2), there are a number of mathematical methods available to identify the optimum group structure. Two of these are the *upper tail rule* (Everitt et al 2001) and the *silhouette plot* (Kaufman & Rousseeuw 1990).

> "The first is based on the relative sizes of the different fusion levels in the Dendrogram and is sometimes known as the upper tail rule. In detail the proposal is to select the number of groups corresponding to the first stage of the Dendrogram satisfying.

$$\alpha_{j+1} \rangle \bar{\alpha} + k s_{\alpha}$$

---

[31] 'Stopping rule'is the term given to stopping the clustering algorithm at the right point to indicate the data partitioning that best describes the natural clusters in the data.

where α_0, α_1, α_2, …., α_{n-1} are the fusion levels corresponding to stages with *n*, *n-1*, …, 1 clusters. The terms $\bar{\alpha}$ and s_α are respectively the mean and unbiased standard deviation of the *j* previous fusion levels, and *k* is a constant" (Brian S. Everitt *et al.*, 2001. p 77).

The suite of clustering algorithms presented by Kaufman and Rousseeuw (1990) provide a silhouette plot[32] as a means of determining both the quality of clustering and the right number of clusters. The equivalent for Ward's method in this same suite is the banner plot which is a confirmation method used in this research.

> "A further diagnostic that is helpful for determining the number of groups which also operates on the basis of the dissimilarity matrix is the *silhouette plot* suggested by Kaufman and Rousseeuw (1990)". (Brian S. Everitt *et al.*, 2001. p 104) .

The silhouette plot is useful for providing a measurement of the quality of clustering solution obtained where both the strength of individual clusters and the overall cluster solution can be compared. Table 5.7 illustrates Kaufman and Rousseeuw's (1990) quality index.

Table 5.7 Interpretation of Silhouette Values.

Silhouette Coefficient: s(*i*)	**Interpretation**
0.71 – 1.00	A strong structure has been found
0.51 – 0.70	A reasonable structure has been found
0.26 – 0.50	The structure is weak and could be artificial; please try additional methods on this data set.
Less than or equal to 0.25	No substantial structure has been found
	Source (Kaufman *et al.*, 1990. p 88) NB: These figures are directly equivalent to the agglomerative coefficient (AC) used in the Banner Plot (Kaufman *et al.*, 1990, p 213).

[32] For a full discussion on silhouette plots see Kaufman and Rousseeuw (1990).

It is also suggested by Kaufman and Rousseeuw (1990) that the silhouette plot provides a useful basis to compare not just between groups within a cluster analysis but also between algorithms.

> "Silhouette plots for cluster solutions obtained from different choices for the number of groups can be compared and the number of groups chosen so that the quality of the cluster solution is maximized. In this respect the *average silhouette width* – the average of the s (*i*) over the entire data set can be maximized to provide a more formal criterion for selecting the number of groups" (Brian S. Everitt *et al.*, 2001. p 105).

> "When the clustering algorithm does not succeed in finding any "natural" clustering, the overall average silhouette width tends to become very low" (Kaufman *et al.*, 1990. p 98).

It is recommended by Ketchen and Shook (1996) that in order to prevent mistakes and to validate cluster solutions, that a number of methods to identify the group structure should be used together and the results compared in order to validate and add weight to the chosen clustering solution. This opinion is shared by Everitt and is employed in this research - examination of the algorithm, graphing of the fusion coefficient, and the upper tail rule are all utilized.

> "In conclusion, it is advisable not to depend on a single rule for selecting the number of groups, but to synthesize the results of several techniques. (Brian S. Everitt *et al.*, 2001. p 105)

Emphasis has been placed on the topic of the correct number of groups in this chapter because the quality clustering of the clustering solution is critical to strategic group research. The ad hoc nature of some cluster solutions, lack of comparability, and equivocal results have led some researchers to doubt the validity of the approach (Barney *et al.*, 1990; Hatten *et al.*, 1987; Thomas *et al.*, 1988) . See chapter 2 for a fuller discussion of this point.

In order to establish a reliable and external validity, several ideas are proposed in the literature.

> "There are two ways to evaluate reliability. First,.researchers may perform a cluster analysis multiple times, changing algorithms and methods for addressing multicollinearity. The degree of consistency indicates reliability. Second, researchers may split a sample and analyze the two halves independently" (Ketchen *et al.*, 1996. p 447).

Each of the above methods were employed in this research so as to ensure reliability. To establish external validity a number of alternative ideas have been suggested.

> "If reliability has been demonstrated, attention can turn to external validity. This may be done by cluster analyzing both the sample of interest and a second, similar sample and then assessing the similarity of results"

> "Criterion-related validity can be assessed through significance tests with external variables. Such variables should be theoretically related to the clusters, but not used in defining clusters. Given the field's emphasis on defining the strategy-performance relationship, the external variables in strategy research are often performance measures. Significance tests with external variables offer a powerful tool to establish validity of a cluster solution because the technique uses a test statistic thereby avoiding having the researcher provide the meaning of results…we strongly advocate the use of this technique wherever possible" (Ketchen *et al.*, 1996. p 447).

Criterion related validity in the research in this thesis is assessed both through exploring the relative performance between strategic groups and by comparing other relevant variables not included in the cluster analysis. Performance measurement is an intrinsic part of this research, where one of the key issues is choice of measures that accurately reflect the performance of the UK company. More traditional measures, for example, return on sales, reflect the performance of the total company in all markets where results may be expected to be strongly skewed by performance in the US (see chapter 4 for further details). Accounting measures derived from firms' Annual Reports, such as return on sales (ROS) or return on capital employed (ROCE), were not therefore considered applicable as performance measures because they may reflect a firm's global performance rather than simply its performance in the UK. Therefore, following

previous research (Cool, 1985; Cool *et al.*, 1987b; Martens, 1988), market share (SHARE) and weighted market share (WMS) in the UK were chosen as the most appropriate performance variables.

Market share was measured as total firm sales divided by UK pharmaceutical sales. Weighted market share recognises that some companies may choose to dominate a few selected market segments and was measured by the sum of a firm's sales in therapy class i divided by the firm's total sales and multiplied by its sales of products in therapy class i divided by the total market sales of all firms in this segment (Martens, 1988, p249). The advantage of the weighted market share measure is that it recognises the use of niche strategies (Cool, 1985; Martens, 1988)

A further performance measure used was DIFF, which reflects changes in companies' market positions over a given time period. This metric equates to the relative success of the company in improving its market position from a chosen base year versus the competition. Market positions were ranked in terms of total market share, retail and hospital market share. Differences were measured by a choice of analysis of variance (ANOVA), multivariate analysis of variance (MANOVA) and Kruskal Wallis non parametric analysis of variance tests as appropriate. These tests are so widely used in academic research that a detailed discussion of their respective methodology is not included here but the assumptions and limitations of each test will be included within the relevant results sections, which are detailed in the following chapters.

5.6 Conclusion

In conclusion, this research bears a number of similarities to, and is based upon, the earlier work on strategic groups in the US pharmaceuticals market (Cool 1985), but differs from this earlier research in a number of ways. The research in common with these earlier studies adopts a positivist approach and closely follows earlier work in order to aid comparison. This point is important because given the diversity of strategic group studies a number of researchers have chosen to use different methods of determining groups such as frontier benchmarking (Athanassopoulos, 2003,), or multi-dimensional scaling (Pegels & Sekar, 1989,) Alternatively, some researchers have used different clustering algorithms (Zuniga-Vicente *et al.*, 2004a; Zuniga-Vicente *et al.*, 2004b,). These methods were not employed in this research in order to aid direct comparison with previous strategic group studies of the pharmaceutical industry.

The research follows Cool in taking as the unit of analysis each company's prescription pharmaceutical based activities. The approach also follows Cool in attempting to produce a classification of strategy within the pharmaceutical industry, as delineated by companies' strategic group membership. The underlying premise resembles Cool in hypothesizing that membership of different strategic groups will exert an effect on firm performance, i.e., strategy does matter in the pharmaceutical industry. The general methodology follows Cool in first identifying stable strategic time periods across a number of years, then using cluster analysis to reveal "natural" strategic groups. These strategic groups are then tested for statistical differences in terms of market share and weighted market share following Cool.

The principal differences between this research and Cool's study are first, location. This study is based in the UK, a decision that affects the variables which can be used to measure strategy. The nine variables used are effectively equivalent to those chosen by Cool, but a number of others were either not relevant, for example direct to consumer advertising of prescription medicines is not legal in the UK, or the data are not available, for example RDEFFS (see table 5.4). In some cases, for example PIEXP, a different form of proxy was chosen as more appropriate.

The second major difference relates to sample. Cool excluded all but US firms and did not include merged firms in his sample. The methodology which Cool, and previous research (Bogner, 1991; Fiegenbaum *et al.*, 1990; Martens, 1988)adopted, assumes no change in sample throughout the time period. To exclude mergers from my research would be invalid because merged firms dominate the UK industry. Owing to the database used, IMS, it has been possible to construct the ten year trading histories of each company as they were at the year end 2002. But the nature of the IMS database, which only includes ten years of back data, prevented a longer time period study, which is another difference between the research and some earlier work (Bogner, 1991; Cool, 1985).

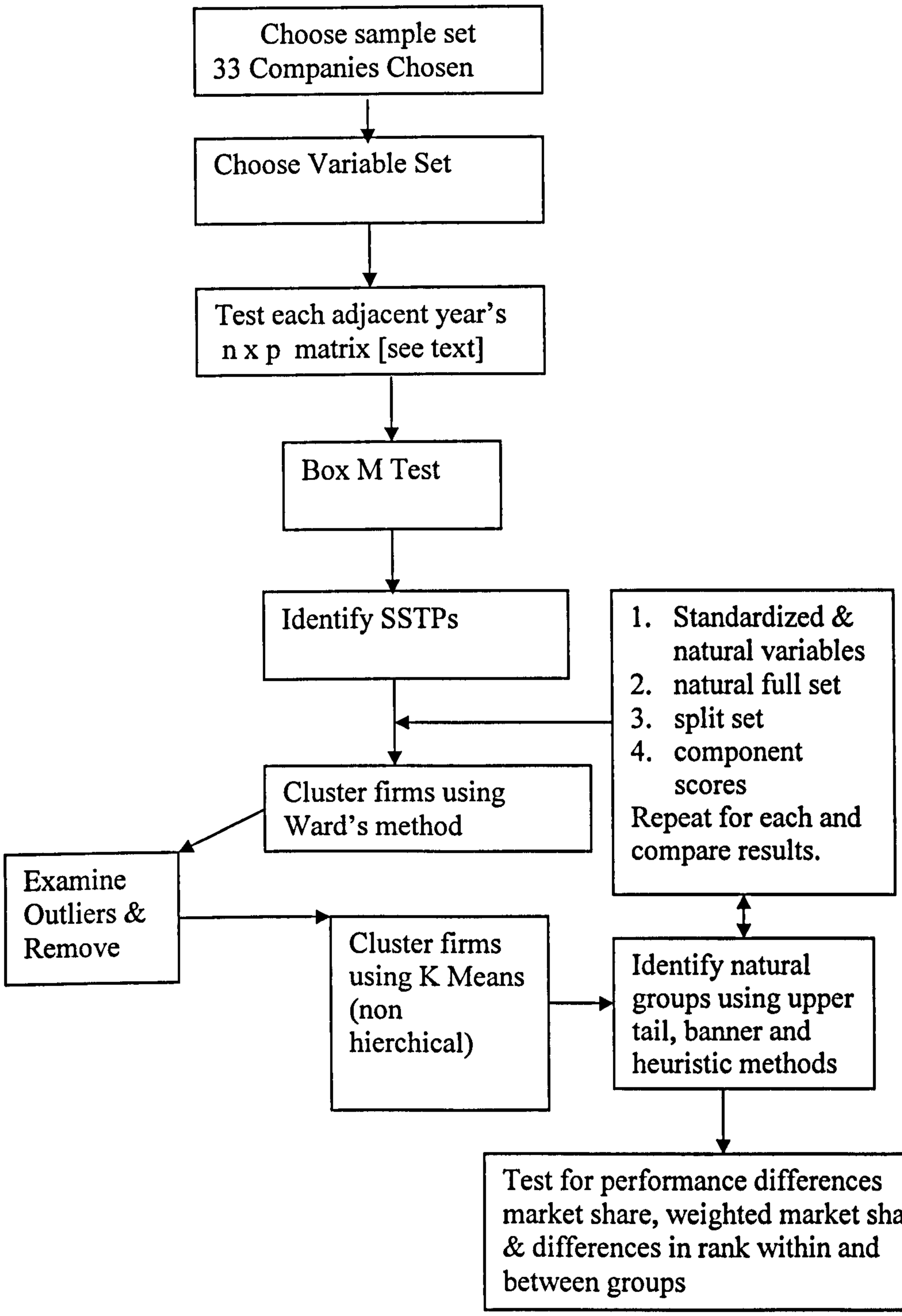
Another and major difference between this study and that of Cool reflects the nature of strategic group research today, where more caution is now applied in the use of cluster analysis. The paper by Ketchen and Shook (1996) highlights a number of flaws that previous research suffered. Hence the importance given in this chapter to addressing the key issues of variable selection, dealing with standardization and the inter relatedness of variables, and the choice of algorithm. Principal differences from Cool in this regard

include the use of both standardized and non standardized variables, the use of split samples, component scores, and a full natural variable set to assess the effect of multicollinearity. Use is made of different algorithms including Ward's method, as used by Cool, and nonhierarchical methods, allowing a reassignment of misplaced groupings to occur.

In this process particular weight is afforded to identification of the natural group structure, where use is made not just of the traditional heuristic methods based on visual inspection of the Dendrogram and the fusion coefficient, but also the use of the upper tail rule to triangulate results.

The next chapter reports the empirical results of the research, where Cool's method is utilized. Essentially three main steps are followed. First the ten year data set is tested to identify the presence of stable strategic time periods. Second, three alternative methods are used to determine strategic groups and the resulting cluster solutions are compared. Finally, the strategic groups are examined and the relationship between group membership and performance is tested. Figure 5.3 below summarizes the method followed when conducting the research reported below.

Figure 5.3 Flowchart of the Research Process



CHAPTER 6

STRATEGIC GROUPS AND STABLE STRATEGIC TIME PERIODS IN THE UK PHARMACEUTICAL INDUSTRY

6.1 Introduction

This chapter presents the first set of empirical results and follows the method used by Cool in his study of the US pharmaceutical industry (Cool, 1985). There are two reasons for adopting this approach. First, previous strategic group research suffers from limited similarity between studies. Factors such as the method adopted, and the variables chosen to identify groupings differ markedly between studies making reliable comparisons between studies difficult. Second, Cool's study stands as the benchmark for later strategic group studies and both Martens (1988) and Bogner (1991) base their method on that adopted by Cool (1985). Through choosing to adopt Cool's approach some comparison is possible between this research and that of earlier these studies.

Despite the aim to link this research to that of previous studies, there are, however, a number of marked differences between the research reported here and the previous work of Cool (1985), Martens (1988) and Bogner (1991). This is because research does not stand still and with the benefit of more recent research (Ketchen *et al.*, 1996; McGee, 2003) some of the more obvious criticisms of the method adopted in these earlier studies are addressed. These changes relate to the use of more than one type of clustering method and addressing the issues of multicollinearity, as recommended by several authorities (Aldenderfer *et al.*, 1984; Everitt *et al.*, 2001; Ketchen *et al.*, 1996; Punj *et al.*, 1983). This research also differs from previous research (Bogner, 1991; Cool, 1985; Martens, 1988) by the inclusion within the sample of merged firms. (see chapter 5 for further details).

The first section of the empirical results reported in this chapter; addresses the identification of stable strategic time periods. Stable strategic time periods (SSTPs) denote a period of relative stability in the pattern of strategic choices taken by the firms included in the sample. This technique features in a number of previous longitudinal strategic group studies (Bogner, 1991; Cool, 1985; Cool *et al.*, 1988; Cool *et al.*, 1987b; Fiegenbaum, 1987; Fiegenbaum *et al.*, 1990; Martens, 1988), where breaks between time periods have been attributed to the impact of environmental change.

> "Our selection of these strategic issues is supported by work on strategic groups in the pharmaceutical industry. Cool and Schendel (1987,1988) examine the industry after the enactment of the 1962 Food and Drug Act amendments and find four stable strategic time periods: 1963-1969, 1970-1974, 1975-1979, and 1980-1982 (when their study ended). The break between 1974 and 1975 roughly corresponds with the changes in rules governing price advertising, and the break between 1979 and 1980 corresponds both with the emergence of biotechnology firms involved in recombinant DNA technology and with the passage of the R&D tax credit. Fiegenbaum, Sunharshan, and Thomas (1990), investigating the period 1974-1981, found three stable strategic time periods (SSTPs): 1974-1975, 1976-1980, and 1981. These breaks also correspond with the strategic issues affecting the industry, which are presented here and in the work of Cool and Schendel (1988; 1987)."(Huff *et al.*, 2000 p. 110)

The stable strategic time periods found in this research are then compared to the key environmental factors such as generic percentages and parallel import penetration identified earlier as factors likely to influence firm strategies. (see chapter 3 for further details).

The second section of this chapter describes the identification and validation of strategic groups found within each of the stable strategic time periods identified. Here, there are important differences between the research presented in this thesis and that of earlier studies (Bogner, 1991; Cool, 1985; Guedri, 1998; Martens, 1988). These include: the

use of both divisive and agglomerative cluster analysis techniques to identify strategic groups, the use of a bootstrapping technique[33] to establish the presence of natural clusters within the data, and the use of variables not included in the cluster analysis to provide external validity of the strategic groups identified. Tests of performance between strategic groups using market share [SHARE], weighted market share {WMS], and the difference [DIFF] in sales ranking across the time period enclosed within each SSTP are then reported. Two of these performance measures, market share and weighted market share, have been used in previous pharmaceutical based strategic group studies (Bogner, 1991; Cool, 1985; Cool *et al.*, 1988; Cool *et al.*, 1987b; Martens, 1988). The final section of this chapter reports the overall findings of this part of the empirical research and presents the conclusions that may be drawn from them.

6.2 Establishing Stable Strategic Time Periods

The method used in this research to identify stable strategic time periods (SSTPs) closely follows that used in previous research (Cool, 1985; Martens, 1988). In summary, the technique relies upon comparing n x p matrices for each year, where n = the companies included within the data set arranged in rows and p = the variables used to represent strategic choices arranged in columns. The statistic used to compare the years is called the Box M test, which measures shifts in the variance-covariance matrices.

The data were arranged in year sets. Each year consisted of 29 companies by 10 variables. The variable set was: PHARMA, DRUGST, BRANGEN, MAINT, FOCUS,

---

[33] Bootstrapping is a "form of resampling in which the original data are repeatedly sampled with replacement for model estimation. Parameter estimates and standard errors are no longer calculated with statistical assumptions, but instead are based on empirical observations" (Hair *et al.*, 1998. 579), p 579.

FOREIGN, RDI, PRODSTR, PROFPROM, and SIZE. These variables were chosen to follow as closely as possible the original fifteen variable set used by Cool (1985). See table 6.1 below.

Table 6.1 A comparison between the variables used by Cool (1985) to identify strategic groups and the variables used to identify strategic groups in this research.

US Strategic Group Variables Cool (1985)		UK Strategic Group Variables	
	At the company level		At the company level
PHARMA	% prescription sales in total domestic drug sales	PHARMA	Pharmaceutical sales / total world sales
DRUGST	% drug store sales in total domestic drug sales	DRUGST	UK retail chemist sales/total UK sales of pharmaceuticals
BRANGEN	% branded generic Prescription sales in total domestic Prescription sales	BRANGEN	This represents the availability of cheaper substitutes, best represented in the UK by parallel import sales/total UK sales[34]
COMMGEN	% commodity generic sales in total domestic Prescription sales	Not used	In the UK commodity generics sales are not distinguishable by manufacturer
MAINT	% maintenance drug sales in total domestic Prescription sales	MAINT	This variable distinguishes chronic (long-term) from acute (short-term) therapy. Chronic therapy sales/total UK sales
FOCUS	(Prescription sales in 3 largest therapeutic categories)/(total domestic Prescription sales)	FOCUS	(Prescription sales in 3 largest therapeutic categories)/(total UK Prescription sales)
FOREIGN	% total firm sales generated abroad [Cool's analysis was restricted to US based firms which all complied with the same accounting procedures and distinguished home from foreign sales.]	FOREIGN	A very problematic variable. Annual reports differ significantly in terms of how geographical sales are reported which makes accurate comparison difficult.

[34] When total sales is used as a denominator it refers to total UK pharmaceutical sales, unless otherwise stated.

RDS	(total firm R&D)/(Worldwide health care sales)	RDI	(total firm R&D) /(worldwide health care sales)
RDEFFS	(No of New drug applications submitted)/(No of Investigational New Drugs)	Not used	This data attempts to measure the movement of product submission through the regulatory body and is not available in the UK, where frequently a European wide application is often sought with a different country as rapporteur.
RDORIENT	(NCEs approved/NCEs submitted)	Not used	As above
PRODSTR	(No of NCEs)/(total No of New Products)	PRODSTR	Sales of products less than 2 years old
PROFPROM	(total domestic professional promotion)/ (total domestic Prescription sales)	PROFPROM	(total UK professional promotion) / (total UK Prescription sales)
CONSADV	(total domestic consumer promotion) / (total domestic Prescription sales)	N/A	Direct to consumer advertising of prescription products is not allowed in the UK
DISTR	% of total domestic drug sales shipped directly to drug stores and hospitals	N/A	In the UK national pharmaceutical wholesalers offer twice daily delivery, therefore virtually all distribution is via a wholesaler for retail and hospital customers
SIZE	LN (total domestic drug sales)	SIZE	LN (total domestic drug sales)

Five variables used by Cool were not included in the study, either because they were inappropriate to the UK e.g. CONSADV and DISTR or because the data were

unavailable e.g. RDEFFS, RDORIENT and COMMGEN. (For further details on this point see Chapter 5.)

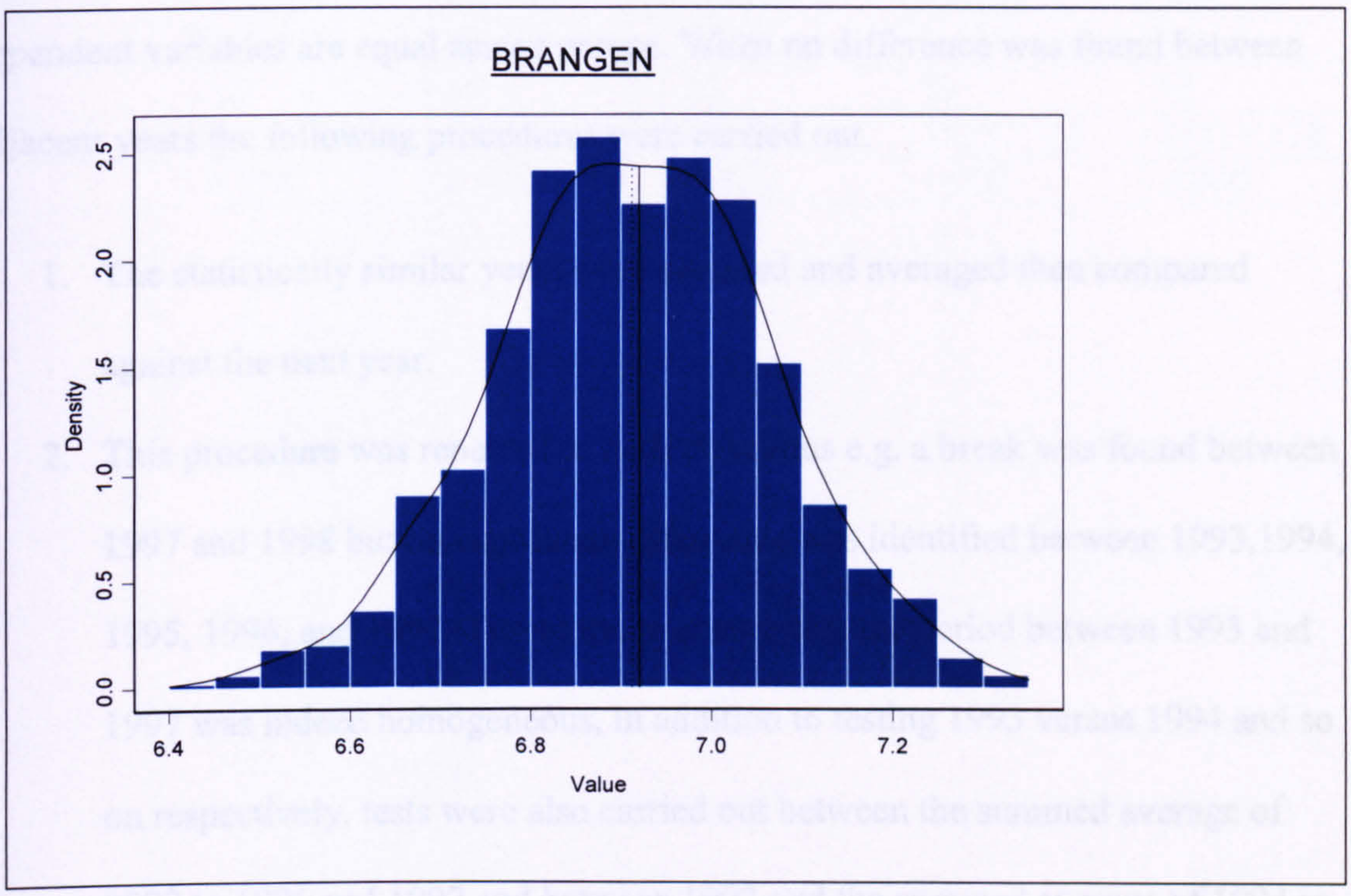
Each year's dataset was then compared against the adjacent year using Box's M test of equality of covariance matrices.

> "The test uses the generalized variances, that is, the determinants of the within-covariance matrices. It is very sensitive to non-normality. Thus, one may reject with the Box test because of a lack of multivariate normality, not because the covariance matrices are unequal. Therefore before employing the Box test, it is important to see whether the multivariate normality assumption is reasonable. ... a check of marginal normality for the individual variables is probably sufficient" (Stevens, 2002. p 271).

Tests for normality revealed that a number of the variables, principally BRANGEN, PHARMA, PROFPROM, DRUGST, FOCUS and FOREIGN, were significantly different from normal. This was attributed to two main reasons. First, the variables were ratios or percentages and not therefore distributed from minus to plus infinity, as assumed by a Normal Distribution (see glossary). Here as appropriate, a log x +1 transformation was carried out as recommended by Stevens (2002). Second, the small sample size of 29 was considered an issue. The variables were, however, expected to show a central tendency and given a large sample would be expected to follow a normal distribution around the mean. Given that Box M requires reasonable normality and measures covariance symmetry, it was assumed that evidence of a central tendency should suffice. As Stevens points out, only reasonable normality is required and in the event of the normality assumption being violated a highly significant result would occur, i.e. two years would be given as significantly different when they were in fact homogeneous. In order to assess whether the assumption of an underlying broadly normal distribution was correct, each variable was bootstrapped. Figure 6.1, shows one

of the results, for the bootstrapped variable BRANGEN, which illustrates that the assumption of a broadly normal distribution appears justified.

Figure 6.1 Bootstrap of BRANGEN variable



The full set of bootstrapped variables are shown in appendix A. All of these variables follow a broadly normal distribution, and appear to meet the Box M requirement for marginal normality, as suggested by Stevens (2002). This level of normality, based upon central tendency, is not sufficient, however, to allow the use of parametric significance tests, so the non-parametric alternative i.e. Kruskal Wallis was used to test for performance differences between the groups. This decision follows the approach used in previous research; "Since in about half the tests the assumptions of equal variances across the different treatments (i.e. firms) were violated, a parametric ANOVA was not performed. Its non-parametric counterpart the Kruskal-Wallis one-way analysis of variance, was therefore applied" (Cool & Schendel, 1988 p 216,)

Cluster analysis does not make any assumptions with regard to normality or otherwise of the data clustered.

Box's M tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups. When no difference was found between adjacent years the following procedures were carried out.

1. The statistically similar years were summed and averaged then compared against the next year.
2. This procedure was repeated in both directions e.g. a break was found between 1997 and 1998 but no significant difference was identified between 1993,1994, 1995, 1996, and 1997. Therefore, to ensure that the period between 1993 and 1997 was indeed homogeneous, in addition to testing 1993 versus 1994 and so on respectively, tests were also carried out between the summed average of 1993 to 1996 and 1997 and between 1993 and the summed average of 1994 to 1997. Also, all combinations of adjacent years in between were tested.

SSTP 1

This consisted of the period from 1993 to 1997 which differed significantly from 1998, as illustrated in table 6.2.

Table 6.2 Box's Test of Equality of Covariance Matrices 1993 to 1998

	1993 - 94	1994 - 95	1995 - 96	1996 - 97	1997 - 98
Box's M	52.115	33.770	14.070	29.559	255.900
F	0.766	0.497	0.207	0.435	3.763
Df1	55	55	55	55	55
Df2	10127.118	10127.118	10127.118	10127.118	10127.118
Sig	0.898	0.999	1.000	1.000	0.000

SSTP 2

No significant difference was found between the years 1993 to 1997. A break occurred with the single year 1998, marking the start of a second SSTP. From 1998 to 2002 a second SSTP was found. The test results are shown in table 6.3.

Table 6.3 Box's Test of Equality of Covariance Matrices 1998 to 2002

	1998 - 99	1999 - 00	2000 – 01	2001 - 02
Box's M	55.248	51.109	18.039	36.707
F	0.812	0.751	0.265	0.540
Df1	55	55	55	55
Df2	10127.118	10127.118	10127.118	10127.118
Sig	0.838	0.913	1.000	0.998

Tables 6.4 and 6.5 show that no statistically significant differences existed between combinations of years within 1993 to 1997, thus confirming the first stable strategic time period.

Table 6.4 Confirmation of First Stable Strategic Time Period [Ascending Years]

	1993/4 - 95	1993/5 - 96	1993/6 - 97
Box's M	38.843	37.393	34.260
F	0.571	0.550	0.504
Df1	55	55	55
Df2	10127.118	10127.118	10127.118
Sig	0.996	0.997	0.999

Table 6.5 Confirmation of First Stable Strategic Time Period [Descending Years]

	1996/7 - 95	1995/7 - 94	1994/7 - 93
Box's M	26.353	37.253	57.661
F	0.387	0.548	0.848
Df1	55	55	55
Df2	10127.118	10127.118	10127.118
Sig	1.000	0.997	0.781

Tables 6.6 and 6.7, show that no statistically significant differences existed between combinations of years within the period 1998 to 2002, thus confirming the second stable strategic time period.

Table 6.6 Confirmation of Second Stable Strategic Time Period [Ascending Years]

	1998 – 1999/02	1999 – 2000/02	2000 – 2001/02
Box's M	95.999	50.922	36.087
F	1.412	0.749	0.531
Df1	55	55	55
Df2	10127.118	10127.118	10127.118
Sig	0.024	0.916	0.998

Here it is important to note that the figure of 0.024 is not regarded as significant for the Box M test, which means that the year (1998) is not seen to differ significantly from the years 1999 to 2002. The Box M test is highly sensitive and a significance level of 0.01 is recommended.

> "It is very sensitive, especially to the presence of non-normal variables. A significance test of .01 or less is used as an adjustment for the sensitivity of the statistic" (Hair *et al.*, 1998. p 328).

Table 6.7 Confirmation of Second Stable Strategic Time Period [Descending Years]

	2002 – 1998/01	2001 – 1998/00	2000 – 1998/99
Box's M	36.820	53.801	78.782
F	0.541	0.791	1.158
Df1	55	55	55
Df2	10127.118	10127.118	10127.118
Sig	0.998	0.868	0.198

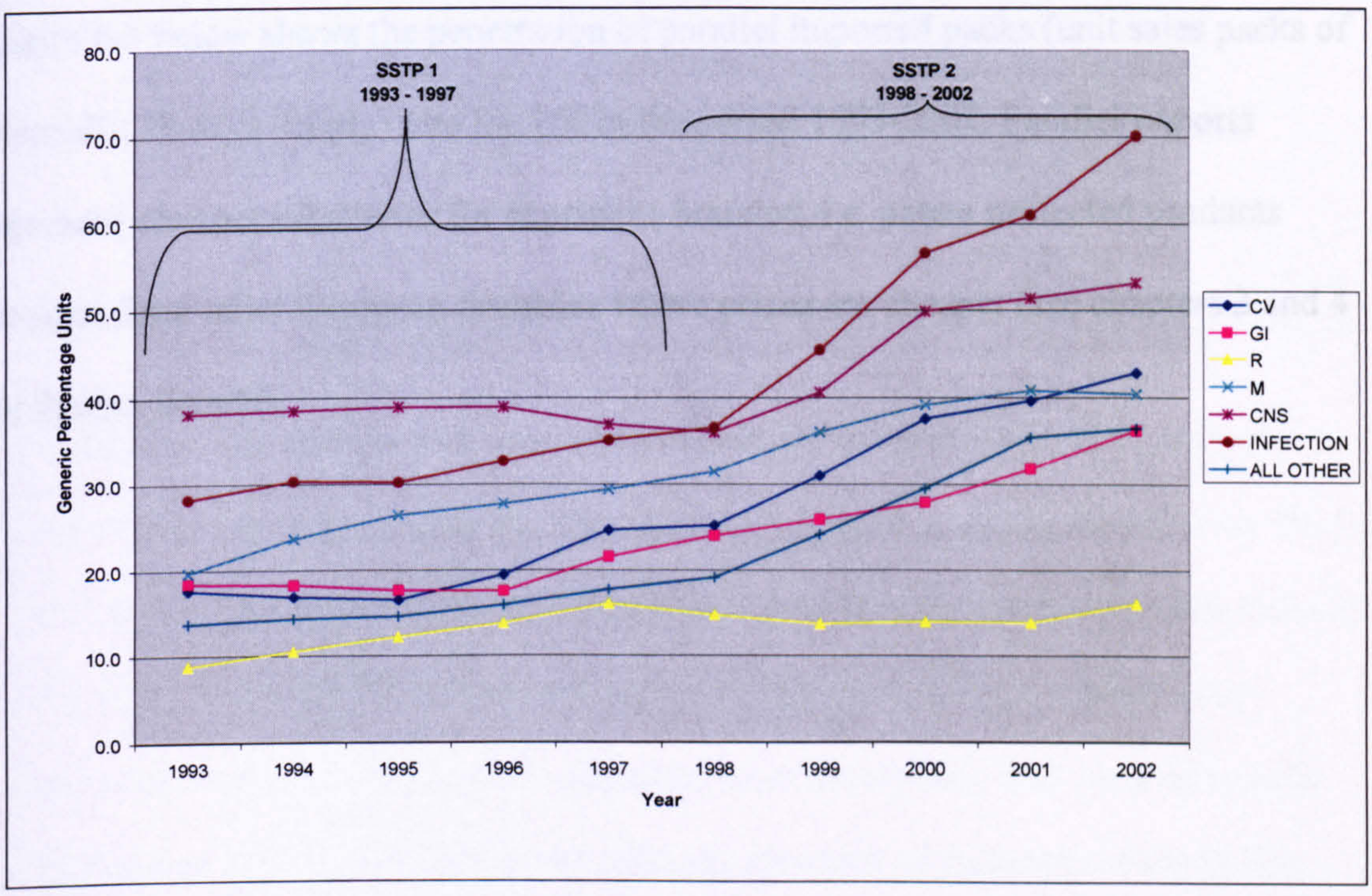
In the absence of any statistically significant difference between the years 1998 to 2002 a second SSTP is confirmed. The above two sets of results indicate the presence of two stable strategic time periods within the UK pharmaceutical industry between the years 1993 to 2002. The first strategic time period spanned from 1993 to 1997 and the second from 1998 to 2002. This result also supports the decision to accept the data as approximating to a normal distribution because, as Stevens points out, in the event of the normality assumption being violated we would expect a number of highly significant breaks, not the presence of two five year long stable periods as found here (Stevens, 2002). In the next section the environmental factors earlier identified (see Chapter 3) will be compared against each of these SSTPs.

6.3 The Relationship Between Stable Strategic Time Periods and Environmental Variables.

Figure 6.2 below illustrates the penetration of generic pharmaceuticals by PACT (chapter 3 for further details on PACT) category into the UK pharmaceutical industry from 1993 to 2002. The widespread use of generics is regarded as an important factor affecting pharmaceutical company strategy for three principle reasons. First, because prescribing habits of GPs in the UK were directly measured against their PACT figures and GPs were strongly incentivized to prescribe generically (see chapter 3 for further

details). Second, the availability of cheap generics rapidly eroded branded pharmaceutical sales leading to a rapid decline of company sales (see chapter 3 for further details). Third, health authority pharmaceutical advisers actively encouraged practices to regularly review their prescribing habits using PACT and to actively manage prescribing costs through the adoption of formularies and generic prescribing defaults on the practice computing system.

Figure 6.2 Generic Penetration Across the PACT categories used to measure GP prescribing.

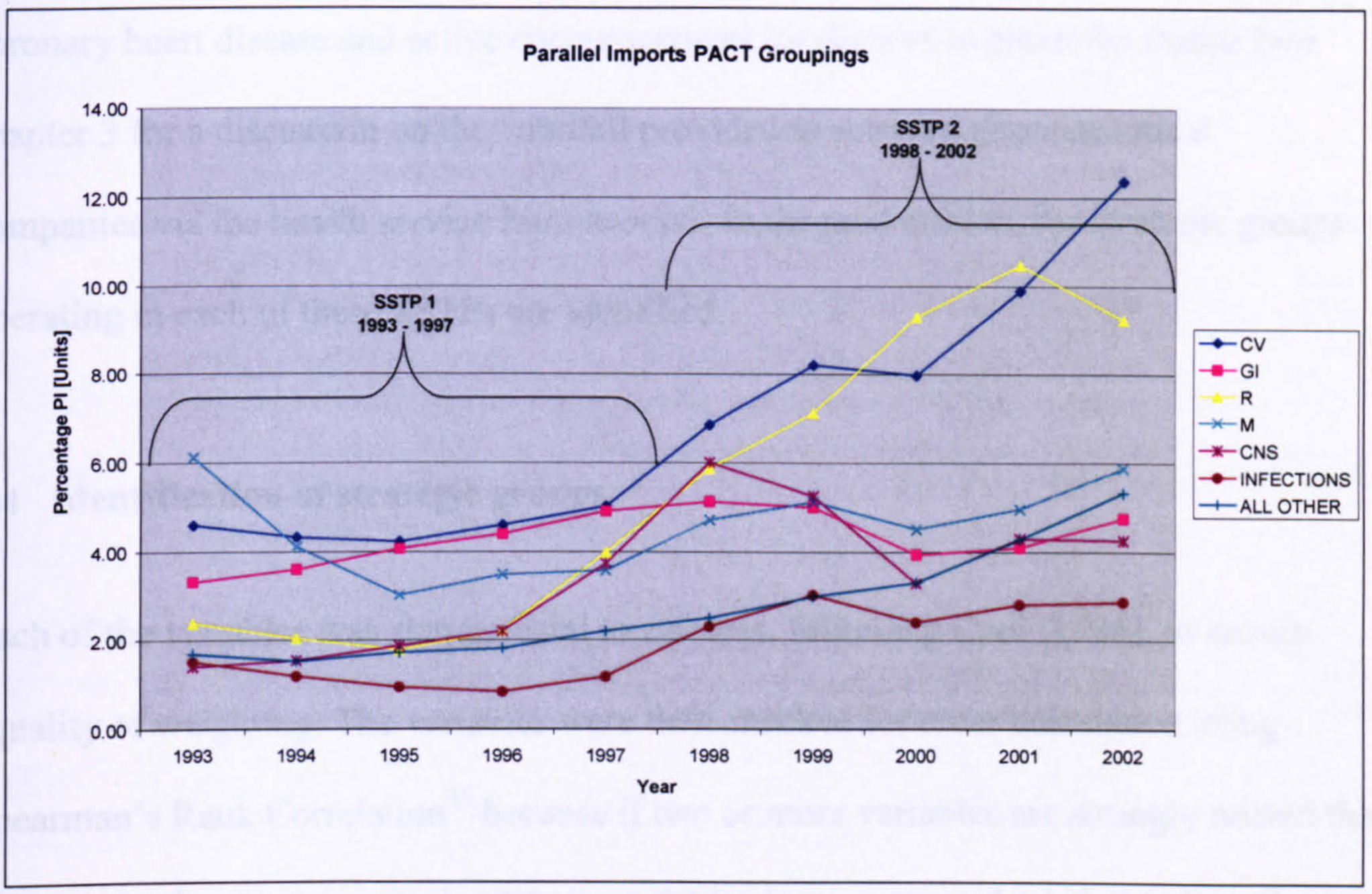


The key in the above figure refers to the respective PACT categories: CV = cardiovascular products, GI = gastrointestinal products, R = respiratory products, M = musculoskeletal products, CNS = central nervous system products, infection products is the sixth main PACT category, and products not included in these six categories are classified as "all other" products.

The above figure illustrates a clear change at the end of 1997 with some categories, notably infection and CNS products, showing a sharp increase in generic usage. An exception to this upward trend is shown by the respiratory products category, which is a class of products strongly influenced by patient choice of the delivery device, or inhaler, in which they are packaged. These devices are not available as cheap generic substitutes. This environmental change therefore appears to agree with the two stable strategic time periods identified in the earlier analysis reported above.

Figure 6.3 below shows the penetration of parallel imported packs (unit sales packs of generally 28 days supply) into the UK in the period 1993-2002. Parallel imports represent cheaper substitutes for expensive branded, i.e. patent protected products sourced from other European countries where prices are cheaper (see chapters 3 and 4 for further details).

Figure 6.3 Parallel Imports Penetration Across the PACT categories used to measure GP prescribing.



Parallel imports exert an important effect on pharmaceutical strategy because their availability, which varies between companies (see Chapter 4) affects the revenues which companies obtain in return for their promotional activities. If a company creates demand for its product in the UK but the pack used to fill the prescription is sourced from another European country, the UK subsidiary loses the revenue. This problem is made all the more acute by the Department of Health clawback of excess pharmacy profits, which assumes that pharmacies actively source and dispense parallel imports and in effect forces pharmacists to do so (see Chapter 3 and Chapter 4 for further details).

The above figure 6.3 again shows a clear difference between the two stable strategic time periods 1993 – 1997 and 1998 – 2002, identified earlier. In particular there is a marked difference in the importation of respiratory and cardiovascular products. The increased usage of parallel imported respiratory products [R] possibly reflects the

demand for cheaper substitutes, in the absence of equivalent generics. The rapid uptake of cardiovascular products [CV] marks the effect of the health service frameworks for coronary heart disease and active encouragement for doctors to prescribe statins (see chapter 3 for a discussion on the windfall provided to selected pharmaceutical companies via the health service frameworks). In the next section, the strategic groups operating in each of these SSTPs are identified.

6.4 Identification of strategic groups.

Each of the variables was standardized to z scores, following Cool (1985), to ensure equality of weighting. The variables were then checked for cross correlation using Spearman's Rank Correlation[35] because if two or more variables are strongly related the effect upon the cluster analysis of these variables is strengthened relative to the other variables, thus in effect altering the variable's weighting (for further discussion of this point see the previous chapter). These results are listed in table 6.8.

[35] Spearman's Rank is a non parametric statistic and therefore makes no assumption regarding the underlying distribution of the data.

Table 6.8 Correlation Between Variables SSTP1

	A	B	C	D	E	F	G	H	I	J
BRANGEN – A	1.00	0.047	-0.458	-0.041	0.411	0.027	0.541	-0.189	0.383	**0.792**
DRUGST – B	-0.047	1.00	0.352	-0.235	0.016	-0.201	-0.261	0.188	-0.304	-0.096
FOCUS – C	-0.458	0.352	1.00	0.071	-0.028	0.157	-0.279	0.363	-0.125	-0.365
FOREIGN – D	-0.041	-0.235	0.071	1.00	-0.113	-0.043	0.137	-0.149	0.163	0.052
MAINT – E	0.411	0.016	-0.028	-0.113	1.00	0.018	0.042	0.214	0.038	0.227
PHARMA – F	0.027	-0.201	0.157	-0.043	0.018	1.00	0.130	-0.058	0.513	0.087
PRODSTR – G	0.541	-0.261	-0.279	0.137	0.042	0.130	1.00	-0.208	0.466	**0.788**
PROFPROM- H	-0.189	0.188	0.363	-0.149	0.214	-0.058	-0.208	1.00	-0.008	-0.421
RDI – I	0.383	-0.304	-0.125	0.163	0.038	0.513	0.466	-0.008	1.00	0.460
SIZE – J	**0.792**	-0.96	-0.365	0.052	0.227	0.087	**0.788**	-0.421	0.460	1.00

The highest correlation between this set of variables was found to be 0.79 between BRANGEN and SIZE and 0.79 between PRODSTR and SIZE (Shown in bold). What is a significant correlation is a matter of judgement. This value falls below the figure of 0.9 and above suggested as the point where multicollinearity between variables may become an issue, (Tabachnick *et al.*, 2001. p 82). Therefore, all of this variable set may be included in each analysis. Nevertheless, two analyses were carried out in order to check for the effect of SIZE if included within the variable set. It may also be argued that SIZE represents an outcome of strategy rather than a strategic choice variable per se.

The variables were clustered first using Ward's method, following Cool (1985). The distance metric employed was squared Euclidean distance (see glossary). A second

analysis was then run using a k means method, a nonhierarchical algorithm which takes the original data partitions as the starting point. This in effect rechecks the classification of cases to groups and has the advantage of being able to reallocate poorly classified cases. This approach is recommended to compensate for a weakness of hierarchical algorithms, which having combined two cases together cannot later reassign a poorly classified case (for further details see chapter 5). The entire clustering analysis was then repeated applying no transformation to the data in order to identify the effect of the z score transformation.

The results are shown in table 6.9.

Table 6.9 Initial Clustering Solution for SSTP1 Employing All Variables

	SSTP1 [Z Score]	SSTP1 [No Transformation]
Number of Variables	10	10
Number of Clusters	7	4
Clustering Method	Ward's Method	Ward's Method
Cluster 1:	3M AKZO RB BAY SOL PG	3M PG RB AKZO BAY SOL
Cluster 2:	BAX	AVE PHR JJ NVA
Cluster 3:	BI SAG MER IVX NOV	ABB WYE YAM BMS SPL LIL MSD PFZ IVX NOV BAX ROC
Cluster 4:	LUN	AZ GSK SS BI SAG MER LUN
Cluster 5:	SPL YAM	
Cluster 6:	ABB JJ WYE AVE PHR NVA ROC AZ GSK	
Cluster 7:	BMS MSD LIL PFZ SS	

The key to company names has been provided earlier in the thesis but is repeated here, in table 6.10 for the reader's convenience.

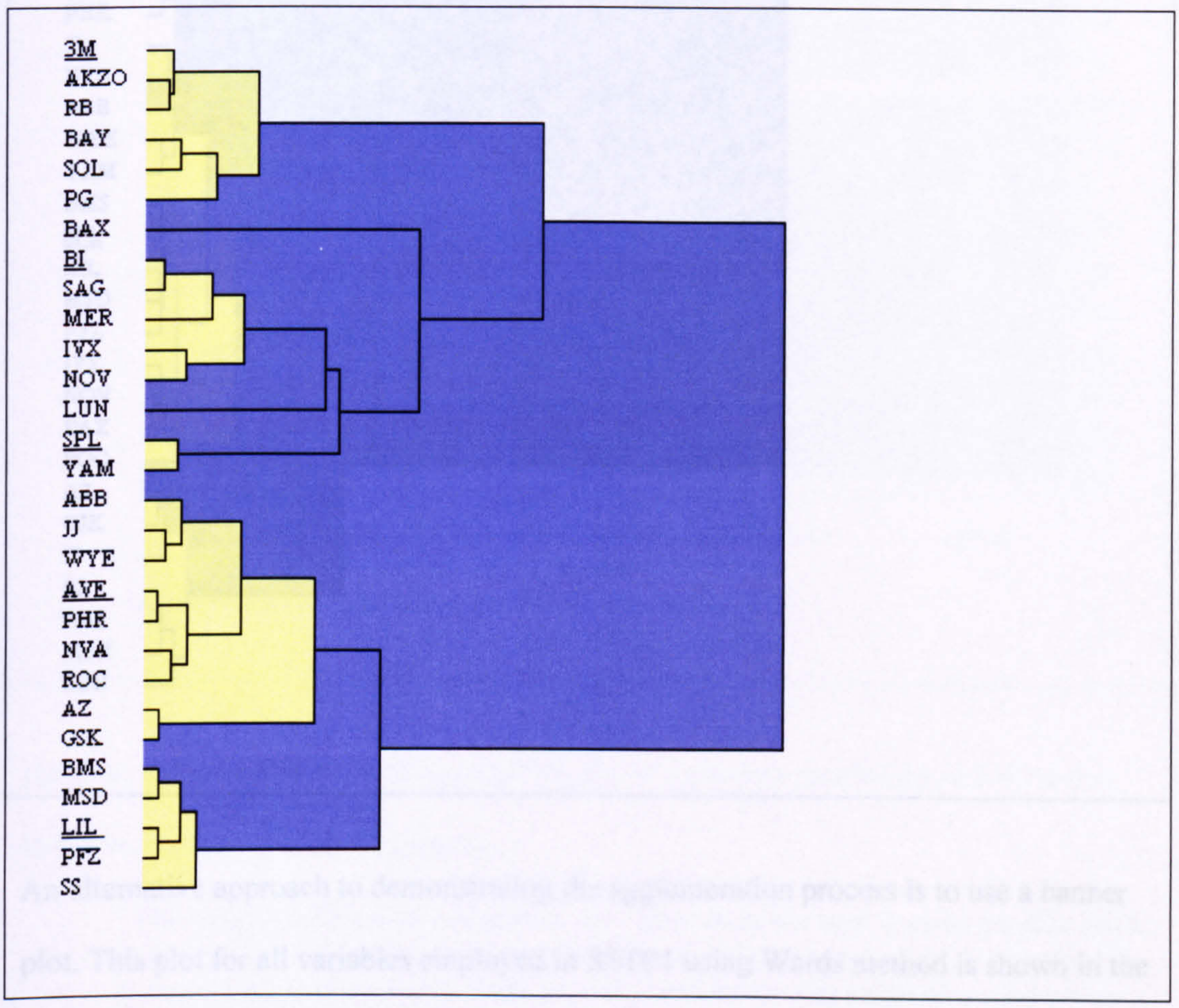
Table 6.10 List of companies and their abbreviations included in this analysis

ABBREVIATION	COMPANY
3M	Minnesota Mining and Manufacturing
ABB	Abbott Laboratories
AKZO	Akzo Nobel
AVE	Aventis
AZ	Astra Zeneca
BAX	Baxter
BAY	Bayer
BI	Boehringer Ingelheim
BMS	Bristol Myers Squibb
CELL	Celltech
EIS	Eisai
GSK	Glaxo Smith Kline
IVX	Ivax
JJ	Johnson & Johnson
LIL	Lilly
LUN	Lundbeck
MER	E Merck
MSD	Merck Sharpe and Dohme
NOV	Novo
NVA	Novartis
PFZ	Pfizer
PG	Proctor & Gamble
PHR	Pharmacia
RB	Reckitt Benkisser
ROC	Roche
SAG	Schering AG
SHI	Shire Pharmaceuticals
SOL	Solvay
SPL	Schering Plough
SS	Sanofi Synthelabo
TAK	Takeda
WYE	Wyeth
YAM	Yamanouchi

The Dendrogram illustrating each of these clustering processes is provided in figures 6.4 and 6.5 respectively. The most closely similar companies are adjacent to each other on the Dendrogram and the most typical company within each group or group exemplar

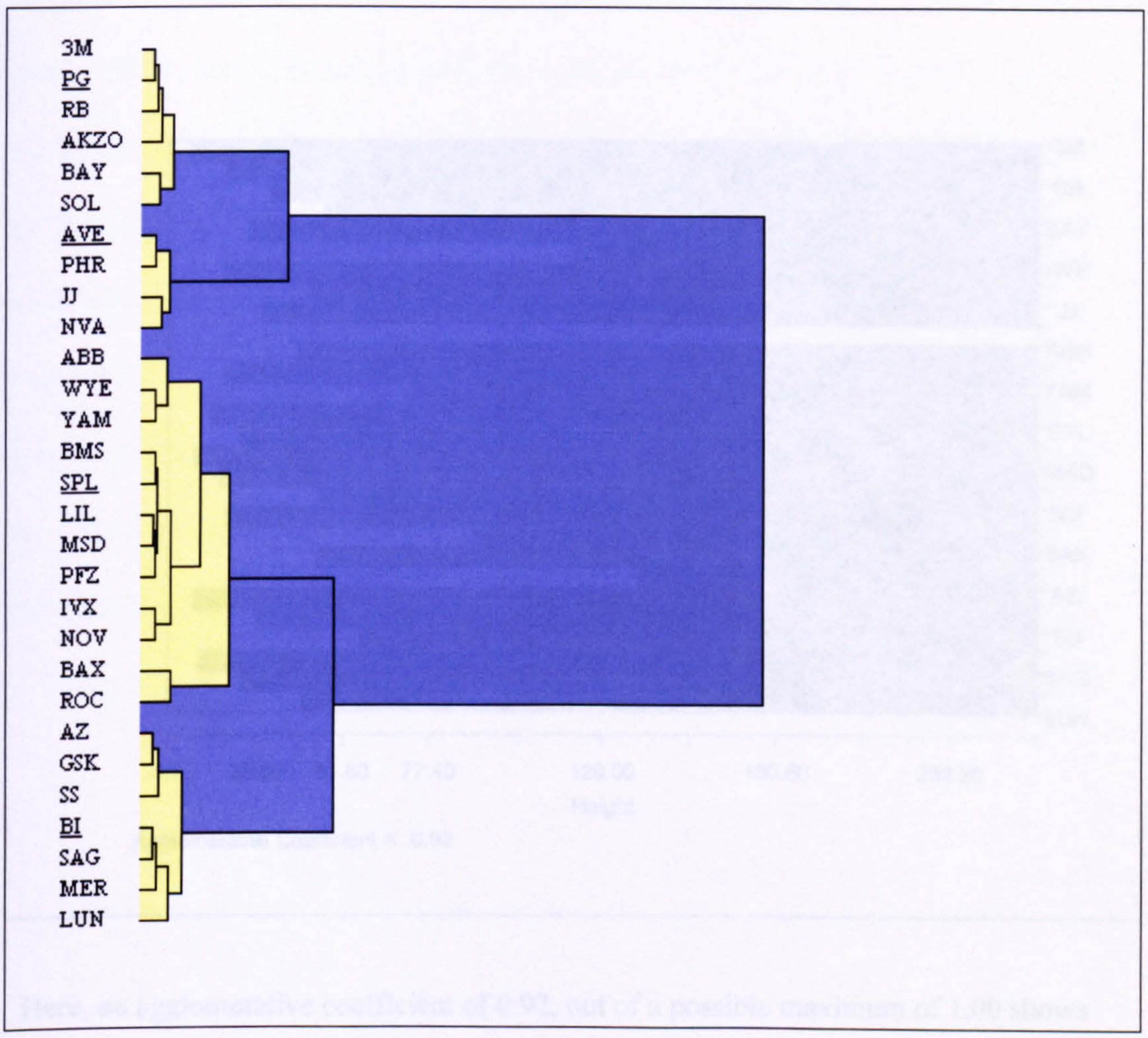
is underlined. The distance from left to right represents the value of the fusion coefficient[36]. Shading is used to provide a clearer contrast between clusters.

Figure 6.4 Ward's Method Dendrogram: SSTP1 Data Set Standardized to Z Scores



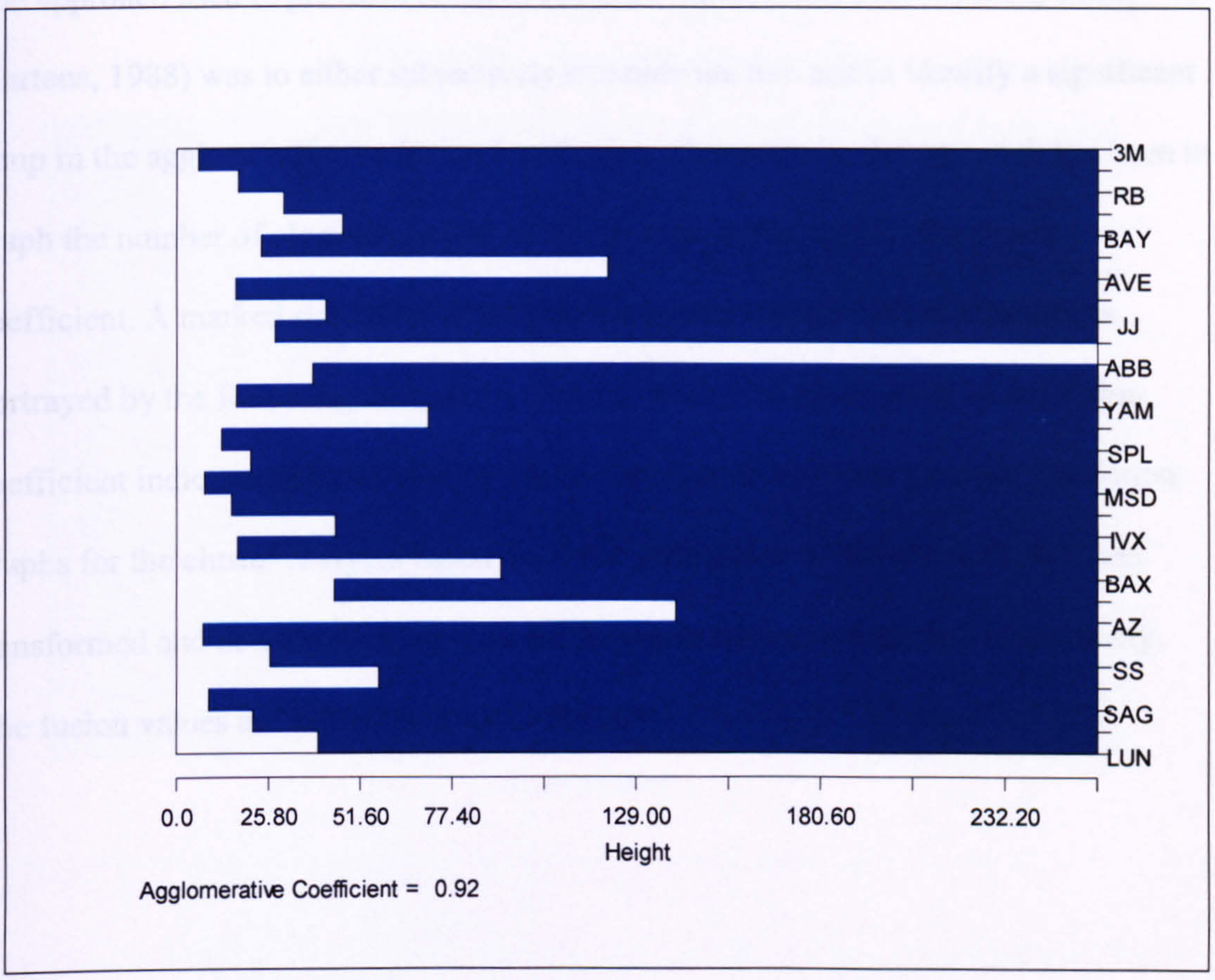
[36] The fusion or amalgamation coefficient is the numerical value at which various cases merge to form a cluster (Aldenderfer *et al.*, 1984. p 54), page 54.

Figure 6.5 Ward's Method Dendrogram: SSTP1 Data Set - No Transformation



An alternative approach to demonstrating the agglomeration process is to use a banner plot. This plot for all variables employed in SSTP1 using Wards method is shown in the below figure 6.6

Figure 6.6 Ward's Method Banner Plot: SSTP1 Data Set - No Transformation



Here, an agglomerative coefficient of 0.92, out of a possible maximum of 1.00 shows that a very strong structure is present.

> "The overall width of the banner is very important because it gives an idea of the amount of structure that has been found by the algorithm. Indeed, when the data possess a clear cluster structure, the between-cluster dissimilarities (and hence the highest level) will become much larger than the within-cluster dissimilarities, and as a consequence the black lines in the banner become longer" (Kaufman *et al.*, 1990). "Thus, an agglomerative coefficient of close to 1, means that a very clear clustering structure has been identified" (Kaufman *et al.*, 1990, p. 213).

This nested tree structure suggests that several different groups may be present in the data. The key question is how to determine the right number of clusters? The

appropriate tree partition can be used as the starting point for the k means algorithm. The approach used in previous research (Bogner, 1991; Cool, 1985; Guedri, 1998; Martens, 1988) was to either subjectively examine the tree and to identify a significant jump in the agglomeration or fusion coefficient. Alternatively, the approach has been to graph the number of clusters implied by a hierarchical tree against the fusion coefficient. A marked flattening of the graph suggests that no new information is portrayed by the following mergers of clusters, while a sharp increase in the fusion coefficient indicates that two sharply dissimilar clusters have been joined. The fusion graphs for the cluster analyses based upon the application of Ward's method to the transformed and non transformed data are shown in figures 6.6 and 6.7 respectively. The fusion values are available in appendix A.

Figure 6.6 Plot of Fusion Process for Standardized Data – SSTP1

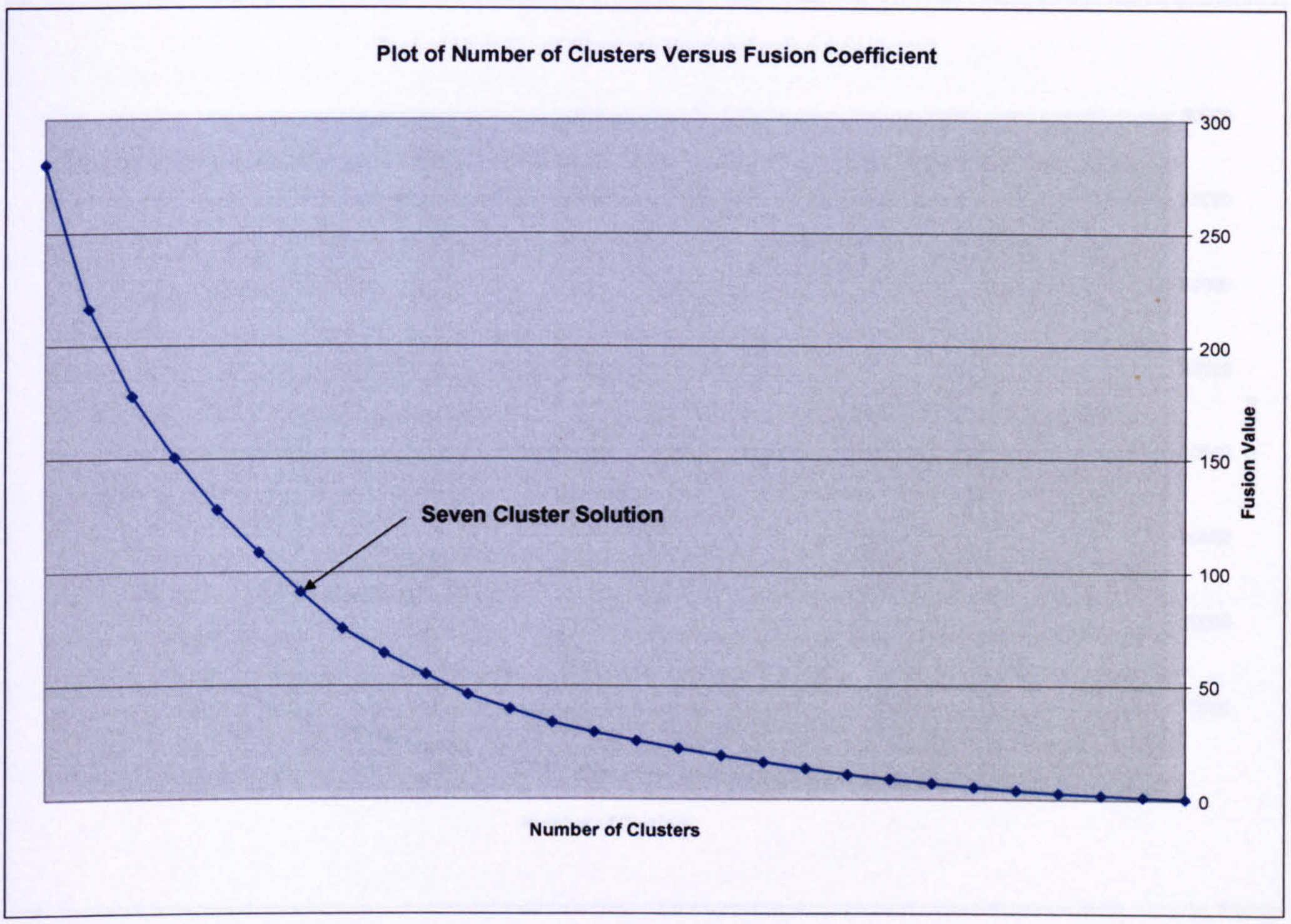
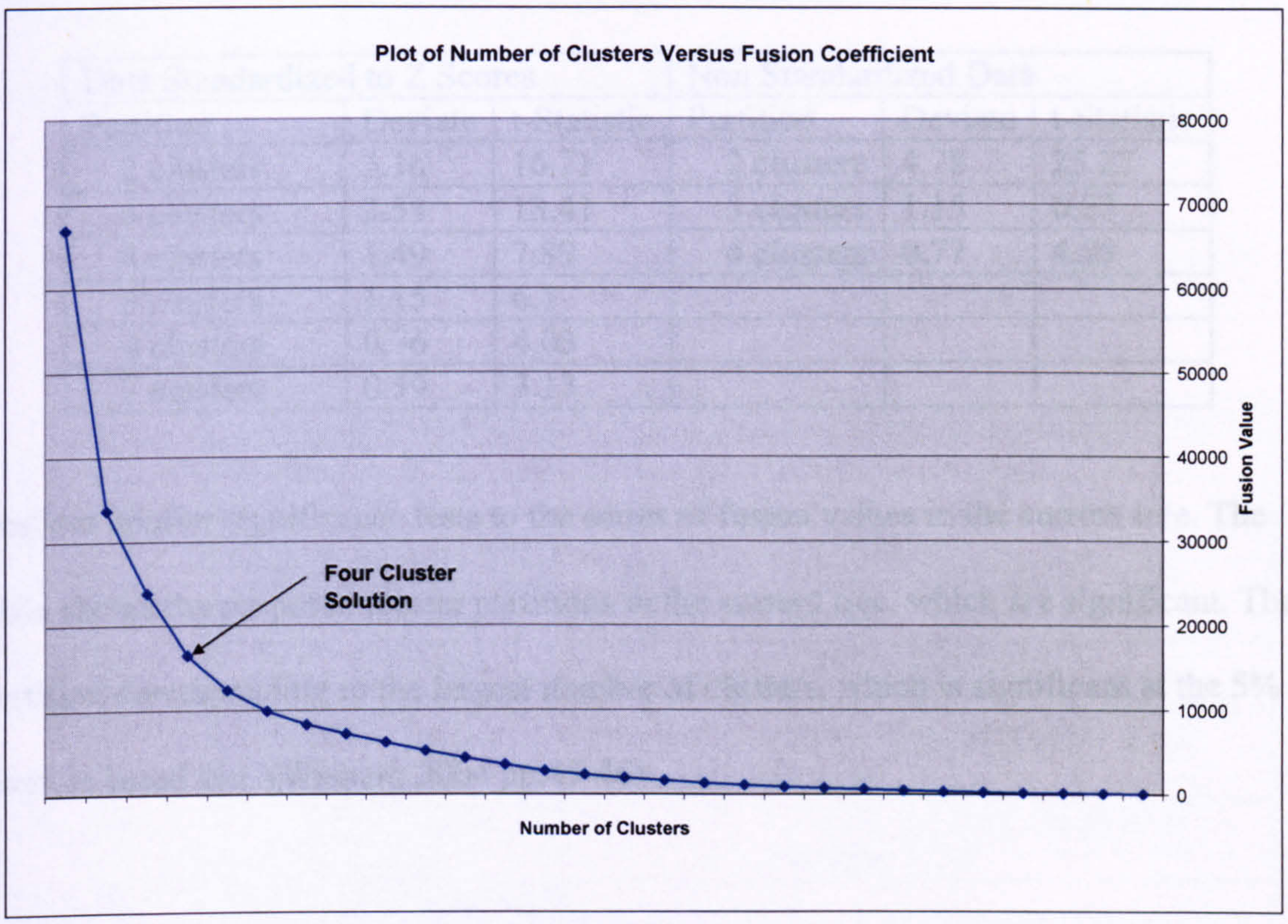


Figure 6.7 Plot of Fusion Process for Non Standardized Data – SSTP1



This process of "cutting the tree" has been criticized as subjective providing researchers with the ability to choose what best suits their purpose. (Note the significant difference, in figure 6.7 above between the distance between the 3 and 4 cluster solutions as compared to the distance between the 4 and 5 cluster solutions). An alternative approach is to use a significance test. The Best cut upper tail method is used here (see glossary). The results of this test comparing both standardized and non-standardized data are shown in table 6.11.

Table 6.11 Upper tail test for the right cluster solution

Data Standardized to Z Scores			Non Standardized Data		
Partition	Deviate	t-Statistic	Partition	Deviate	t-Statistic
2 clusters	3.16	16.71	2 clusters	4.78	25.27
3 clusters	2.53	13.41	3 clusters	1.15	6.07
4 clusters	1.49	7.89	4 clusters	0.77	4.05
5 clusters	1.15	6.1			
6 clusters	0.76	4.03			
7 clusters	0.59	3.13			

Best cut applies significance tests to the series of fusion values in the current tree. The table shows the proposed cluster partitions in the current tree, which are significant. The partition corresponding to the largest number of clusters, which is significant at the 5% level, is listed last. (Wishart, 2004 pp.45-46)

The upper tail test and the agglomeration values suggest a 7 and 4 cluster solution, respectively, for the z scored and non standardized data. These tree partitions were then used as seed points for the next step in the clustering procedure. This is because the k means clustering method requires a starting point from which to optimize the solution. These starting points can either be the cluster centroids (see glossary) or the tree partitions.

As previously discussed, a drawback with Ward's method is that once combined within a cluster that situation cannot be reversed. In order to correct for this, a second cluster analysis was then carried out using a non-hierarchical k means clustering method[37]. This is probably the most widely applied non-hierarchical clustering technique, which has the advantage that every time a firm changes between clusters the centroids of both its

[37] The k means algorithm attempts to minimise the average squared distance between clusters, yielding so called centroids (Kaufman *et al.*, 1990).

old and new cluster are recalculated (Kaufman *et al.*, 1990). The use of this second clustering method in effect reconfirms the clustering solution ensuring that any inappropriately clustered case is reassigned. These results are shown in table 6.12.

Table 6.12 K Means Clustering Solution for SSTP1 Employing All Variables

	SSTP1 [Z Score]	SSTP1 [No Transformation]
Number of Variables	10	10
Number of Clusters	7	4
Clustering Method	K Means	K Means
Cluster 1:	3M AKZO RB SOL PG	3M PG RB AKZO BAY SOL
Cluster 2:	BAX	AVE PHR JJ NVA
Cluster 3:	BI SAG MER IVX NOV	ABB WYE YAM BMS SPL LIL MSD PFZ NOV BAX ROC
Cluster 4:	LUN	IVX AZ GSK SS BI SAG MER LUN
Cluster 5:	SPL YAM	
Cluster 6:	AVE PHR NVA ROC AZ GSK	
Cluster 7:	BAY ABB JJ WYE BMS MSD LIL PFZ SS	

The following changes are observed with the clustering solution based upon z scores (Comparing tables 6.9 and 6.12 respectively).

1. Bayer is removed from cluster 1 and reassigned to cluster 7.
2. Abbott and Johnson & Johnson are moved from cluster 6 to cluster 7.

Aside from these changes, there are a number of marked similarities between the two solutions.

1. Clusters 2, 3, 4 and 5 are identical.

2. Baxter and Lundbeck are clustered separately. These were not, however, regarded as outliers and removed from the analysis because, as will be described in more detail later, these companies appear to operate a distinct and different strategy within the UK pharmaceutical market.

Comparing the two cluster solutions based upon non standardized data, the following observations can be made.

1. There is only one change of position - Ivax is moved from cluster 3 to cluster 4. Aside from this, the two clustering solutions are identical.
2. There are no outliers or single firm groups.

What is obvious is that relative scale effects do appear to exert a marked effect because the cluster analysis based upon transformed data suggests a 7 cluster solution as against a 4 cluster solution without transformation. Before addressing the question of which is the most robust solution, the same analysis, excluding the SIZE variable, is compared in the following tables 6.13 and 6.14.

Table 6.13 Initial Clustering Solution for SSTP1 Excluding SIZE Variable

	SSTP1 [Z Score]	SSTP1 [No Transformation]
Number of Variables	10	10
Number of Clusters	7	4
Clustering Method	Ward's Method	Ward's Method
Cluster 1:	3M RB AKZO BAY SOL PG	3M PG RB AKZO BAY SOL
Cluster 2:	BAX	AVE PHR JJ NVA
Cluster 3:	BI SAG MER IVX NOV	ABB WYE YAM BMS SPL LIL MSD PFZ IVX NOV BAX ROC
Cluster 4:	LUN	AZ GSK SS BI SAG MER LUN
Cluster 5:	SPL YAM	
Cluster 6:	ABB JJ WYE AVE PHR NVA ROC AZ GSK	
Cluster 7:	BMS MSD LIL PFZ SS	

Table 6.14 K Means Clustering Solution for SSTP1 Excluding SIZE Variable

	SSTP1 [Z Score]	SSTP1 [No Transformation]
Number of Variables	10	10
Number of Clusters	7	4
Clustering Method	K Means	K Means
Cluster 1:	3M RB AKZO SOL PG	3M PG RB AKZO BAY SOL
Cluster 2:	BAX	AVE PHR JJ NVA
Cluster 3:	BI SAG MER IVX NOV	ABB WYE YAM BMS SPL LIL MSD PFZ NOV BAX ROC
Cluster 4:	LUN	IVX AZ GSK SS BI SAG MER LUN
Cluster 5:	SPL YAM	
Cluster 6:	JJ AVE PHR NVA ROC AZ GSK	
Cluster 7:	BAY ABB WYE BMS MSD LIL PFZ SS	

The effect of removing SIZE from the cluster solution appears minimal. Johnson and Johnson remains assigned to group 6, rather than moved into group 7 within the transformed data set; but aside from this there are no changes. Therefore, in the interests of parsimony and to remove any doubt of multicollinearity the second clustering solution excluding SIZE was retained.

The issue now is which of the two cluster solutions is the most robust? Here the methods used to validate cluster solutions are, first, to test for significance on the variables used to create the clusters. See table 6.15 for the group means of each of the variables.

Table 6.15 Mean values for each variable by cluster

Variable	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7
BRANGEN	4.4	0	2.28	5.64	4.65	7.96	8.7
DRUGST	90.85	28.45	81.99	50.73	83.93	79.77	88.18
FOCUS	87.51	58.36	89.48	100	75.96	57.68	82.43
FOREIGN	52.59	48.07	72.55	100	36.51	66.12	43.34
MAINT	0.33	0.06	0.22	1	0.03	0.36	0.72
PHARMA	8.77	100	100	100	89.08	61.56	96.27
PRODSTR	4.81	1.23	6.47	3.99	5.09	8.44	6.49
PROFPROM	0.04	0.01	0.04	0.07	0.1	0.04	0.05
RDI	0.05	0.05	0.13	0.15	0.11	0.13	0.12

This approach has been widely employed in previous strategic group research, Cool (1985) for example, used one way analysis of variance to test between cluster means. Here the Kruskal-Wallis test, the non-parametric alternative to a one way between-groups analysis of variance is used. The results of this test are shown in table 6.16.

Table 6.16 Kruskal-Wallis test on variables between groups – SSTP1

Clustering Based Upon	Z Scores			Non standardized variables		
Number of Clusters	7			4		
Variable	Chi-Square	df	Sig	Chi-Square	Df	Sig
BRANGEN	20.668	6	0.002	2.484	3	0.478
DRUGST	12.792	6	0.046	6.803	3	0.078
FOCUS	16.183	6	0.013	12.346	3	0.006
FOREIGN	17.875	6	0.007	21.447	3	0.000
MAINT	15.630	6	0.016	0.155	3	0.985
PHARMA	20.808	6	0.002	20.444	3	0.000
PRODSTR	21.282	6	0.002	11.936	3	0.008
PROFPROM	11.819	6	0.066	0.379	3	0.944
RDI	15.599	6	0.016	13.518	3	0.004

Taken on face value both cluster solutions appear valid in terms of sorting clusters into significantly different groups. However, as pointed out by Aldenderfer and Blashfield (1984), cluster analysis methods, by definition, will separate entities into clusters that have virtually no overlap along the variables being used to create the clusters.

> "Significance tests for differences among the clusters along these variables should always be positive. Since these tests are positive, regardless of whether clusters exist in the data or not, the performance of these tests is useless at best and misleading at worst"(Aldenderfer *et al.*, 1984. p 65).

This test, which has frequently been used in previous strategic group research, must therefore be disregarded, but it does illustrate that the clustering algorithm has performed as expected.

A second validation technique involves testing whether the same cluster solution can be reliably replicated across a series of data sets. Here the aim is to demonstrate the validity of the clustering solution.

> "If a cluster solution is repeatedly discovered across different samples from the same general population, it is plausible to conclude that this solution has some

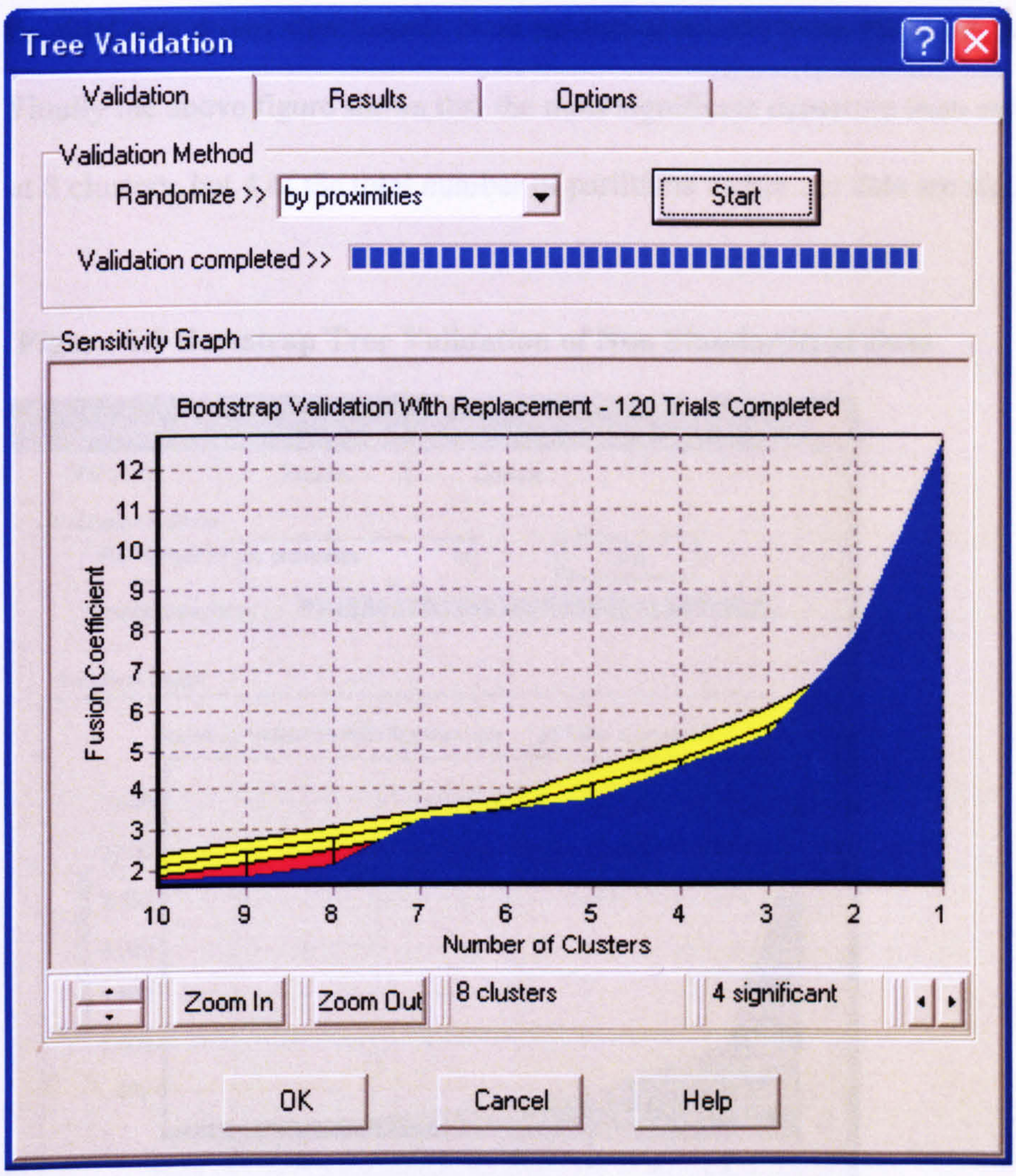
> generality. A cluster solution that is not stable is unlikely to have general utility" (Aldenderfer *et al.*, 1984. p 65).

The clustering data were therefore replicated using a bootstrapping tree validation technique and the clustering solution compared. This tree validation technique compares a tree obtained for a given dataset with the family of trees generated by random permutation of the same data or the associated proximity matrix.

> "A distribution is obtained for the set of trees from the randomly permuted data and a confidence interval is constructed around the mean. The tree for the given data is then compared with this confidence interval and significant departures from random are identified. This procedure seeks to reject the underlying hypothesis that the data is randomly distributed. It searches for tree sections that correspond to the greatest departure from randomness, and in trials when random data were evaluated it reassuringly reported no significant clusters". (Wishart, 2004 p 46)

The results of this bootstrap validation technique are shown in figures 6.8 and 6.9 for the standardized and non standardized data sets, respectively. The bootstrap results figures can be found in appendix A.

Figure 6.8 Bootstrap Tree Validation of Standardized Data

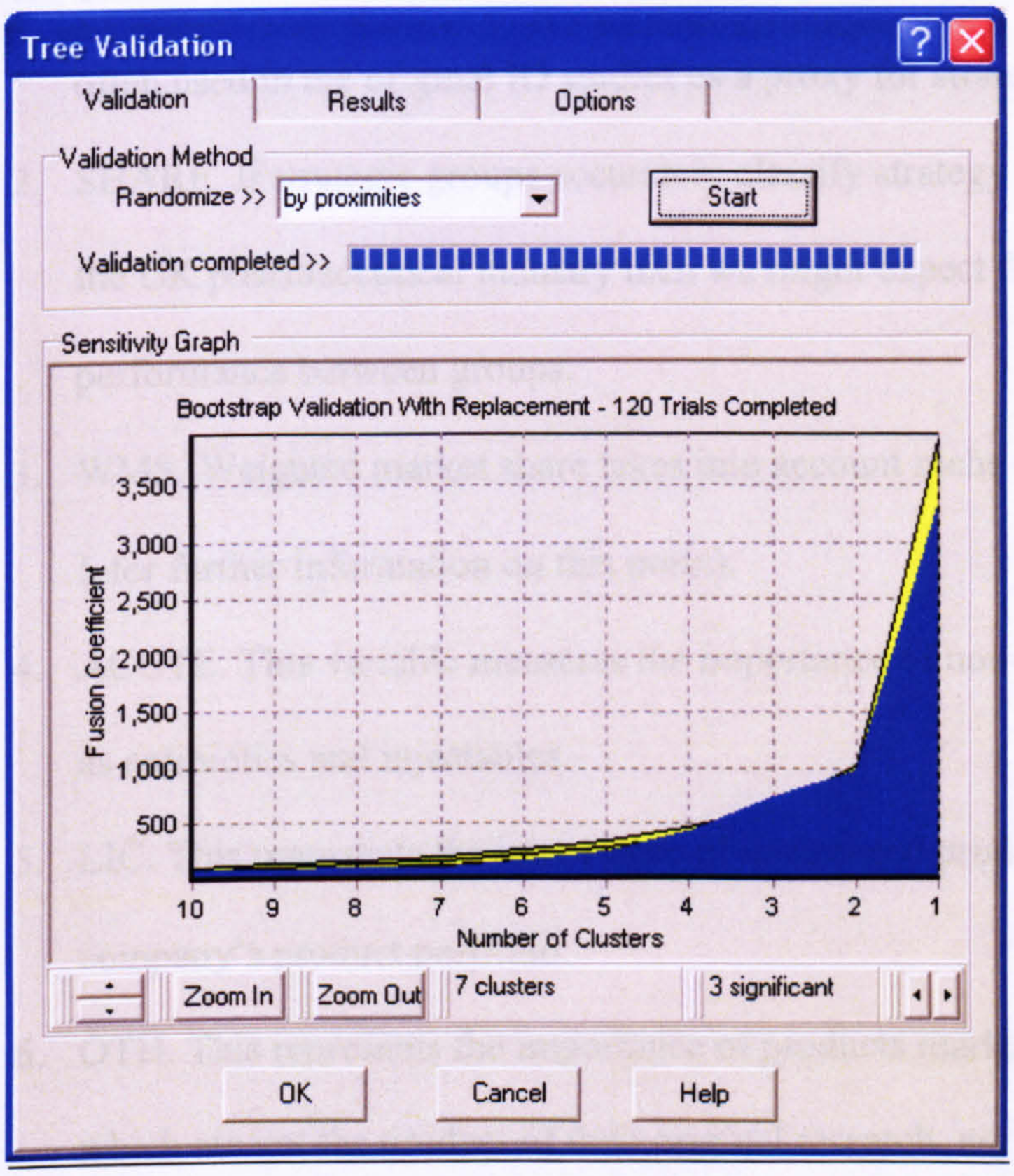


The solid area at the base of the above figure shows the fusion values that correspond to the actual data as presented. Above this solid area, the area encompassed by the next two lines show the range of fusion values obtained from 120 trials of randomising the data; The central line within this latter area represents the mean of the fusion values for each number of clusters, obtained from the random trials. The width encompassed by the two lines either side of this central line is 1 standard deviation about the mean. Finally looking at the base of the figure directly between the 10 and 7 clusters points on

the scale a further area above the first solid area but below the two lines either side of the standard deviation line can be seen. This area shows where the fusion values for the original data depart significantly from random at the 5% level. (Wishart, 2004).

Finally the above figure shows that the most significant departure from random occurs at 8 clusters, but 4 of the total number of partitions within our data are significant.

Figure 6.9 Bootstrap Tree Validation of Non Standardized Data



In the above figure the 7 cluster solution departs most significantly from random, but 3 of the total number of partitions differ significantly at the 5% level.

This replication technique in effect checks the internal consistency of the solution. It does not support the validity of the clusters formed but does confirm that a set of natural

breaks occur in the data. The clusters that we have discovered in the data appear to be natural clusters. But validity of the clusters requires considering whether they mean anything in practice when applied to meaningful variables that were not used to generate the clustering solution. Here the following variables were used to test the validity of the clusters.

1. SIZE. This was excluded from the second analysis and is a variable that was often used in the original IO studies as a proxy for strategy.
2. SHARE. If strategic groups accurately classify strategy and strategy matters in the UK pharmaceutical industry then we might expect differences in performance between groups.
3. WMS. Weighted market share takes into account niche strategies. (See Chapter 5 for further information on this point).
4. ACUTE. This variable measures the importance of non-chronic therapies such as antibiotics and injectables.
5. LIC. This represents the importance of in-licensed products within the company's product portfolio.
6. OTH. This represents the importance of products marketed by the company which are not the product of their original research, nor subject to a licensing agreement, for example marketing an off-patent drug in a new delivery system, such as the Oxis Turbohaler marketed by Astra Zeneca.
7. MERGER. This is a categorical variable where 1 indicates a company that has taken part in no merger activity during the study period, 2 a company that is the product of one merger, and 3 a serial merger candidate.

8. NATION. This is a categorical variable denoting each company's country of origin.
9. ADV. Company spend on advertising.
10. DET. The number of unit details (sales calls) conducted by the company.

The Kruskal Wallis test was used to measure the differences between groups and the results of this external validation are presented in table 6.17.

Table 6.17 Kruskal-Wallis test on external variables between groups – SSTP1

Clustering Based Upon	Z Scores			Non standardized variables		
Number of Clusters	7			4		
Variable	Chi-Square	df	Sig	Chi-Square	df	Sig
SIZE	23.917	6	0.001	5.885	3	0.117
SHARE	23.945	6	0.001	6.191	3	0.103
WMS	14.670	6	0.023	2.040	3	0.564
ACUTE	12.376	6	0.054	2.382	3	0.497
LIC	9.697	6	0.138	4.727	3	0.193
OTH	6.108	6	0.411	0.498	3	0.919
MERGER	21.255	6	0.002	10.444	3	0.015
NATION	7.350	6	0.290	2.970	3	0.406
ADV	18.632	6	0.005	8.605	3	0.035
DET	17.885	6	0.007	4.780	3	0.189

The results of this test are that both cluster solutions achieve external validation. The 4 cluster solution based upon non standardized data achieved significance on two strategic variables, the use of merger and advertising respectively. In contrast, the 7 cluster solution appears to provide a clearer insight into strategic choice within the UK pharmaceutical industry during the period 1993 to 1997 with six out of the ten variables (SIZE, SHARE, WMS, MERGER, ADV and DET) achieving significance and ACUTE achieving a significance value of 0.054.

The benefits of this external validation through the use of relevant variables are;

> "The power of external validation is that it directly tests the generality of a cluster solution against relevant criteria...the value of a cluster solution that has successfully passed an external validation is much greater than a solution that has not"(Aldenderfer *et al.*, 1984, p 66).

The stronger of these two solutions is therefore selected to classify the pattern of strategic choices within the UK pharmaceutical industry for the first stable strategic time period. The strategic groupings for SSTP1 are therefore as presented in table 6.18.

Table 6.18 Strategic groups within the UK pharmaceutical industry 1993-1997

	SSTP1
Time Period	1993 - 1997
Number of Strategic Groups	7
SG1:	3M RB AKZO SOL PG
SG 2:	BAX
SG 3:	BI SAG MER IVX NOV
SG 4:	LUN
SG 5:	SPL YAM
SG 6:	JJ AVE PHR NVA ROC AZ GSK
SG 7:	BAY ABB WYE BMS MSD LIL PFZ SS

We now turn to the second stable strategic time period, 1998 – 2002.

Here, precisely the same procedure was followed as described above. First, the variables were checked for multicollinearity using Spearman's Rank. These results are presented in table 6.19.

Table 6.19 Correlation Between Variables SSTP2

	A	B	C	E	F	G	I	J
BRANGEN – A	1.000	0.296	-0.029	0.498	0.288	0.549	0.489	0.693
DRUGST - B	0.296	1.000	**0.798**	0.236	-0.024	-0.201	0.011	0.078
FOCUS - C	-0.029	**0.798**	1.000	0.118	-0.001	-0.486	-0.078	-0.245
MAINT - E	0.498	0.236	0.118	1.000	0.050	0.098	0.148	0.210
PHARMA - F	0.288	-0.024	-0.001	0.050	1.000	0.439	**0.799**	0.415
PRODSTR - G	0.549	-0.201	-0.486	0.098	0.439	1.000	0.437	**0.805**
RDI - I	0.489	0.011	-0.078	0.148	**0.799**	0.437	1.000	0.419
SIZE - J	0.693	0.078	-0.245	0.210	0.415	**0.805**	0.419	1.000

This dataset presents more problems than the SSTP1 data set. The effected variables are shown in bold For the purpose of this exercise a figure in excess of 0.75 was arbitrarily chosen as a cut off point. This falls well below Tabachnick and Fidells figure of 0.90, although opinions do vary on this point;

> "…there is no universally accepted rule of thumb concerning how high is too high. Still, most investigators would probably agree that correlations of r > .80 between predictors should be considered very problematic" (Licht, 2000. p 45).

Three interactions therefore present a problem. The first is the 0.798 correlation between DRUGST and FOCUS, the second the 0.799 correlation between PHARMA and RDI, and finally the 0.805 correlation between SIZE and PRODSTR. The decision was therefore made to run two sets of analyses and compare the results. This approach is suggested by a number of authorities (Aldenderfer *et al.*, 1984; Ketchen *et al.*, 1996; Punj *et al.*, 1983). Each set of analysis was then repeated for non standardized variables.

The two variable sets are shown in table 6.20.

Table 6.20 Variable Set for SSTP2 Analysis

Full Set	Variable set 1	Variable set 2
BRANGEN	BRANGEN	BRANGEN
DRUGST	DRUGST	-
FOCUS	-	FOCUS
FOREIGN	FOREIGN	FOREIGN
MAINT	MAINT	MAINT
PHARMA	PHARMA	-
PRODSTR	-	PRODSTR
PROFPROM	PROFPROM	PROFPROM
RDI	-	RDI
SIZE	SIZE	-

6.5 SSTP2 Variable Set 1

As before, each set of variables was initially clustered using Ward's method. Two sets of analyses were carried out for each of the two variable sets, once with variables standardized to unit variance by means of z scores and once with non standardized variables. The results of this initial cluster analysis for the first variable set, excluding FOCUS, PRODSTR and RDI, are shown in table 6.21.

Table 6.21 Initial Clustering Solution for SSTP2 Employing Variable Set 1

	SSTP2 [Z Score]	SSTP2 [No Transformation]
Number of Variables	7	7
Number of Clusters	7	5
Clustering Method	Ward's Method	Ward's Method
Cluster 1:	3M AKZO RB PG SOL	3M RB PG SOL BAY AKZO ABB JJ MSD
Cluster 2:	LUN SPL YAM	AVE NVA MER ROC AZ LUN BI
Cluster 3:	BAX	BAX
Cluster 4:	IVX NOV SAG	BMS SPL LIL WYE PFZ YAM GSK SAG IVX NOV
Cluster 5:	ABB BAY JJ AVE NVA BI ROC MER	PHR SS
Cluster 6:	AZ GSK WYE BMS LIL MSD PFZ	
Cluster 7:	PHR SS	

Figure 6.9 shows the Dendrogram for the Z scored data of variable set 1. The Dendrogram for the non standardized data is illustrated in Figure 6.10. The cluster solutions for the standardized and non standardized data, provided by the best cut test are again shown.

Figure 6.9 Dendrogram of clustering solution for variable set 1 [standardized data] achieved by Ward's Method.

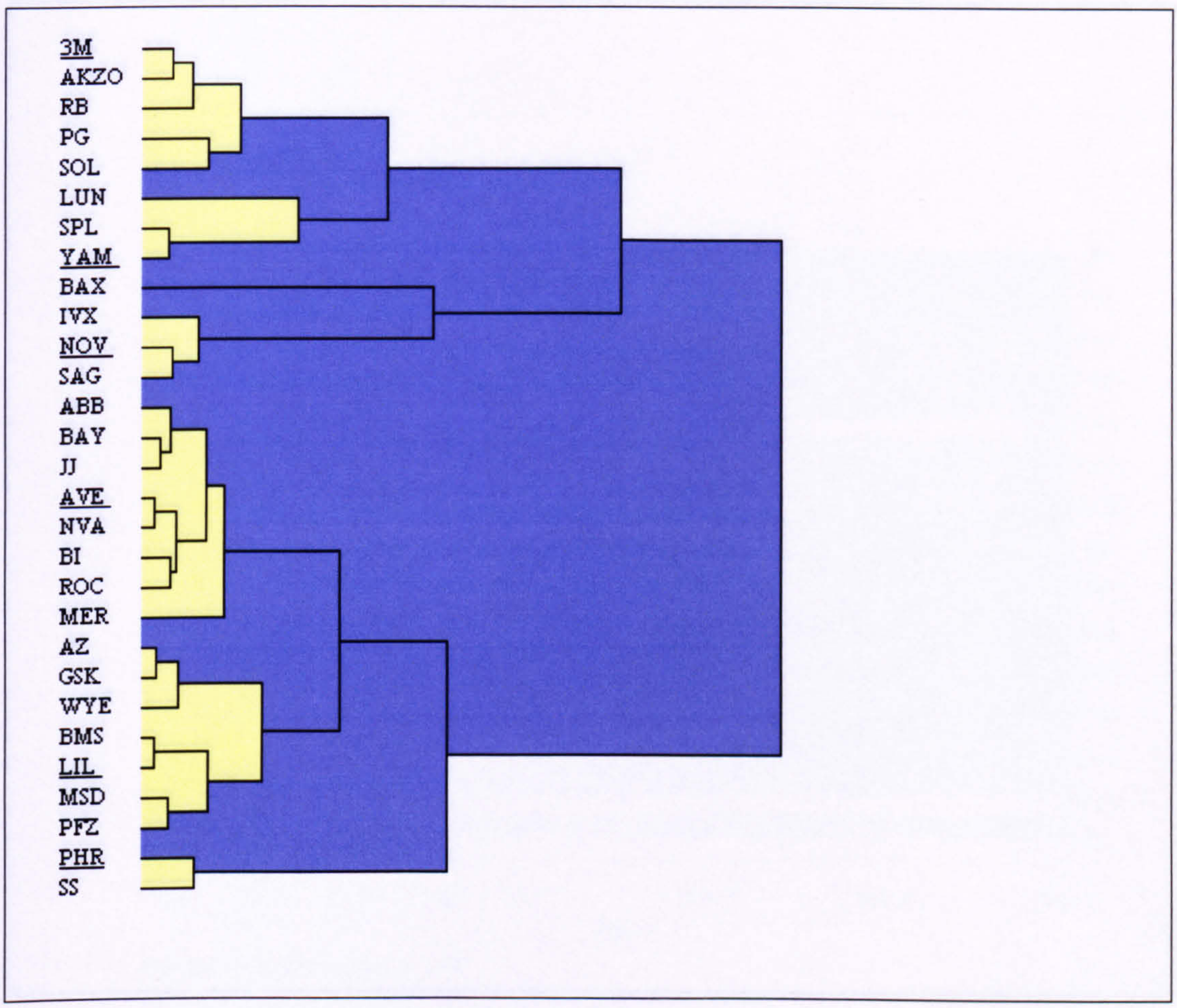


Figure 6.10. Dendrogram of clustering solution for variable set 1 [non standard data] achieved by Ward's Method

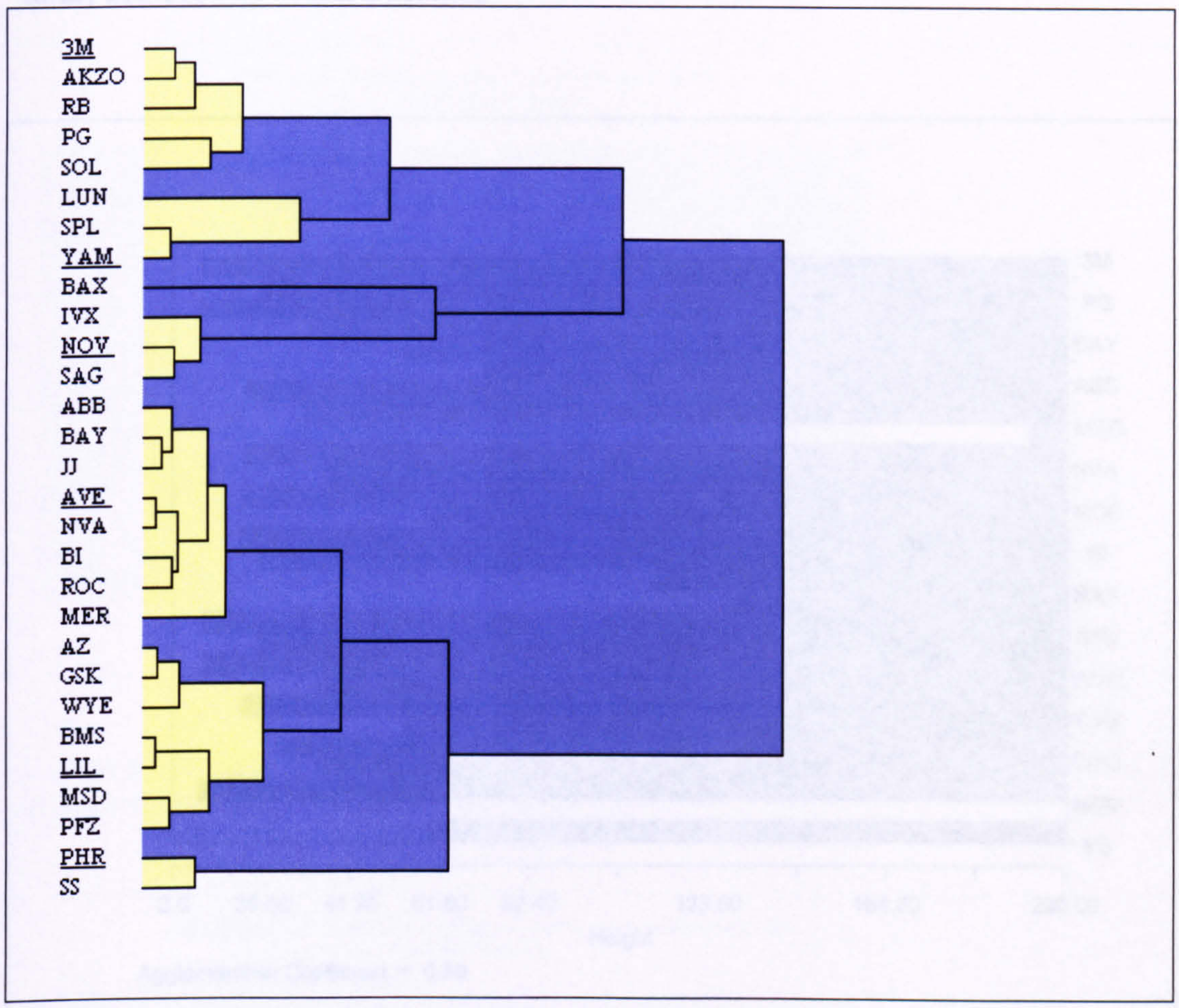
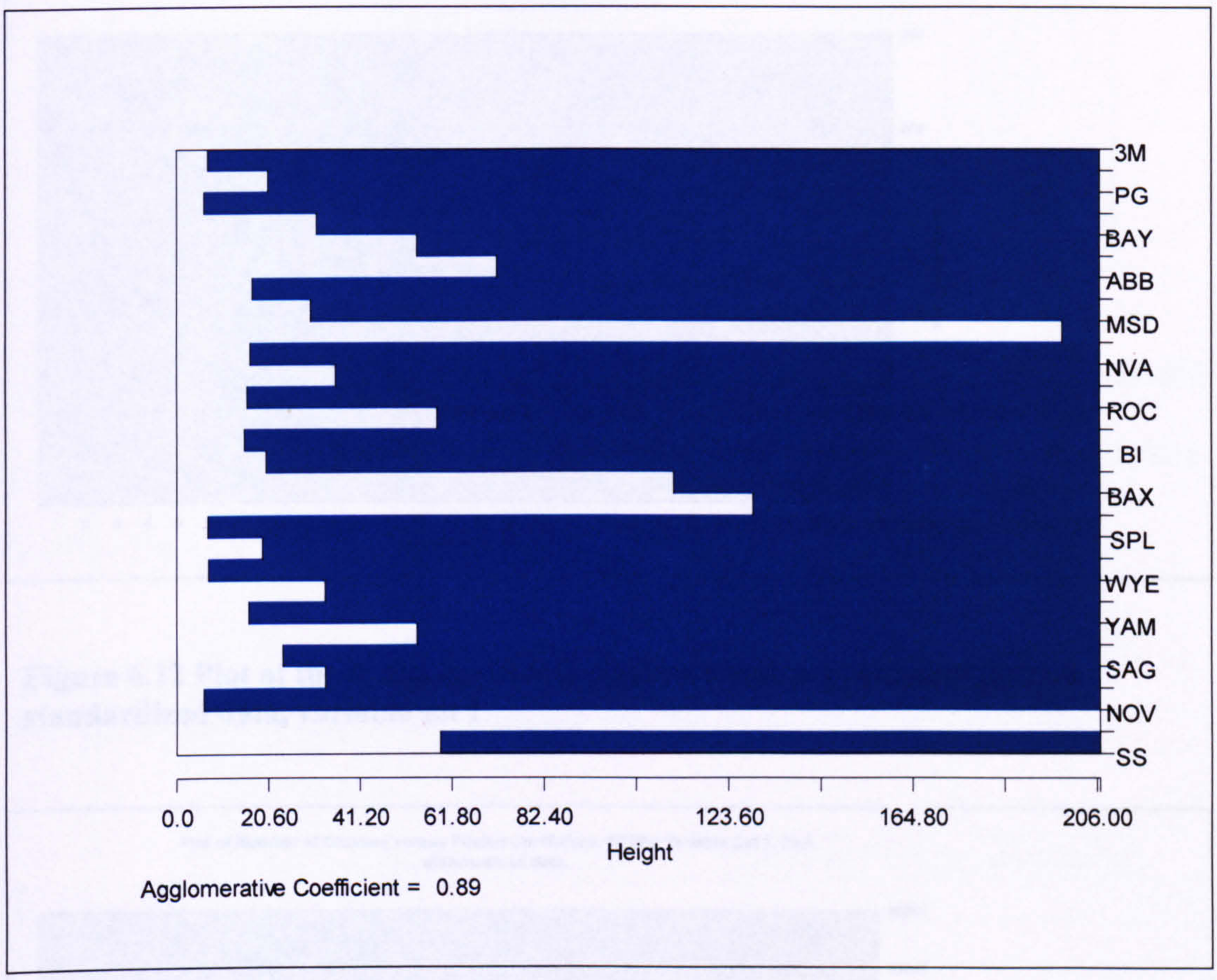


Figure 6.11 below, shows a banner plot of this same set of data. Here an agglomerative coefficient of 0.89 indicates that a very strong structure is again present within the data.

Figure 6.11 Banner Plot of clustering solution for variable set 1 [non standard data] achieved by Ward's Method



As previously, examination of the fusion coefficient together with the best cut upper tail significance test was used to determine the correct number of groups. The fusion graphs are illustrated in figures 6.11 and 6.12 and the upper tail test results are presented in table 6.22. (See appendix A for the agglomeration schedules for each of the fusion graphs.)

Figure 6.11 Plot of the fusion coefficient against number of clusters for standardized data, variable set 1

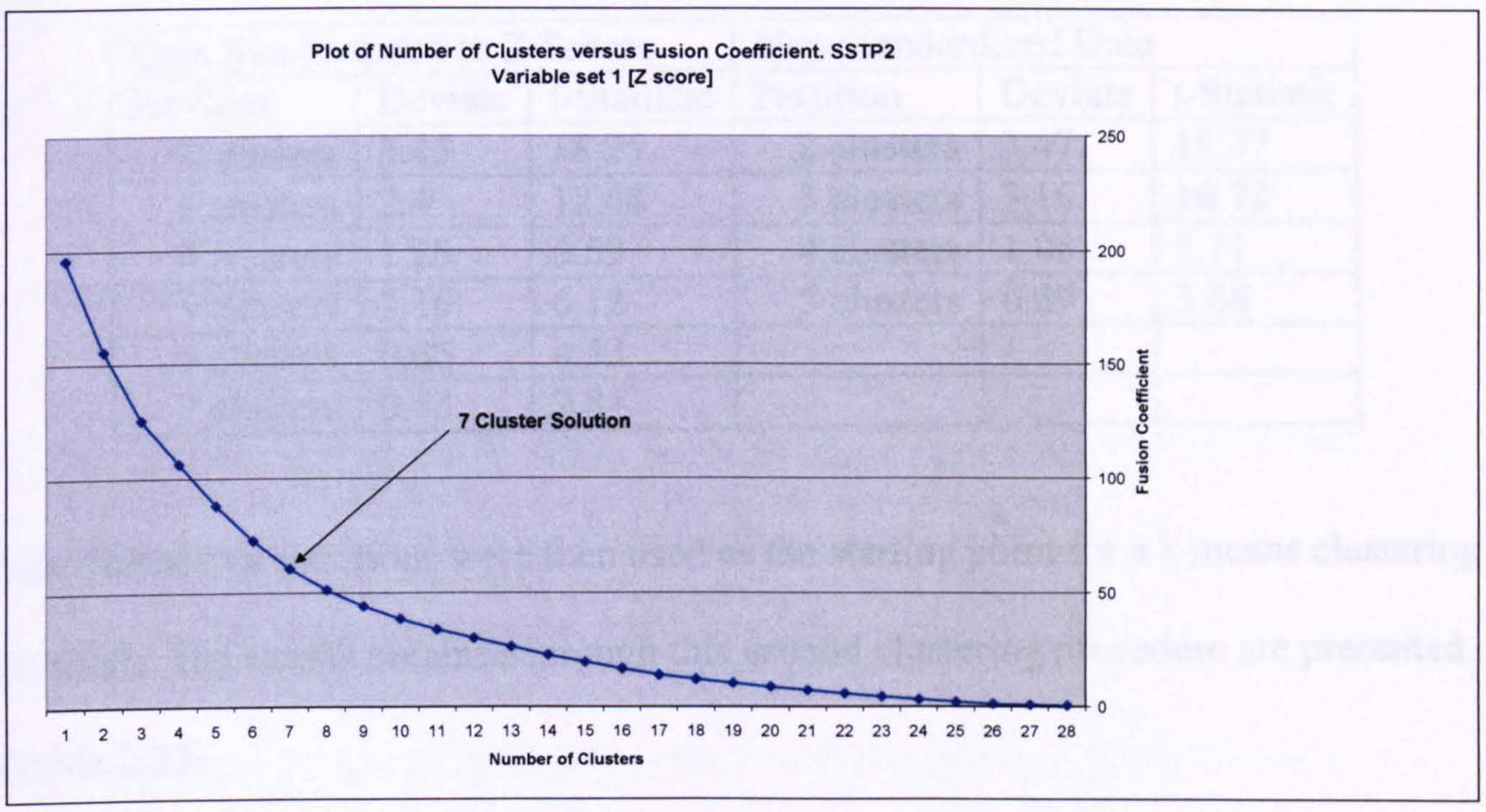
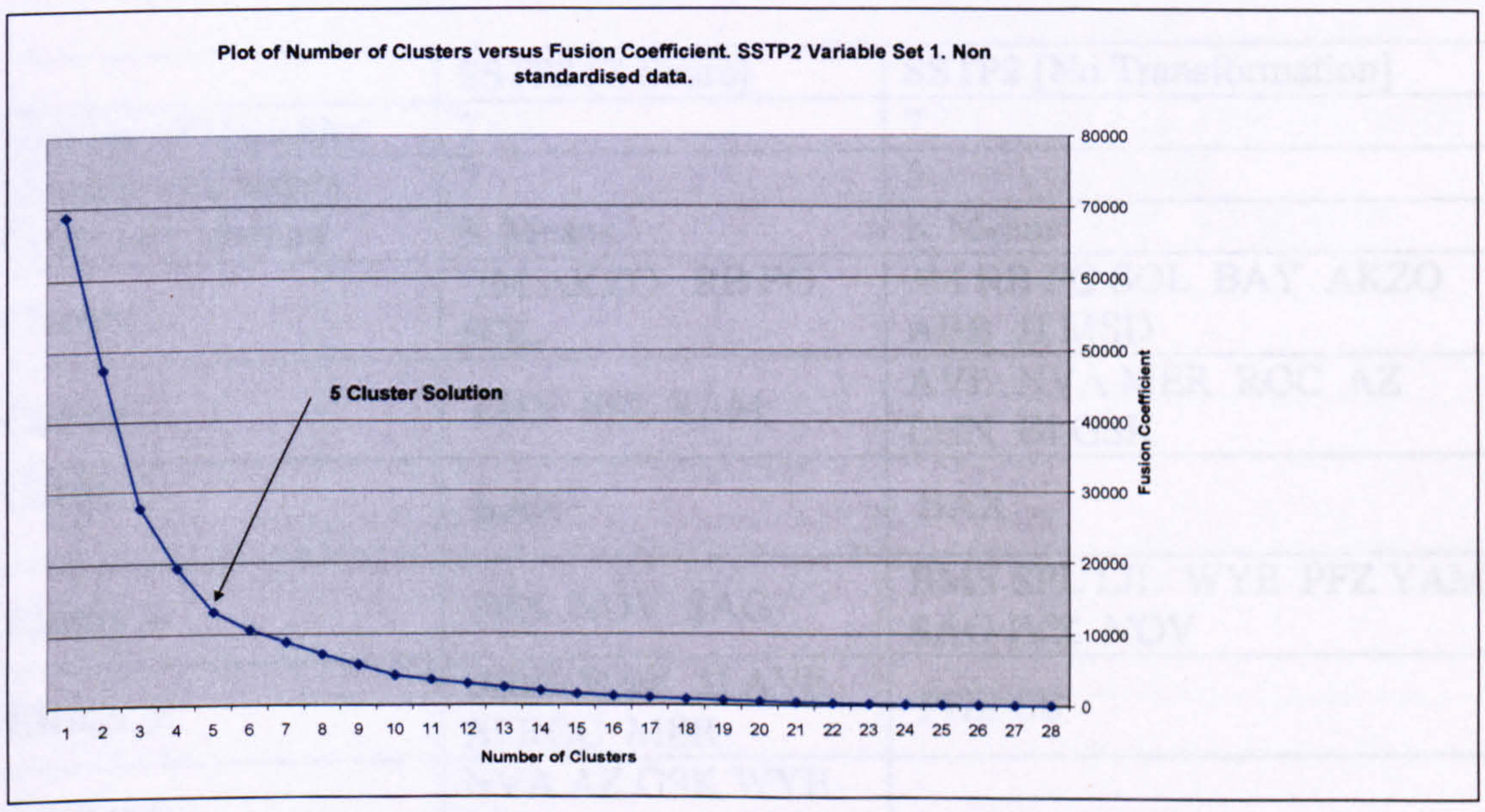


Figure 6.12 Plot of the fusion coefficient against number of clusters for non standardized data, variable set 1



The disparity between adjacent cluster solutions is particularly striking for the 5 cluster solution shown in figure 6.12.

Table 6.22 Upper tail test for the right cluster solution applied to variable set 1

Data Standardized to Z Scores			Non Standardized Data		
Partition	Deviate	t-Statistic	Partition	Deviate	t-Statistic
2 clusters	3.45	18.25	2 clusters	3.47	18.37
3 clusters	2.4	12.68	3 clusters	3.16	16.72
4 clusters	1.25	6.59	4 clusters	1.08	5.71
5 clusters	1.16	6.12	5 clusters	0.69	3.64
6 clusters	0.86	4.53			
7 clusters	0.53	2.81			

These initial tree partitions were then used as the starting point for a k means clustering algorithm. The results obtained through this second clustering procedure are presented in table 6.23.

Table 6.23 K Means Clustering Solution for SSTP2 Employing Variable Set 1

	SSTP2 [Z Score]	SSTP2 [No Transformation]
Number of Variables	7	7
Number of Clusters	7	5
Clustering Method	K Means	K Means
Cluster 1:	3M AKZO RB PG SOL	3M RB PG SOL BAY AKZO ABB JJ MSD
Cluster 2:	LUN SPL YAM	AVE NVA MER ROC AZ LUN BI GSK
Cluster 3:	BAX	BAX
Cluster 4:	IVX NOV SAG	BMS SPL LIL WYE PFZ YAM SAG IVX NOV
Cluster 5:	ABB BAY JJ AVE BI ROC MER	PHR SS
Cluster 6:	NVA AZ GSK WYE BMS LIL MSD PFZ	
Cluster 7:	PHR SS	

The changes delivered by this second clustering procedure are relatively minor. For the standardized data one change in membership is made with Novartis moving from

cluster 5 to cluster 6. With the non standardized data there was also one change with Glaxo Smith Kline moving from group 4 to group 2. These minor changes suggest that a strong cluster membership has been achieved. The same procedure was then repeated for Variable set 2.

6.6 SSTP2 Variable Set 2

The results of this initial cluster analysis for the first variable set, excluding DRUGST, PHARMA and SIZE are shown in table 6.24.

Table 6.24 Initial Clustering Solution for SSTP2 Employing Variable Set 2

	SSTP2 [Z Score]	SSTP2 [No Transformation]
Number of Variables	7	7
Number of Clusters	6	3
Clustering Method	Ward's Method	Ward's Method
Cluster 1:	3M AKZO SOL YAM	3M NOV BAX IVX RB BAY MSD SAG AVE NVA GSK ABB BMS LIL PFZ SPL WYE JJ SOL PG YAM
Cluster 2:	LUN	AKZO MER AZ BI ROC LUN
Cluster 3:	BAX IVX RB	PHR SS
Cluster 4:	ABB BAY BMS JJ MER MSD PG LIL PFZ	
Cluster 5:	AVE NVA ROC AZ GSK BI WYE NOV SAG SPL	
Cluster 6:	PHR SS	

The clustering results for the second set of variables reveal a marked change in structure, particularly for the non standardized variables where the number of groups found dropped from 5 to 3. As before, the best cut upper tail significance test and examination of the change in fusion coefficient were used to determine the correct

number of groups. The fusion process is illustrated in figures 6.13 and 6.14 and the results of the upper tail significance test are presented in table 6.25.

Figure 6.13 Plot of the fusion coefficient against number of clusters for standardized data, variable set 2

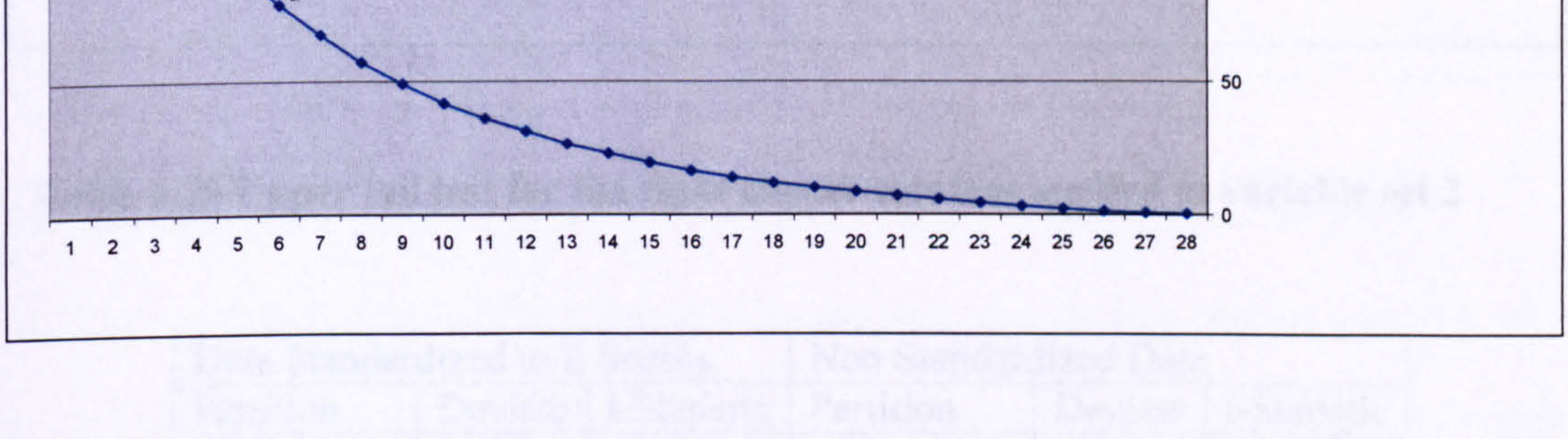


Figure 6.14 Plot of the fusion coefficient against number of clusters for standardized data, variable set 2

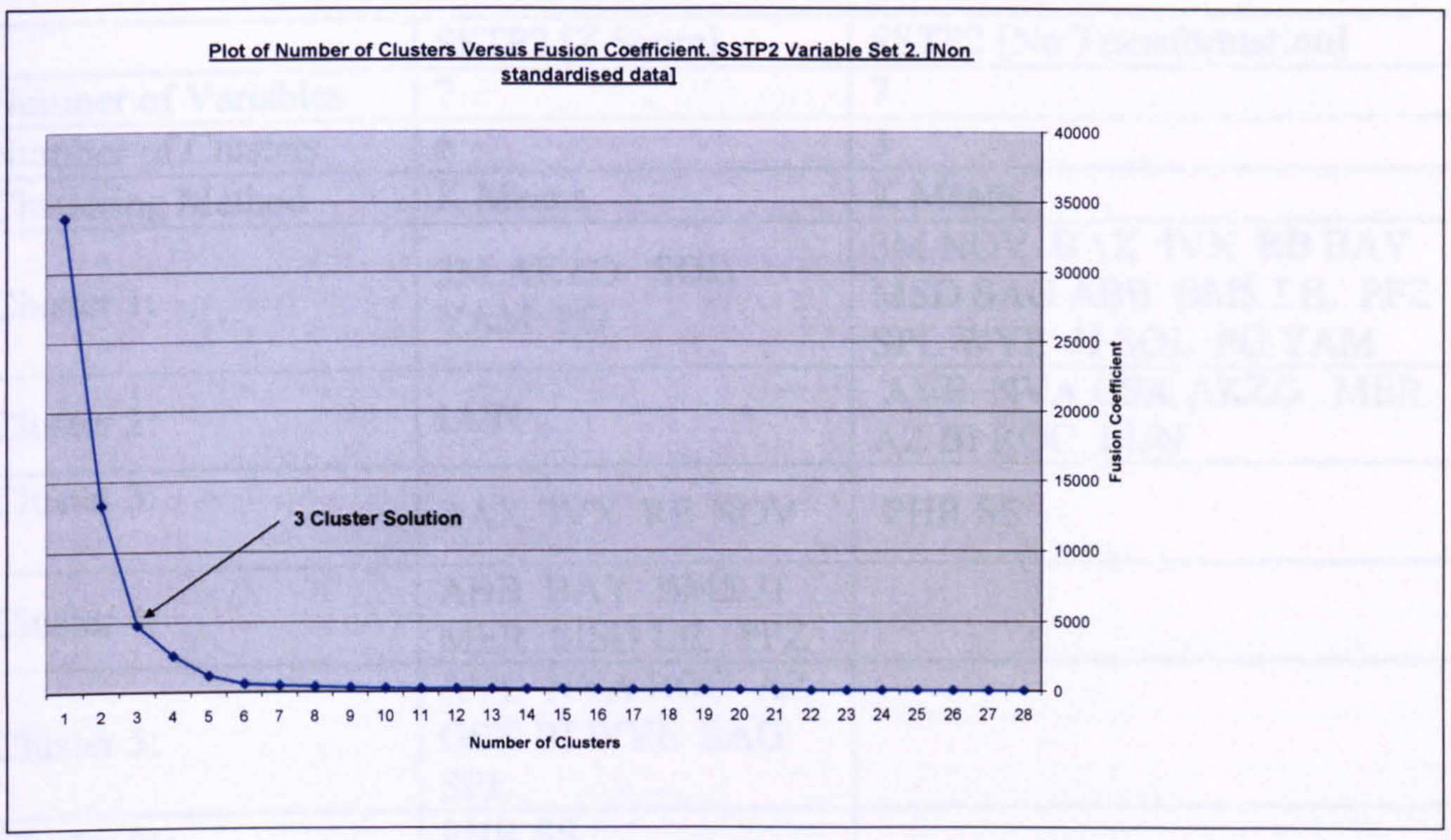


Table 6.25 Upper tail test for the right cluster solution applied to variable set 2

Data Standardized to Z Scores			Non Standardized Data		
Partition	Deviate	t-Statistic	Partition	Deviate	t-Statistic
2 clusters	3.5	18.53	2 clusters	4.68	24.77
3 clusters	2.2	11.63	3 clusters	1.76	9.33
4 clusters	1.42	7.54			
5 clusters	1.12	5.92			
6 clusters	0.71	3.73			

The appropriate tree partitions were then used as the starting point for a k means algorithm. These results are presented in table 6.26.

Table 6.26 K Means Clustering Solution for SSTP2 Employing Variable Set 2

	SSTP2 [Z Score]	SSTP2 [No Transformation]
Number of Variables	7	7
Number of Clusters	6	3
Clustering Method	K Means	K Means
Cluster 1:	3M AKZO SOL YAM PG	3M NOV BAX IVX RB BAY MSD SAG ABB BMS LIL PFZ SPL WYE JJ SOL PG YAM
Cluster 2:	LUN	AVE NVA GSK AKZO MER AZ BI ROC LUN
Cluster 3:	BAX IVX RB NOV	PHR SS
Cluster 4:	ABB BAY BMS JJ MER MSD LIL PFZ	
Cluster 5:	AVE NVA ROC AZ GSK BI WYE SAG SPL	
Cluster 6:	PHR SS	

This second clustering produces a few changes to the initial solution. For the standardized data set Proctor and Gamble moves from cluster 4 to cluster 1 and Novo is moved from cluster 5 to cluster 3. With the non standardized data set Aventis, Novartis and Glaxo are moved from cluster 1 to cluster 2. The greater change observed with this clustering process may suggest a less stable clustering solution.

Given the fact that the two sets of variables do not produce a very close solution, it was then decided to repeat the results with the full data set using *principal component analysis*. This approach is recommended as an alternative way to avoid the problem of multicollinearity (Ketchen *et al.*, 1996; Punj *et al.*, 1983). As before this procedure was carried out using both standardized and non standardized data. Five principal components were found to represent 89% of the data set. (For the principal component scores, see appendix A.)

6.7 SSTP2 Employing a full set of variables

The principle component scores for the standardized and non standardized data set were then first clustered using Ward's method. The results of this procedure are shown in table 6.27.

Table 6.27 Initial Clustering Solution for SSTP2 Employing Full Variable Set and Principle Component Analysis

	SSTP2 [Z Score]	SSTP2 [No Transformation]
Number of Variables	5	5
Number of Clusters	7	4
Clustering Method	Ward's Method	Ward's Method
Cluster 1:	3M AKZO PG SOL RB	3M RB PG SOL BAY ABB JJ MSD AKZO
Cluster 2:	IVX NOV YAM	AVE NVA GSK SAG AZ BI LUN MER ROC BAX
Cluster 3:	LUN	BMS SPL LIL WYE PFZ YAM IVX NOV
Cluster 4:	ABB BAY JJ MER AVE NVA ROC BI SAG SPL	PHR SS
Cluster 5:	AZ GSK BMS LIL WYE MSD PFZ	
Cluster 6:	PHR SS	
Cluster 7:	BAX	

As before, the best cut upper tail significance test and examination of the change in fusion coefficient were used to determine the correct number of groups. The fusion process is illustrated in figures 6.15 and 6.16 and the results of the upper tail significance test are presented in table 6.28.

Figure 6.15 Plot of the fusion coefficient against number of clusters for standardized data, full variable set SSTP2 based on principal components

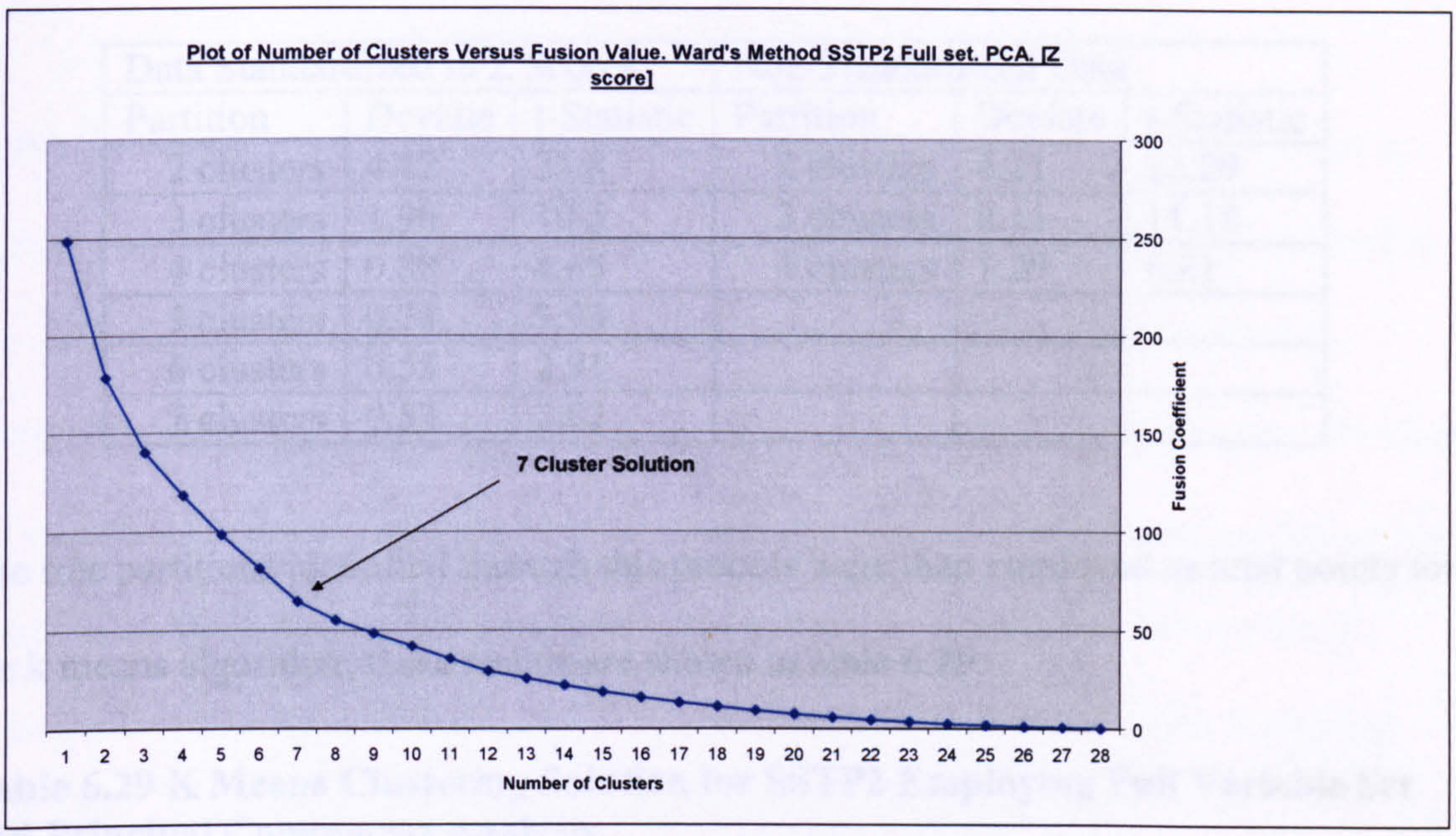


Figure 6.16 Plot of the fusion coefficient against number of clusters for non standardized data, full variable set SSTP2 based on principal components

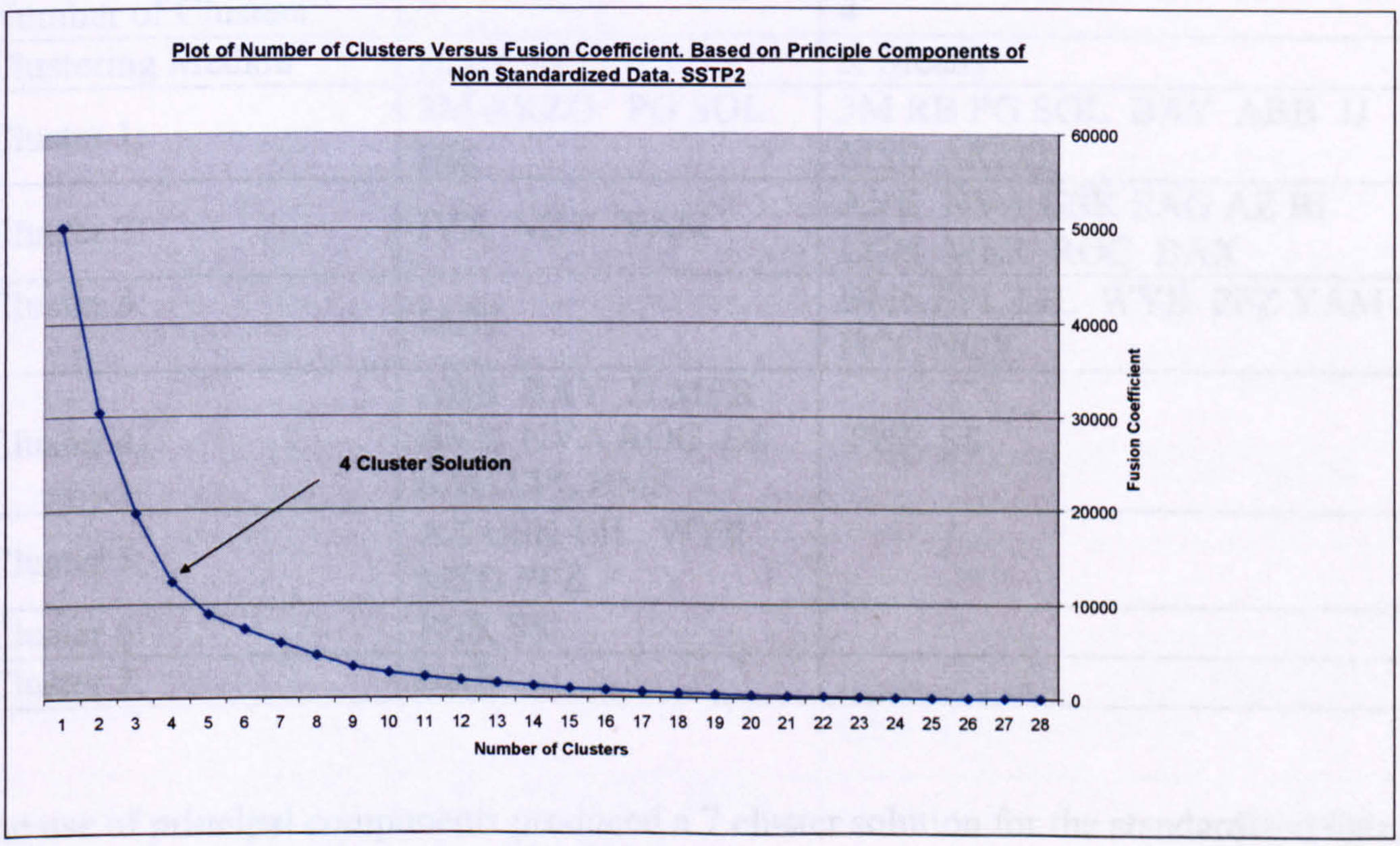


Table 6.28 Upper tail test for the right cluster solution applied to full variable set SSTP2. [Based upon principal components]

Data Standardized to Z Scores			Non Standardized Data		
Partition	Deviate	t-Statistic	Partition	Deviate	t-Statistic
2 clusters	4.12	21.8	2 clusters	4.21	22.29
3 clusters	1.98	10.5	3 clusters	2.11	11.18
4 clusters	0.88	4.65	4 clusters	1.29	6.81
5 clusters	0.74	3.93			
6 clusters	0.55	2.91			
7 clusters	0.53	2.82			

The tree partitions identified through this process were then employed as seed points for the k means algorithm; these results are shown in table 6.29.

Table 6.29 K Means Clustering Solution for SSTP2 Employing Full Variable Set and Principal Component Analysis.

	SSTP2 [Z Score]	SSTP2 [No Transformation]
Number of Variables	5	5
Number of Clusters	7	4
Clustering Method	K Means	K Means
Cluster 1:	3M AKZO PG SOL RB	3M RB PG SOL BAY ABB JJ MSD AKZO
Cluster 2:	IVX NOV YAM	AVE NVA GSK SAG AZ BI LUN MER ROC BAX
Cluster 3:	LUN	BMS SPL LIL WYE PFZ YAM IVX NOV
Cluster 4:	ABB BAY JJ MER AVE NVA ROC BI SAG SPL BMS	PHR SS
Cluster 5:	AZ GSK LIL WYE MSD PFZ	
Cluster 6:	PHR SS	
Cluster 7:	BAX	

The use of principal components produced a 7 cluster solution for the standardized data, which agrees with the 7 cluster first variable set in terms of 3 out of the 7 clusters, although the membership of the other 4 clusters is not identical; 14 out of the remaining 21 firms are classified in the same groups. The result for the non standardized data

produced a 4 cluster solution, which is midway between the 5 and 3 cluster solutions achieved with the first and second set of variables respectively.

It was discussed in the previous chapter that avoiding multicollinearity may in fact act against the accurate description of strategic choice, where the example cited referred to the synergy achieved between advertising and sales calls. In order to include this possibility within the classification of strategy, a final clustering analysis was performed for all variables in the SSTP set. As before, this analysis included both standardized and non standardized data and the same two step clustering procedure involving Ward's method used in conjunction with the K means algorithm. The result of the clustering analysis employing Ward's method is shown in table 6.30.

Table 6.30 Initial Clustering Solution for SSTP2 Employing Full Variable Set and Principal Component Analysis.

	SSTP2 [Z Score]	SSTP2 [No Transformation]
Number of Variables	10	10
Number of Clusters	7	5
Clustering Method	Ward's Method	Ward's Method
Cluster 1:	3M AKZO SOL PG RB	3M RB PG SOL BAY AKZO ABB JJ MSD
Cluster 2:	IVX NOV	AVE NVA MER ROC AZ BI LUN
Cluster 3:	LUN YAM	BAX
Cluster 4:	ABB BAY JJ MER AVE NVA ROC BI SAG SPL	BMS SPL LIL WYE PFZ YAM GSK SAG IVX NOV
Cluster 5:	AZ GSK WYE BMS LIL PFZ MSD	PHR SS
Cluster 6:	PHR SS	
Cluster 7:	BAX	

As in the previous analyses, the best cut upper tail significance test and examination of the change in fusion coefficient were used to determine the correct number of groups. The fusion result is illustrated in figures 6.17 and 6.18 and the results of the upper tail significance test are presented in table 6.31.

Figure 6.17 Plot of the fusion coefficient against number of clusters for standardized data, full variable set SSTP2

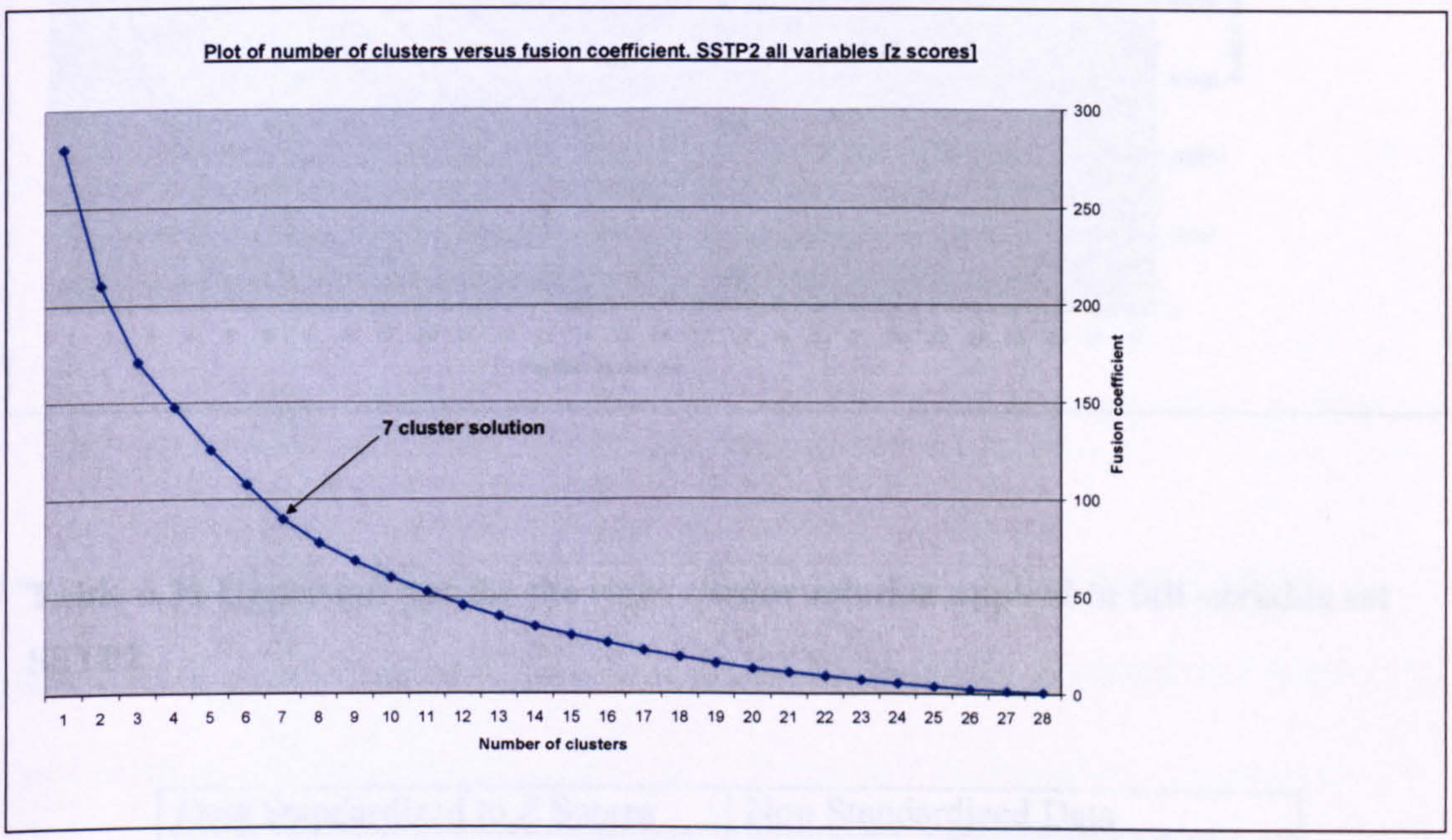


Figure 6.18 Plot of the fusion coefficient against number of clusters for non standardized data, full variable set SSTP2

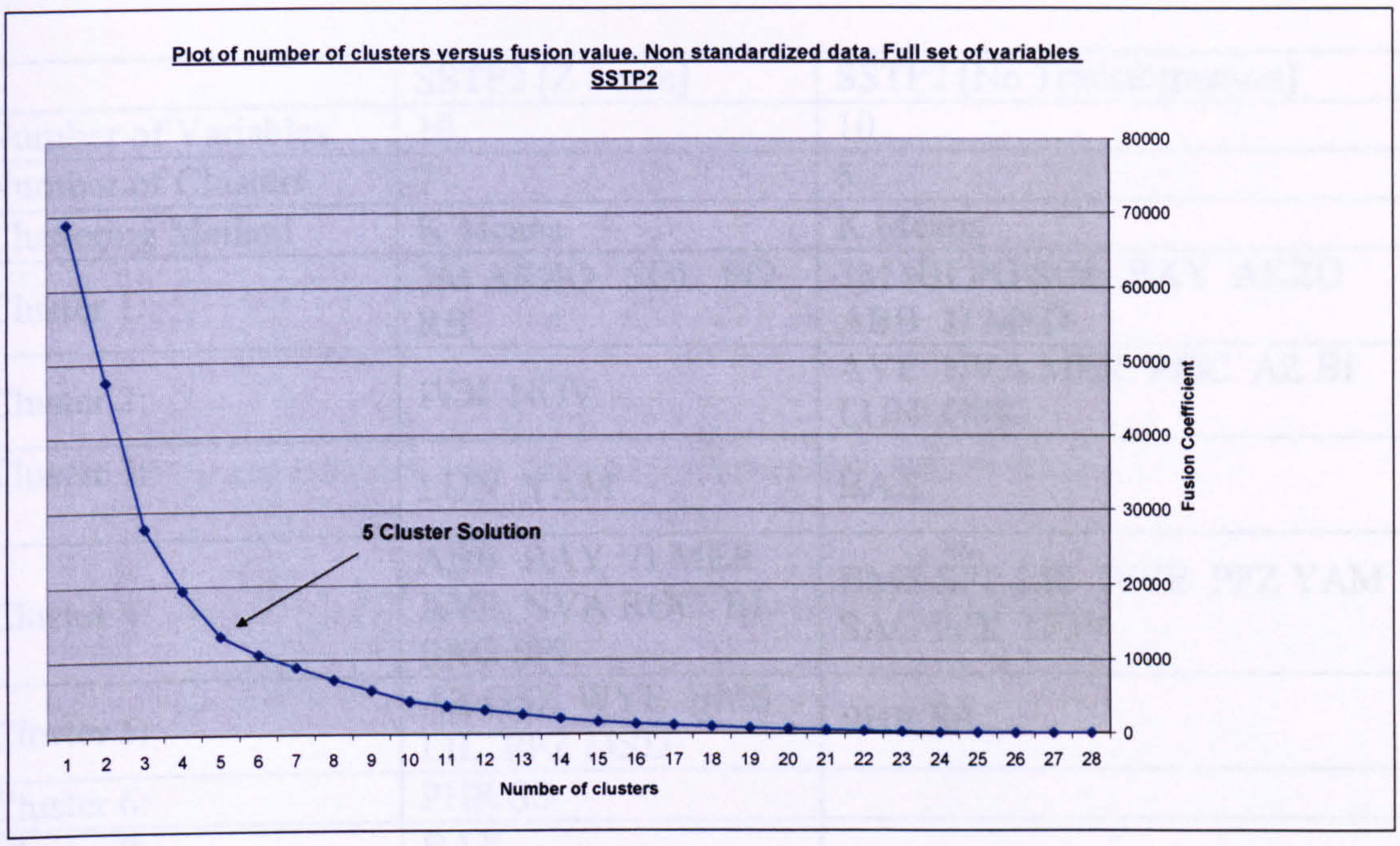


Table 6.31 Upper tail test for the right cluster solution applied to full variable set SSTP2

Data Standardized to Z Scores			Non Standardized Data		
Partition	Deviate	t-Statistic	Partition	Deviate	t-Statistic
2 clusters	4.07	21.52	2 clusters	3.47	18.37
3 clusters	1.99	10.51	3 clusters	3.16	16.73
4 clusters	0.91	4.8	4 clusters	1.08	5.71
5 clusters	0.81	4.29	5 clusters	0.69	3.63
6 clusters	0.54	2.85			
7 clusters	0.52	2.77			

The identified tree partitions were then used as seed points for a k means algorithm. The results of this analysis are presented in table 6.32.

Table 6.32 K Means Clustering Solution for SSTP2 Employing Full Variable Set

	SSTP2 [Z Score]	SSTP2 [No Transformation]
Number of Variables	10	10
Number of Clusters	7	5
Clustering Method	K Means	K Means
Cluster 1:	3M AKZO SOL PG RB	3M RB PG SOL BAY AKZO ABB JJ MSD
Cluster 2:	IVX NOV	AVE NVA MER ROC AZ BI LUN GSK
Cluster 3:	LUN YAM	BAX
Cluster 4:	ABB BAY JJ MER AVE NVA ROC BI SAG SPL	BMS SPL LIL WYE PFZ YAM SAG IVX NOV
Cluster 5:	AZ GSK WYE BMS LIL PFZ MSD	PHR SS
Cluster 6:	PHR SS	
Cluster 7:	BAX	

The clustering solution based on standardized data is very similar to the solution obtained through principal components analysis. There are however two differences: Yamanouchi is placed in cluster 2 not 3, and Bristol Myers Squibb is classified in cluster 5 not 4. The analysis based upon non standardized data is again similar, but with a few differences. Here, Baxter is placed into a group of its own and Schering AG is classified in the same group as Schering Plough.

Which grouping best represents strategy within the UK pharmaceutical industry from 1998 to 2002? To answer this question the alternative analyses were compared using three principal confirmatory procedures. First, they were compared on their ability to produce clusters based on differences between group means. As discussed earlier, although this does not validate the clusters, it is to be expected that an efficient clustering procedure will produce statistically distinct clusters. Second, a bootstrapping procedure was used to check that a replication of the data set contains a similar set of

"natural clusters". Finally, each of the groups was compared against relevant strategic variables that were not used in the clustering procedure to test for external validity.

The test between group means was carried out using the Kruskal Wallis one way analysis of variance test and the results are presented in tables 6.33 and 6.34.

Table 6.33 Kruskal-Wallis test on split variables between groups – SSTP2

Clustering Based Upon	Z Scores			Non standardized variables		
Number of Clusters	7			5		
Variable set 1	Chi-Square	df	Sig	Chi-Square	df	Sig
BRANGEN	24.100	6	0.001	4.634	4	0.327
DRUGST	14.418	6	0.025	7.172	4	0.127
FOREIGN	6.782	6	0.341	19.276	4	0.001
MAINT	10.536	6	0.104	4.851	4	0.303
PHARMA	21.882	6	0.001	21.124	4	0.0003
PROFPROM	16.736	6	0.010	6.563	4	0.161
SIZE	22.102	6	0.001	4.272	4	0.370
Number of Clusters	6			3		
Variable set 2	Chi-Square	df	Sig	Chi-Square	df	Sig
BRANGEN	17.371	5	0.004	1.076	2	0.584
FOCUS	10.800	5	0.055	3.080	2	0.214
FOREIGN	13.342	5	0.020	20.483	2	0.00004
MAINT	17.408	5	0.004	1.785	2	0.410
PRODSTR	23.362	5	0.0003	7.945	2	0.019
PROFPROM	15.802	5	0.007	1.387	2	0.500
RDI	14.727	5	0.012	4.931	2	0.085

Table 6.34 Kruskal-Wallis test on full variable set between groups – SSTP2

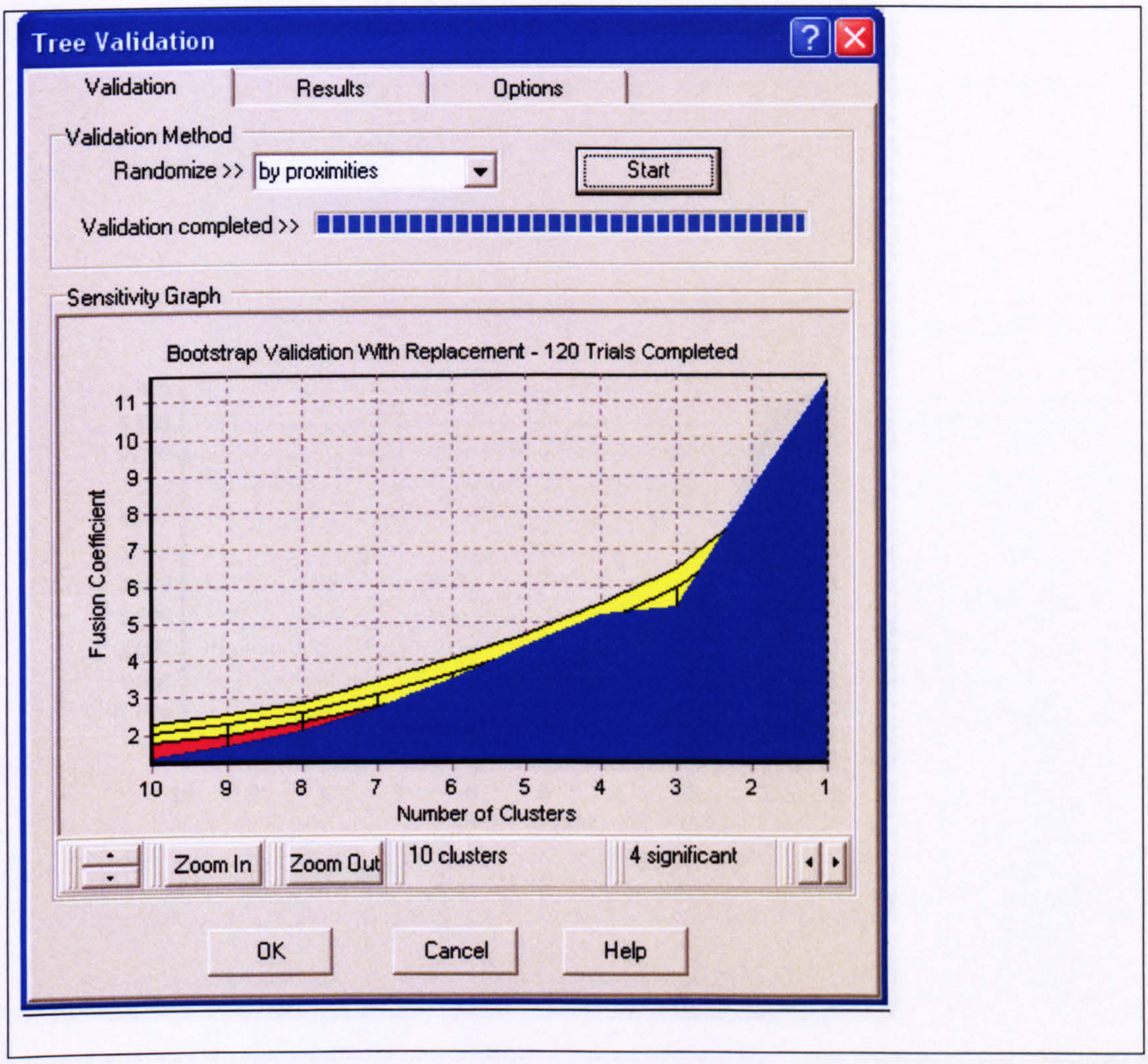
Clustering Based Upon	Z Scores			Non standardized variables		
Number of Clusters	7			4		
Principle Components	Chi-Square	df	Sig	Chi-Square	df	Sig
BRANGEN	22.190	6	0.001	0.883	3	0.830
DRUGST	21.397	6	0.002	8.058	3	0.045
FOCUS	21.990	6	0.001	7.288	3	0.063
FOREIGN	8.642	6	0.195	18.895	3	0.0003
MAINT	10.674	6	0.099	1.655	3	0.647
PHARMA	18.466	6	0.005	19.431	3	0.0002
PRODSTR	21.473	6	0.002	9.265	3	0.026
PROFPROM	10.426	6	0.108	4.777	3	0.189
RDI	16.152	6	0.013	14.835	3	0.002
SIZE	20.994	6	0.002	2.473	3	0.480
Number of Clusters	7			5		
Full Set of Variables	Chi-Square	df	Sig	Chi-Square	df	Sig
BRANGEN	23.058	6	0.001	4.634	4	0.327
FOCUS	21.302	6	0.002	8.034	4	0.090
FOREIGN	6.936	6	0.327	19.276	4	0.001
MAINT	7.675	6	0.263	4.851	4	0.303
PRODSTR	21.145	6	0.002	10.287	4	0.036
PROFPROM	14.917	6	0.021	6.563	4	0.161
RDI	14.544	6	0.024	17.413	4	0.002
DRUGST	19.129	6	0.004	7.172	4	0.127
PHARMA	19.316	6	0.004	21.124	4	0.0003
SIZE	21.208	6	0.002	4.272	4	0.370

It is reassuring that all of the cluster solutions meet some criteria of internal validity, i.e. the clusters differ significantly across at least one variable. The clustering procedure therefore appears to have been robust.

Next the bootstrap tree validation method was used to confirm that each of the cluster solutions was significantly different from random and therefore that the clusters found appear to be a component of a natural structure existing within the data set. The first two analyses comprising tests on variable set 1 are shown in figures 6.19 and 6.20 by

way of illustration. The remaining tree validation procedures, together with the agglomeration procedures which they generate, can be found in Appendix A.

Figure 6.19 Bootstrap Tree Validation of Variable Set 1 SSTP2 [Z Score]



The above figure 6.19 illustrates that there is natural structure in the data and identifies that the ten cluster solution differs most significantly from random. But four of the total number of partitions present in the data are significantly different at the 5% level.[38] This

[38] "This tree validation procedure compares a tree obtained for a given dataset with the family of trees generated by random permutation of the same data or the associated proximity matrix. A distribution is obtained for the set of trees from the randomly permuted data and a confidence interval is constructed

procedure seeks to reject the underlying hypothesis that the data are randomly distributed (Wishart, 2004).

Figure 6.20 Bootstrap Tree Validation of Variable Set 1 SSTP2 [Non standardized]

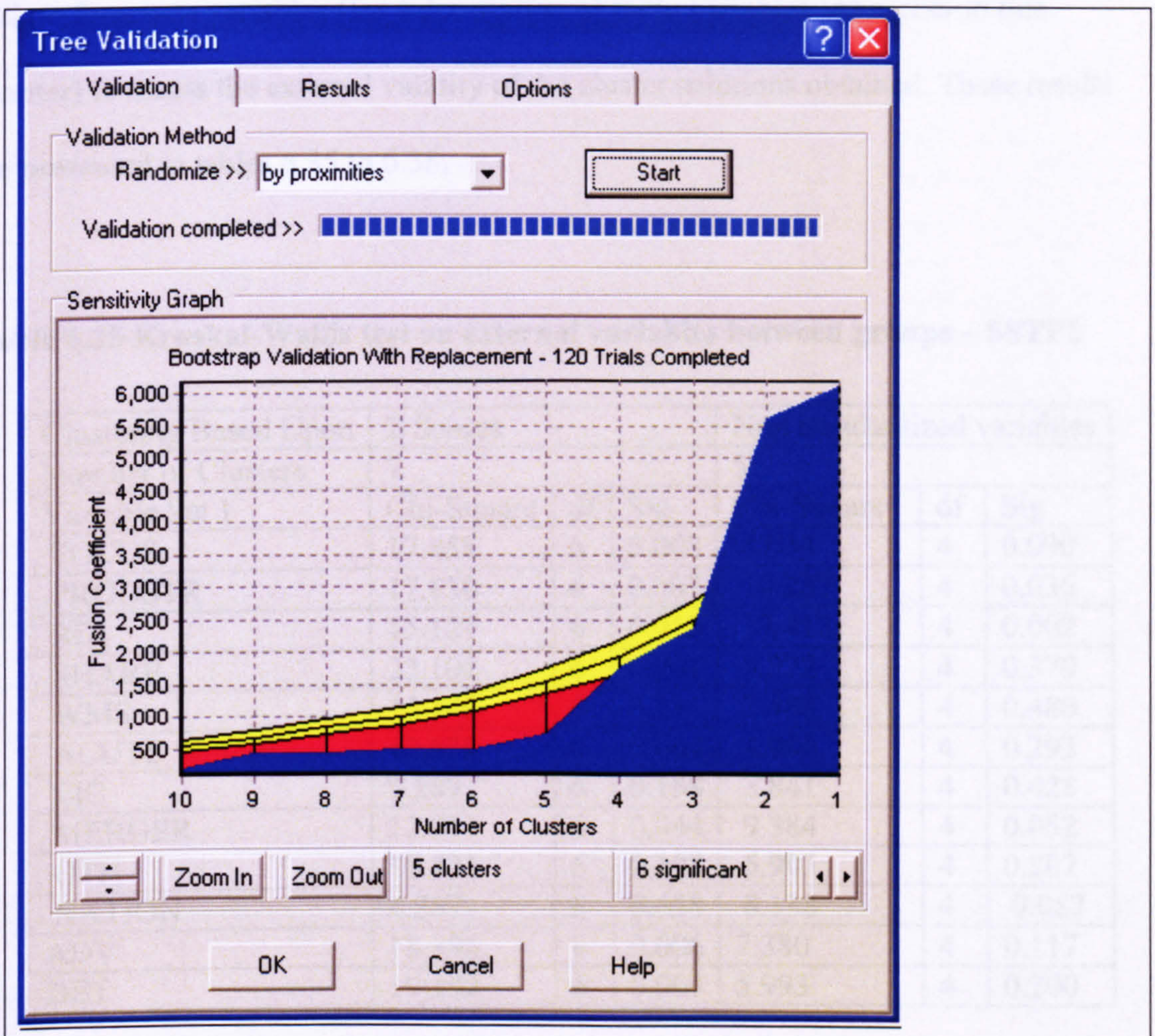


Figure 6.20 shows that a natural structure is present within the non-standardized data. with the five cluster solution departing most significantly from random and six of the total number of partitions significant at the 5% level. In both bootstrap cases illustrated

---

around the mean. The tree for the given data is then compared with this confidence interval and significant departures from random identified" (Wishart, 2004).

above the results indicate that true structure appears to be present in the data i.e. that the clusters found are unlikely to be an artifact of the method applied.

Finally, the clustering solutions were each validated against relevant strategic choice and performance variables (for a description of these variables see earlier in this chapter) to assess the external validity of the cluster solutions obtained. These results are presented in tables 6.35 to 6.38.

Table 6.35 Kruskal-Wallis test on external variables between groups – SSTP2

Clustering Based Upon	Z Scores			Non standardized variables		
Number of Clusters	7			5		
Variable Set 1	Chi-Square	df	Sig	Chi-Square	df	Sig
FOCUS	17.458	6	0.008	8.034	4	0.090
PRODSTR	17.810	6	0.007	10.287	4	0.036
RDI	15.121	6	0.019	17.413	4	0.002
SHARE	22.102	6	0.001	4.272	4	0.370
WMS	16.140	6	0.13	3.488	4	0.480
ACUTE	12.939	6	0.044	4.946	4	0.293
LIC	9.289	6	0.158	3.841	4	0.428
MERGER	12.911	6	0.044	9.384	4	0.052
OTH	10.431	6	0.108	5.903	4	0.207
NATION	4.287	6	0.638	8.138	4	0.087
ADV	18.198	6	0.006	7.380	4	0.117
DET	19.182	6	0.004	5.993	4	0.200

These results indicate that both the standardized and non standardized variable sets produced significant clusters that appear externally valid. The cluster solution based upon z scores appears to more precisely represent strategic choices because, out of the 12 strategic and performance variables compared between groups, 8 are significant at the 5% level. This compares to 3 significant results achieved by the clustering solution based upon non standardized data.

The comparisons for variable set 2 are shown in table 6.37.

Table 6.36 Kruskal-Wallis test on external variables between groups – SSTP2

Clustering Based Upon	Z Scores			Non standardized variables		
Number of Clusters	6			3		
Variable Set 2	Chi-Square	df	Sig	Chi-Square	df	Sig
DRUGST	8.030	5	0.155	3.234	2	0.199
PHARMA	9.358	5	0.096	0.585	2	0.746
SIZE	16.841	5	0.005	2.037	2	0.361
SHARE	16.841	5	0.005	2.037	2	0.361
WMS	7.015	5	0.220	1.074	2	0.584
ACUTE	9.744	5	0.083	1.857	2	0.395
LIC	11.033	5	0.051	1.189	2	0.552
MERGER	12.846	5	0.025	7.779	2	0.020
OTH	7.054	5	0.217	4.362	2	0.113
NATION	5.629	5	0.344	6.894	2	0.032
ADV	17.336	5	0.004	4.789	2	0.091
DET	15.878	5	0.007	3.043	2	0.218

Both sets of clusters appear externally valid and once again the clusters based upon z scores appear to provide a more precise classification of strategic choice, achieving 5 significant results compared to 2 for the non-standardized data.

The comparison between clusters based upon principal component scores is presented in table 6.37.

Table 6.37 Kruskal-Wallis test on external variables between groups – SSTP2

Clustering Based Upon	Z Scores			Non standardized variables		
Number of Clusters	7			4		
PCA Scores Used	Chi-Square	df	Sig	Chi-Square	df	Sig
SHARE	20.994	6	0.002	2.473	3	0.480
WMS	15.325	6	0.018	3.027	3	0.387
ACUTE	15.414	6	0.017	3.547	3	0.315
LIC	10.378	6	0.110	1.316	3	0.725
MERGER	10.966	6	0.89	6.656	3	0.084
OTH	11.418	6	0.076	3.518	3	0.318
NATION	6.473	6	0.372	6.538	3	0.088
ADV	21.750	6	0.001	3.554	3	0.314
DET	20.706	6	0.002	2.465	3	0.482

The cluster solution based upon z scores achieved external validation through achieving significance, at the 5% level, in 5 out of 9 relevant strategic variables. A further variable OTH [products not a result of the company's original research nor subject to a licensing agreement] was significant at the 10% level. The clustering solution based on principal components of non standardized variables failed to achieve external validation and recorded no significant differences based upon the 9 strategic variables tested.

The clustering solution based upon all ten strategic variables but without allowing for multicollinearity is shown in table 6.38.

Table 6.38 Kruskal-Wallis test on external variables between groups – SSTP2

Clustering Based Upon	Z Scores			Non standardized variables		
Number of Clusters	7			5		
All variables included	Chi-Square	df	Sig	Chi-Square	df	Sig
SHARE	21.208	6	0.002	4.272	4	0.370
WMS	14.440	6	0.025	3.488	4	0.480
ACUTE	16.898	6	0.10	4.946	4	0.293
LIC	10.415	6	0.108	3.841	4	0.428
MERGER	10.518	6	0.104	9.384	4	0.052
OTH	9.512	6	0.147	5.903	4	0.207
NATION	8.638	6	0.195	8.138	4	0.087
ADV	18.917	6	0.004	7.380	4	0.117
DET	18.844	6	0.004	5.993	4	0.200

Here the full set of standardized variables achieved external validation with 4 out of 9 significantly different strategic and performance variables. The clustering solution based upon non standardized variables failed to achieve significance across a single strategic variable.

In concluding this section, both variable sets 1 and 2 performed well producing externally valid groupings for both standardized and non standardized data. The use of principal component scores and the full variable set did not appear to significantly improve the quality of the clustering solution, but did provide additional verification for some of the groupings. The common links across the four clustering solutions based upon Z scores are shown in table 6.39.

Table 6.39 Common Links Across Strategic Group Clustering Solutions

	Variable Set 1	Variable Set 2	Principal Components	Full Set of Variables
Group A	3M AKZO RB PG SOL	3M AKZO SOL **YAM** PG	3M AKZO PG SOL RB	3M AKZO SOL PG RB
Group B	LUN **SPL YAM**	LUN	LUN	LUN **YAM**
Group C	IVX NOV **SAG**	**BAX** IVX **RB** NOV	IVX NOV **YAM**	IVX NOV
Group D	BAX	-	BAX	BAX
Group E	ABB BAY JJ AVE BI ROC MER	ABB BAY BMS JJ MER **MSD LIL PFZ**	ABB BAY JJ MER AVE **NVA** ROC BI **SAG SPL BMS**	ABB BAY JJ MER AVE **NVA** ROC BI **SAG SPL**
Group F	NVA AZ GSK WYE BMS LIL MSD PFZ	**AVE** NVA **ROC** AZ GSK **BI** WYE **SAG SPL**	AZ GSK LIL WYE MSD PFZ	AZ GSK WYE BMS LIL PFZ MSD
Group G	PHR SS	PHR SS	PHR SS	PHR SS
Number of Clusters	7	6	7	7

Differences compared to variable set 1 are marked in bold. Overall there is strong agreement across the board. Group A are the industrial companies, three out of the 4 solutions are in agreement. Only the cluster solution based upon variable set two places Reckitt Benckisser in a different group and transposes Yamanouchi. Group G is common across the board. The clustering solution based upon variable set 2 places Baxter in the company of Ivax, Novo and Reckitt Benckisser. Group C includes Ivax and Novo across the board.

Groups E and F contain a number of companies common to all clustering solutions but the results are particularly close between variable set 1 and the two solutions based upon a full variable set. It is clear from table 6.40 that the 7 cluster solution appears the stronger, which applies in three out of four cases. An issue with cluster analysis is that

different variables may present new perspectives on the data but too many variables may obscure relationships. In the interests of parsimony, it makes sense to proceed with clusters based upon two approaches. First, on variable set 1 and then, second, to use principal components as an alternative view, which offers the chance to include some input from the entire variable set. The decision to use principal components recognizes the fact that some strategic investment decisions, for example sales force activity and advertising spend, will inevitably act in concert. This lessens the criticism that inter related variables, by acting in effect as a "block vote", therefore alter the weighting and hence skew the analysis. This criticism assumes that variables should be independent. This is not necessarily true of investments made in advertising and sales force activity toward a common objective. It is however, clear for this data that the solutions based upon standardized data appear more useful, which may imply that differences in scale do, indeed, exert some kind of skewing effect.

The result of the analyses based upon the standardized data for variable set 1 and principal components was then used to test performance differences across strategic groups. This analysis comprises the final section of this chapter.

6.8 Performance differences across strategic groups.

During the two stable strategic time periods, 1993 to 1997 and 1998 to 2002, the following strategic groups were identified in the discussion above, see table 6.40.

Table 6.40 Strategic groups across the two stable strategic time periods

	SSTP1	SSTP2 [A]	SSTP 2 [B]
Time Period	1993 – 1997	1998 – 2002	1998 – 2002
Number of Strategic Groups	7	7 [VARIABLE SET 1]	7 [PCA]
SG1:	3M RB AKZO SOL PG	3M RB AKZO SOL PG	3M RB AKZO SOL PG
SG 2:	BAX	BAX	BAX
SG 3:	BI SAG MER IVX NOV	IVX NOV SAG	IVX NOV YAM
SG 4:	LUN	LUN SPL YAM	LUN
SG 5:	SPL YAM	PHR SS	PHR SS
SG 6:	JJ AVE PHR NVA ROC AZ GSK	ABB BAY JJ AVE BI ROC MER	ABB BAY JJ MER AVE NVA ROC BI SAG SPL BMS
SG 7:	BAY ABB WYE BMS MSD LIL PFZ SS	NVA AZ GSK WYE BMS LIL MSD PFZ	AZ GSK LIL WYE MSD PFZ

These three strategic group sets were then tested against the following three performance measures. First, SHARE which represents market share. Second, WMS [Weighted Market Share], which recognizes the value of niche strategies following the earlier research of Cool (1985) and Martens (1988). Finally, DIFF which measures the companies ranking difference across each of the stable strategic time periods, for example, a company moving from 22nd place in 1993 to 20th place in 1997 will have improved its DIFF score by 2.

These market based measures were chosen rather than profit or cost measures primarily for reasons of data availability. The standard profit and cost measures, taken from company annual reports, apply to the total company not the UK subsidiary. A second reason for utilizing these variables is that previous research has used share and weighted market share (Cool, 1985; Cool *et al.*, 1987a; Martens, 1988).

Each of these measures was compared across groups using the Kruskal Wallis one way analysis of variance test. These results are presented in table 6.41.

Table 6.41 Performance differences between strategic groups

	SSTP 1			SSTP2 [A]			SSTP2 [B]		
Performance Variable	Chi Square	Df	Sig	Chi Square	Df	Sig	Chi Square	Df	Sig
SHARE	24.753	6	0.0004	22.102	6	0.001	20.994	6	0.002
WMS	16.658	6	0.011	16.140	6	0.013	15.325	6	0.018
DIFF	13.334	6	0.038	7.881	6	0.247	11.509	6	0.074

The results are, that for the first stable strategic time period performance differs significantly across strategic groups on all three measures. With the second strategic time period, both clustering solutions return a similar result with a significant difference at the 5% level between groups for both SHARE and WMS, but no significant difference found between groups at this level of significance in terms of DIFF. However, at the 10% level of significance, a significant result was found for DIFF between groups using the principal components method.

6.9 Conclusions

The research reported in this chapter found that two stable strategic time periods, 1993-1997, and 1998 – 2002, existed within the ten years encompassed by the study. Each SSTP was five years in length and the break between the two periods appears to coincide with a marked change in a number of key environmental factors.

Across each time period analyses based on both data standardized to z scores and non-standardized data were carried out. Each separate clustering solution was then compared using three validation procedures; internal validity, bootstrapping and external validity. Consistently, the clustering solutions based upon standardized data were found to produce a more detailed and robust solution. External validity, i.e. comparison between groups using strategy and performance measures not included in the original analysis, was taken as an indication of a stronger solution. For the first stable strategic time period analysis of standardized data, using a combination of both Ward's method and the K means clustering algorithm, returned a seven cluster solution, which differed significantly, at the 5% level, on eight variables, and at the 10% level, on one variable. In contrast, the same analysis applied to non-standardized data produced a four cluster solution, which achieved significance at the 5% level on five variables and at the 10% level on one variable.

The seven strategic groups identified in the first stable strategic time period consisted of; an industrial conglomerate group of highly diversified firms (3M, Reckitt Benckisser, Akzo Nobel, Solvay, Procter & Gamble); a group containing one firm

(Baxter), which is a firm specializing in hospital solutions; a group of largely medium sized, European firms, that each concentrate on a small selection of therapy areas (Boehringer Ingelheim, Schering Healthcare, Merck KGAA, Ivax, Novo); a Danish company (Lundbeck) which focuses on two therapy areas marketed almost exclusively to GPs; a group consisting of two medium sized firms (Schering Plough,Yamanouchi) focusing upon largely GP based activities across a selected range of therapy areas; a group consisting of heavyweight, largely european based firms which address a broad range of therapy areas, invest heavily in research, have participated in significant merger activity and generally have a strong hospital presence (Johnson & Johnson, Aventis, Pharmacia, Novartis, Roche, Astra Zeneca, Glaxo Smith Kline); a mix of firms, which with the exception of Bayer focus almost exclusively on pharmaceutical and healthcare based activity, directed strongly at the GP market (Bayer, Abbott, Wyeth, Bristol Myers Squibb, Merck Sharpe & Dohme, Lilly, Pfizer, Sanofi Synthelabo.)

Analysis of the second stable strategic time period was complicated by a greater degree of inter-relatedness between variables. A number of strategies can be employed to deal with multicollinearity. Several approaches were used: the variable set was divided into two groups, each of which was analyzed separately and the results compared; principal component analysis scores were used; and a full set of variables was also analysed. In each case both standardized and non-standardized data sets were used and the results compared using three validation methods. Once again analysis using standardized data appeared to outperform non standardized data, which suggests that scale differences are a significant factor in the analysis of this type of pharmaceutical data. This finding

supports the decision of earlier researchers to utilize standardized data (Bogner, 1991; Cool, 1985; Martens, 1988).

Different treatments applied to the SSTP 2 variable sets each produced slightly different results, that is to say there were a good deal of similarities. When comparing the standardized to non-standardized data treatments both sets of analysis produced significant clusters that achieved external validity. The result with standardized data was more robust and gave a greater degree of precision. When twelve strategic and performance variables were compared across strategic groups, eight out of twelve were significant at the 5% level, for the standardized data, as compared to three out of twelve utilizing the non-standardized data.

The analytical method employing either principal components or the full variable set performed less well. Neither of these methods achieved an externally valid solution with the non-standardized data. This result implies that both interaction between variables and scale effects exert a significant effect within this type of data set and that it is right to correct for them. Use of principal components or the inclusion of the full variable set did not, however, appear to significantly improve the quality of the clustering solution, but it did provide additional verification for some of the groupings. A comparison of the four different treatments, utilizing standardized data are shown in table 6.40. Overall there is strong agreement across these four solutions. Three out of four suggest a very similar seven cluster solution (see table 6.40). Of these three out of four, the seven cluster solution was chosen as most reliable based on cross-comparison between the solutions and performance on external validity tests.

The following seven strategic groups were found in the second stable strategic time period:

SG1: The industrial conglomerates. All of these companies have relatively minor interests in pharmaceuticals, which represent a fraction of their diversified chemical based business interests. Across the three "seven" cluster solutions, the common members of this strategic group were 3M, Akzo Nobel, Reckitt Benkisser, Proctor and Gamble and Solvay.

SG2: A singleton strategic group consisting of Baxter, a niche player specializing in hospital solutions that spends relatively little on either promotion or R&D.

SG3: A specialist pharmaceutical group consisting of firms concentrating very strongly in one or two selected therapy areas, namely Ivax (respiratory), Novo (anti-diabetic drugs) Schering AG (women's health).

SG4: A group of medium sized pharmaceutical companies with a common member in Lundbeck, a specialist across two therapy areas employing strong GP based promotion. On two occasions out of three Yamanouchi was placed in this group and once Schering Plough was included. These are all mid sized players, employing moderate R&D but reasonably strong promotion spend.

SG5: This group consisted of a common membership of Sanofi Synthelabo and Pharmacia. Both are large companies with a very wide portfolio of therapy areas.

SG6: This consisted of medium to large sized companies employing average promotion, often with strong hospital interests and slightly diversified interests. Roche, for example, is strong in diagnostics and consumer health, Abbott in nutrition and J&J in consumer products. The core members of this group are Abbott, Bayer, Johnson & Johnson, Aventis, Boehringer Ingelheim, Roche and E Merck.

SG7: The heavyweight pharmaceutical specialists are included within this group. Common traits include strong R&D, aggressive promotion, broad range of therapeutic areas and strong presence in all major markets. Common members include Astra Zeneca, Glaxo Smith Kline, Wyeth, Bristol Myers Squibb, Lilly, Merck Sharpe and Dohme, and Pfizer. Additional validation is provided by the recent book. *The Merck Druggenaut*, which in its profile of Merck identifies Pfizer as its "benchmark" competitor (Hawthorne, 2003).

The results of this research show that a relatively stable intra-industry structure consisting of seven strategic groups existed in the UK pharmaceutical industry across both the two, five year, stable strategic time periods. (see table 6.41). This supports the premise that a strong "natural structure" exists.

Each of these strategic groups were tested for performance differences using three market specific variables: SHARE, WMS and DIFF. These performance measures were chosen both for reasons of data availability and because this is a UK based study. It is because the strategy employed by pharmaceutical companies in the UK may differ from strategies employed elsewhere that standard performance measures such as ROCE (return on capital employed) or EBIT (earnings before income and tax), readily

obtainable from company annual reports, could not be used. Use of SHARE and WMS is also in accord with previous research (Cool, 1985; Martens, 1988) and permits comparison of the research in this thesis with those studies.

Comparison across the seven strategic groups for the period 1993 – 1997 found significant differences at the 5% level, or better, for all three performance measures. The results for the second time period, 1998 – 2002, were less clear cut. Here, both the seven variable set and the solution based upon principal components, for standardized data, showed a significant difference between groups for SHARE and WMS at the 5% level. The solution based on principal components also achieved significance at the 10% level for DIFF, but this result was not replicated using the alternative seven variable solution.

The fact that only two stable strategic time periods (SSTPs) were identified in this research suggests that the operating environment for pharmaceutical companies in the UK was relatively stable throughout this study. The first of these, from 1993 to 1997, appears more benign in competitive terms as illustrated by the sharp rise in generic and branded substitution which marks the break between these two SSTPs.

Seven strategic groups were identified in each of these stable strategic time periods. In the first period the difference between large and medium firms appeared less distinct possibly because pressure upon me-too products was less pronounced at this time.

Within the second time period, a number of the strategic groups present represent quite different market positions. Strategic group one consists of five industrial firms, each with broad interests in chemicals where pharmaceuticals represent a minority interest. Within this group 3M typifies membership with a modest research and promotional

PAGE

MISSING

IN

ORIGINAL

CHAPTER 7

DYNAMICS BETWEEN STRATEGIC GROUPS AND MERGERS IN THE UK PHARMACEUTICAL INDUSTRY 1993-2002

7.1 Introduction

The previous chapter explored the structure of the UK pharmaceutical industry following a method used in previous research (Cool, 1985; Martens, 1988). This necessitated taking a simplified view of the industry by excluding companies that were not present for the entire duration of this study and by assuming that companies had existed in their current form throughout the study period. In this chapter the underlying dynamics of the industry are explored with the aim of answering the following two research questions:

1. Do firms that move from one strategic group to another consistently move into a higher performing group and are such moves concomitant with environmental change?
2. Do mergers occur more frequently between strategic groups or within strategic groups?

During the period encompassed by this study the pharmaceutical industry experienced several waves of consolidation. It is therefore necessary to explore the change in industry structure, research that has been largely ignored in previous longitudinal strategic group studies on the pharmaceutical industry (Cool, 1985; Fiegenbaum *et al.*, 1990; Martens, 1988). Reasons for the exclusion of merged firms may include the fact that changing sample sizes between years made operationalizing the idea of stable strategic time periods more problematic, or that mergers were less of an issue in the time periods covered by earlier research. Cool explains his exclusion of merged firms as follows;

> "First, it was necessary to exclude foreign drug firms because of the lack of reliable data on various strategy (geographic scope, patent data, R&D outlays) and performance (profitability) dimensions...A second criteria imposed on the sample selection was that firms needed to exist as separate legal entities over most of the 1963-1982 period)"(Cool, 1985).

Three alternatives to dealing with mergers were considered. First, merged companies can be excluded from the research. This has the advantage of providing a clean uncomplicated solution but as discussed earlier (see chapter 5) to exclude merged companies from this research would exclude a number of the most prominent industry players and substantially weaken the value of any results because merger is a fact of life in this industry. Second, firms can be considered to have always existed in the form that existed at the end of 2002. This approach, adopted in the previous chapter, allowed both the utilization of Cool's method to this research and permitted the inclusion of merged companies. It is also a pragmatic choice because the IMS database, the industry standard which is used in this research, automatically recalculates the ten years back data when a company merges and thus effectively expunges the earlier separate companies from the data. Third, each merged firm can be effectively deconstructed using archival data into its original form, which is the approach adopted in this chapter.

7.2 The Dataset

The dataset for this research question differs slightly from that employed in the previous chapter. This is because it includes those firms swallowed up during the process of industry consolidation, which presents significant problems of data availability. The set of companies, included in this aspect of the research together with the abbreviations used in subsequent sections, are presented in table 7.1

Table 7.1 Companies included in the following analysis

ABBREVIATION	COMPANY
3M	3M Corporation
ABB	Abbott
AKZ	Astra Zeneca
AST	Astra
BAX	Baxter International
BAY	Bayer
BI	Boehringer Ingelheim
BM	Boehringer Mannheim
BMS	Bristol Myers Squibb
BOO	Boots
CEL	Celltech
CGY	Ciba-Geigy
DUP	Dupont
FIS	Fisons
GLX	Glaxo Labs
HOE	Hoechst
IVX	Ivax
JJ	Johnson & Johnson
KNO	Knoll
LED	Lederle Laboratories
LIL	Lilly
LOR	Lorex Synthelabo
LUN	Lundbeck
MER	E Merck
MMD	Marion Merrell Dow
MSD	Merck Sharpe & Dohme
NOV	Novo
PFZ	Pfizer
PG	Procter & Gamble
PHA	Pharmacia
PU	Pharmacia Upjohn
RB	Reckitt Benckisser
ROC	Roche
RPR	Rhone Poulenc Rorer
SAG	Schering AG
SAN	Sanofi
SAND	Sandoz
SEA	Searle

SKB	Smith Kline Beecham
SOL	Solvay
SPL	Schering Plough
SS	Sanofi Synthelabo
SYN	Syntex
UPJ	Upjohn
WEL	Wellcome
WL	Warner Lambert
WYE	Wyeth
YAM	Yamanouchi
ZEN	Zeneca

The choice of variables used here are by necessity limited due to the availability of data.[39] The variables used to initially separate companies into strategic groups are described in table 7.2.

Table 7.2 Variables Used to Separate Companies Into Strategic Groups.

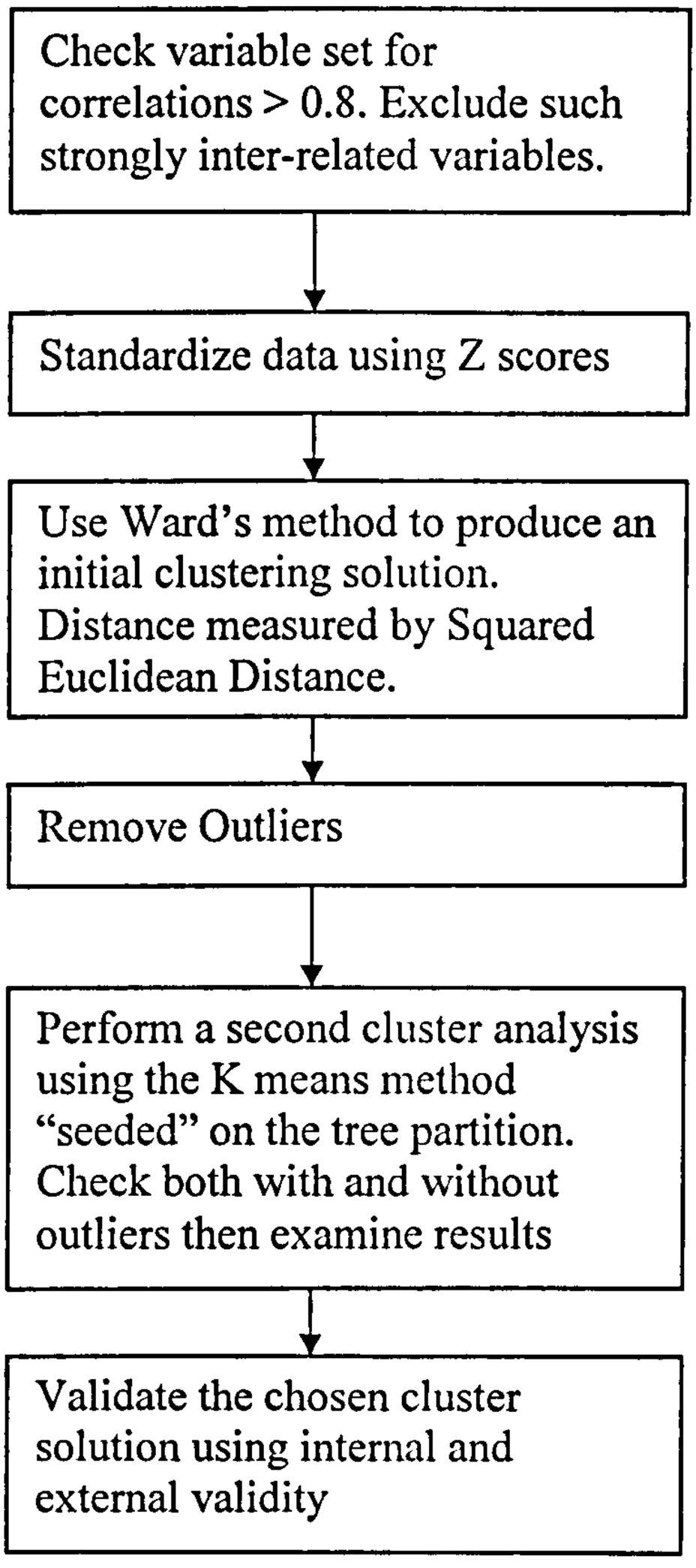
ABBREVIATION	VARIABLE DEFINITION
3R	Proportion of retail sales generated by top 3 therapeutic areas
FOCUS	Proportion of sales derived from pharmaceuticals
FOREIGN	Proportion of sales derived from overseas
HSAL	Proportion of sales derived from hospital segment
NEWPRO	Sales of products < 2 years old.
PINT	Total promotional expenditure divided by total UK sales
RDI	Total research expenditure divided by total world sales

In this chapter, years with differing numbers of firms are taken to stand alone rather than being consolidated into stable strategic time periods. The principal reason for this is that the number of firms, both due to mergers and to new entrants e.g. Eisai, Shire and Takeda, differs between years. For adjacent years where the number of firms' remains constant the Box M test will be used to test homogeneity and if found the years will be averaged (see chapters 5 and 6 for details) in accord with Cool's method. This method

[39] Some of the companies ceased to exist over ten years ago. In these earlier years the availability of data from sources such as Datastream and Annual Reports is patchy and of variable quality.

found to be most effective in the previous chapter was used to differentiate strategic groups; see figure 7.1.

Figure 7- 1 Flowchart of data analysis employed in this chapter



A check for inter-related variables revealed no strong correlations i.e. > 0.8[40]other than SIZE. This variable was therefore removed from the dataset used to cluster firms, leaving seven variables 3R, HSAL, NPH, NPR, RDI and PINT. The correlation was

[40] This figure is suggested in the literature as a point where inter-related variables may become problematic see chapters 5 and 6 for further details.

carried out using Spearman's Rank test and the results of this analysis are shown in table 7.3.

Table. 7.3 Correlations between variables used to differentiate strategic groups

	3R	FOCUS	FOREIGN	HSAL	NPRO	PINT	RDI
3R	1.000	-0.039	-0.250	-0.672	-0.039	0.137	-0.076
FOCUS	-0.039	1.000	-0.061	0.216	-0.108	-0.242	0.340
FOREIGN	-0.250	-0.061	1.000	0.228	0.003	-0.414	-0.161
HSAL	-0.672	0.216	0.228	1.000	-0.034	-0.252	0.192
NPRO	-0.039	-0.108	0.003	-0.034	1.000	0.027	-0.037
PINT	0.137	-0.242	-0.414	-0.252	0.027	1.000	0.031
RDI	-0.076	0.340	-0.161	0.192	-0.037	0.031	1.000

7.3 Strategic group membership 1993 – 1994

The first two years 1993 and 1994 both contain 47 companies so the homogeneity between these two years was tested using the Box M test (see chapters 5 and 6 for further details). The results of this test are shown in table 7.4

Table 7.4 Test of homogeneity between 1993 and 1994

Box's M	47.757
F	1.203
df1	36.000
df2	27836.864
Sig.	0.188

This test confirms that the years 1993 and 1994 do not differ significantly and may therefore be treated as part of the same strategic time period. This finding is in agreement with the research reported in the previous chapter, which also found no difference between 1993 and 1994. The two years were then averaged as per Cool's

method (see chapters 5 and 6 for further detail) and the firms clustered into strategic groups.

The results of this cluster analysis are shown in table 7.5. The pharmaceutical industry is shown to consist of nine strategic groups, only one of which consists of a sole member. This is Baxter which is a specialist in hospital solutions and would therefore be expected to be a niche player.

Table 7.5 Strategic Groups 1993-4

Strategic Group	Ward's Method	K Means
SG 1:	3M RB PG BOO AKZ BAY SOL FIS AST NOV	3M RB PG AKZ BAY SOL FIS AST NOV
SG 2:	CGY GLX	CGY GLX
SG 3:	IVX SEA	BOO IVX SEA
SG 4:	ABB SPL YAM BMS WYE PFZ SAN DUP LIL MMD SYN MSD UPJ	ABB SPL YAM BMS WYE PFZ DUP LIL MMD SYN MSD UPJ
SG 5:	BM LED	BM LED
SG 6:	KNO LOR	KNO LOR
SG 7:	BAX	BAX
SG 8:	BI SAG RPR WEL MER SAND PHA ZEN CEL LUN	BI SAG RPR WEL MER SAND PHA ZEN CEL LUN
SG 9:	HOE ROC SKB JJ WL	SAN HOE ROC SKB JJ WL

The two sets of analyses reveal a virtually identical structure of nine strategic groups. Strategic groups 2,5,6,7 and 8 are identical. The difference is that the K means analysis has reallocated Boots from strategic group 1 to strategic group 3 and Sanofi from group 4 to 9. Outlier analysis identifies cases that are relatively remote from the clusters. These outliers are ordered by their Squared Euclidean Distances and here six companies Boots, Astra, Novo, Ivax, Celltech and Lundbeck were further than a value of 0.6 away

from the cluster mean[41]. The presence of firms identified as outliers, i.e. displaying a set of strategic investments and decisions not wholly congruent with their group but not different enough to justify a singleton position, supports the observation that strategic groups may consist of a core central group of members, an inner group which closely follows the same pattern of strategic investments, and a number of less centrally aligned secondary group members, which represent an outer group less committed to the strategy described by their strategic group membership (McNamara *et al.*, 2003). For example, the removal of Boots, Astra and Novo from group 1 leaves a tight group of companies with strong interests outside pharmaceuticals - 3M, Reckitt, Procter and Gamble, Akzo, Solvay and Bayer are all strongly diversified chemical companies.

Internal group validity for the identified cluster solution was confirmed by the Upper tail significance test, which shows that a nine cluster solution corresponds to the largest number of clusters, which is significant at the 5% level; see table 7.6.

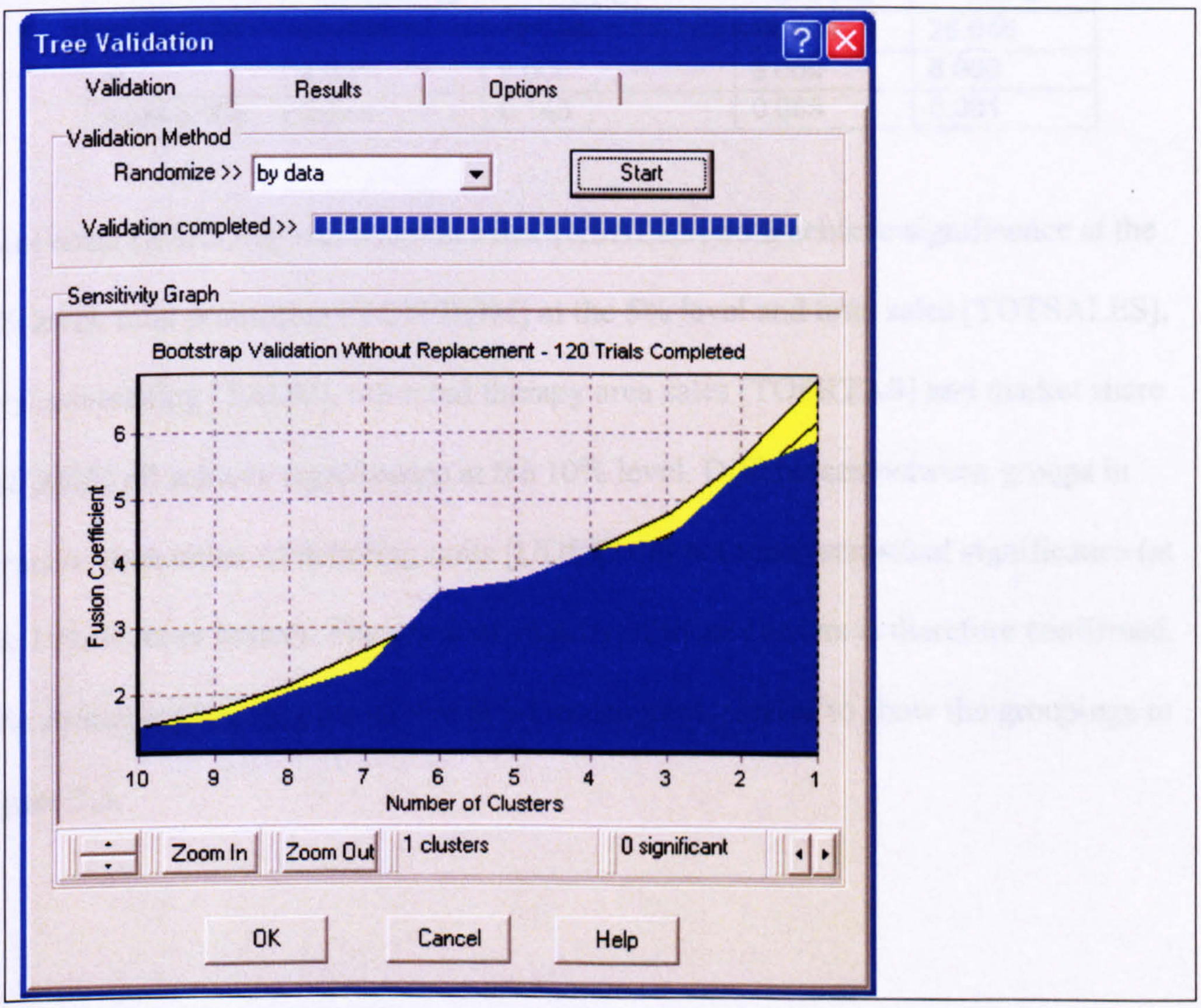
[41] The use of outlier analysis reveals those firms that are peripheral to their assigned cluster which is a useful procedure to identify the most tightly defined clusters that describe the densest part of the data.

Table 7.6 Upper Tail Significance Test showing the correct number of clusters 1993-1994

Partition	Deviate	t-Statistic
2 clusters	3.65	24.75
3 clusters	2.91	19.72
4 clusters	2.29	15.53
5 clusters	2.01	13.65
6 clusters	1.73	11.75
7 clusters	1.66	11.24
8 clusters	0.58	3.97
9 clusters	0.39	2.66

The presence of a natural structure within the data was confirmed by bootstrapping validation see figure 7.2.

Figure 7.2 Bootstrap Validation of 1993-4 Data



This is not a strong result and indicates that a strong natural structure has not been found within the raw z score data. On applying the same technique to the proximities used to construct the clusters[42] a stronger result was obtained. See Appendix B.

External validation was tested by using a Kruskal Wallis one way analysis test. The results of this validation procedure are listed in table 7.7.

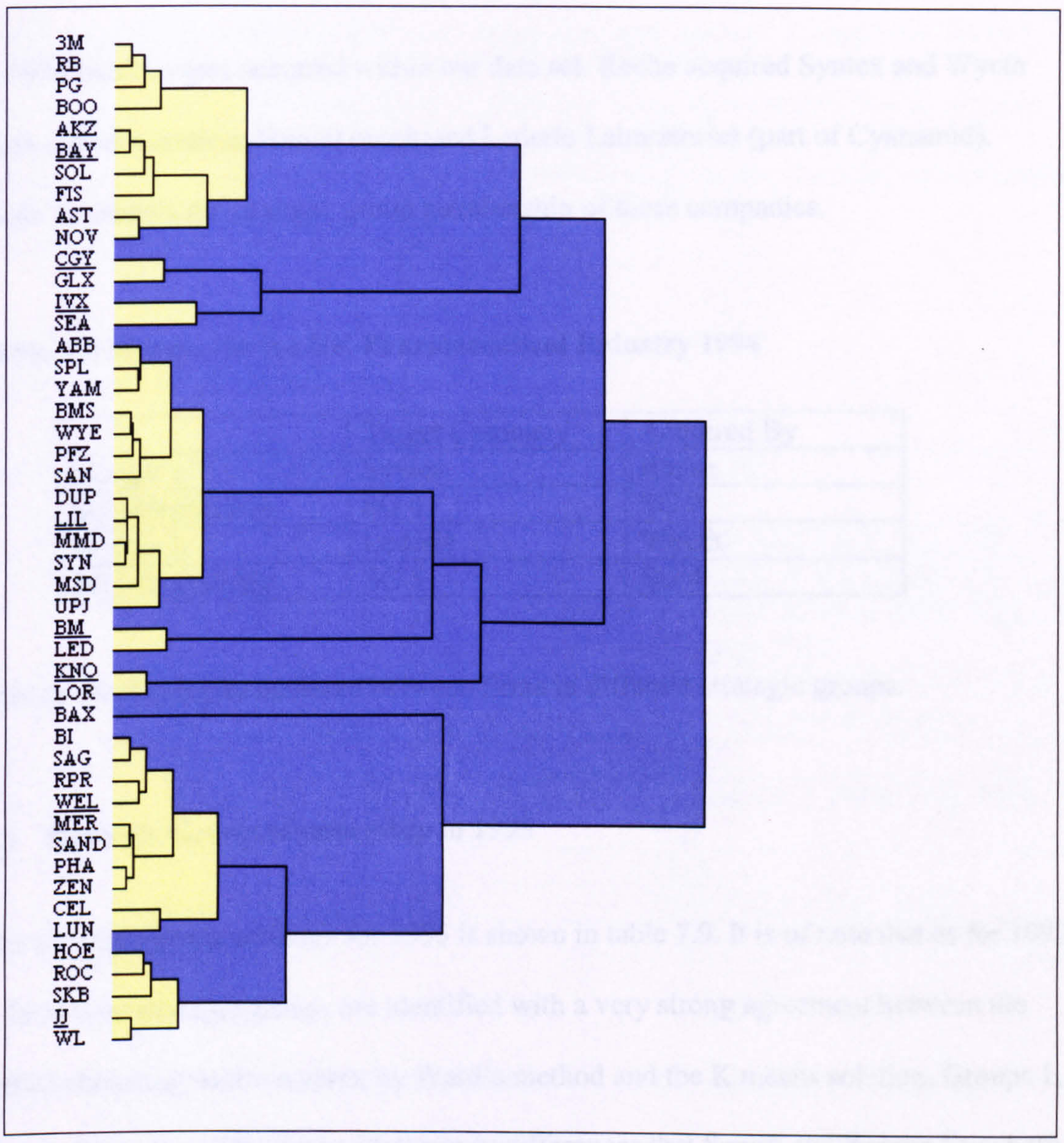
Table 7.7 Kruskal Wallis test of external validity of 1993-4 strategic groups

	HSALES	TADV	TOPRTAS	TOTPROM
Chi Square	21.560	15.319	13.916	16.609
df	8.000	8.000	8.000	8.000
Asymp. Sig.	0.006	0.053	0.084	0.034
	TOTSALES	UDET	SHARE	RSAL
Chi Square	14.509	12.189	14.509	26.045
df	8.000	8.000	8.000	8.000
Asymp. Sig.	0.069	0.143	0.069	0.001

Here retail [RSALES] and hospital sales {HSALES] both achieve significance at the 1% level, total promotion [TOTPROM] at the 5% level and total sales [TOTSALES], total advertising [TADV], top retail therapy area sales [TOPRTAS] and market share [SHARE] all achieve significance at the 10% level. Differences between groups in terms of thenumber of detailing units [UDET] did not reach statistical significance (at the 10% level or better). The external validity of these clusters is therefore confirmed. The strategic groupings are shown in a Dendrogram, shaded to show the groupings in figure 7.3.

[42] Proximity or closeness between each pair of objects can assess similarity, where measures of distance or difference is used, with smaller distances or differences representing greater similarity. Similarity matrices constructed from these measures form the basis for clustering where squared Euclidean distance is the normal distance measure applied in this thesis. Some clustering algorithms construct the reciprocal dissimilarity matrix as a method of determining the relative affinity between objects.

Figure 7.3 Dendrogram of Strategic Groups in the UK Pharmaceutical Industry 1993-1994



The most typical member or exemplar of each strategic group is underlined.

7.4 Mergers in the1993-1994 period.

In 1994 two mergers occurred within our data set. Roche acquired Syntex and Wyeth (then called American Home) purchased Lederle Laboratories (part of Cyanamid). Table 7.8 shows the strategic group membership of these companies.

Table 7.8 Mergers in the UK Pharmaceutical Industry 1994

	Target Company	Acquired By
Merger 1	Syntex	Roche
SG Membership	SG 4	SG 9
Merger 2	Lederle	Wyeth
SG Membership	SG 5	SG 4

In both cases mergers occurred between firms in different strategic groups.

7.5 Strategic Group Membership in 1995

The strategic group structure for 1995 is shown in table 7.9. It is of note that as for 1993 – 1994 nine strategic groups are identified with a very strong agreement between the initial clustering solution given by Ward's method and the K means solution. Groups 1, 5, 6, 7, 8 and 9 are identical with the only differences that Sanofi and Zeneca have both been reallocated to group 3. In comparison to the earlier time period, the membership of group 1 is a subset of the earlier years, with the exception of Ciba-Geigy. There are some significant shifts between the two time periods but a number of common combinations remain, for example Abbott, Schering Plough and Yamanouchi are classified together, as are Pfizer, MSD, Lilly and Dupont, for example.

Outlier analysis shows Hoechst, Searle, Novo, Boots, Zeneca, Fisons and Upjohn to be at the edge of their clusters. This appears to be an interesting observation for two

reasons. First, all of these companies changed groups when compared to the previous time period, which supports the idea of outer group members either changing position or exhibiting loose affinity to their core group members. Second, during 1995 four of these seven companies, Fisons, Boots, Upjohn and Hoechst, were involved in mergers, again signaling a significant positional shift. Outlier analysis may therefore prove useful to indicate firms about to make strategic shifts.

Table 7.9 Strategic Groups 1995

Strategic Group	Ward's Method	K Means
SG 1:	3M PG AKZ CGY SOL FIS	3M PG AKZ CGY SOL FIS
SG 2:	ABB SAN SPL YAM KNO LOR	ABB SPL YAM KNO LOR
SG 3:	BM HOE JJ WYE RPR WL SEA	SAN BM HOE JJ WYE RPR WL SEA ZEN
SG 4:	AST PFZ DUP MMD BAY LIL MSD IVX RB NOV BOO ZEN	AST PFZ DUP MMD BAY LIL MSD IVX RB NOV BOO
SG 5:	BAX	BAX
SG 6:	BI SAG GLX MER WEL PHA UPJ	BI SAG GLX MER WEL PHA UPJ
SG 7:	LUN	LUN
SG 8:	BMS SAND ROC SKB	BMS SAND ROC SKB
SG 9:	CEL	CEL

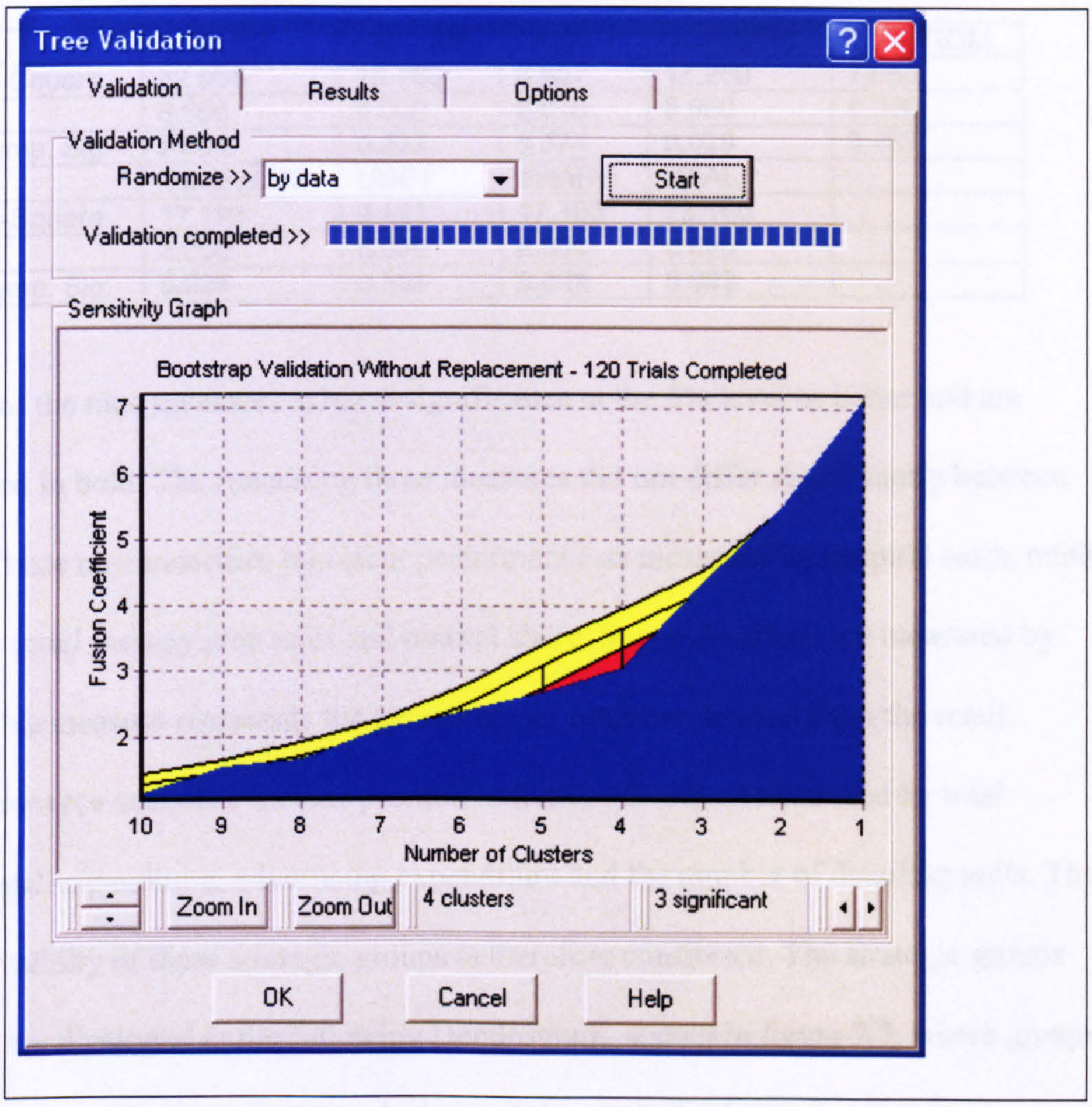
Internal group validity for this cluster solution was confirmed using the Upper tail significance test, which indicated that nine clusters was the largest number of clusters to differ significantly at the 5% level; see table 7.10.

Table 7.10 Upper Tail Significance Test showing the correct number of clusters 1995

Partition	Deviate	t-Statistic
2 clusters	4.1	27.21
3 clusters	3.01	19.97
4 clusters	2.25	14.95
5 clusters	1.36	9.01
6 clusters	1.13	7.47
7 clusters	0.91	6.02
8 clusters	0.75	4.96
9 clusters	0.45	2.96

The presence of a natural structure within the data was confirmed by bootstrapping validation see figure 7.4.

Figure 7.4 Bootstrap Validation of 1995 Data



This figure shows that the data departs most significantly from random at the 4 cluster solution and that 3 of the total number of partitions differ significantly at the 5% level.

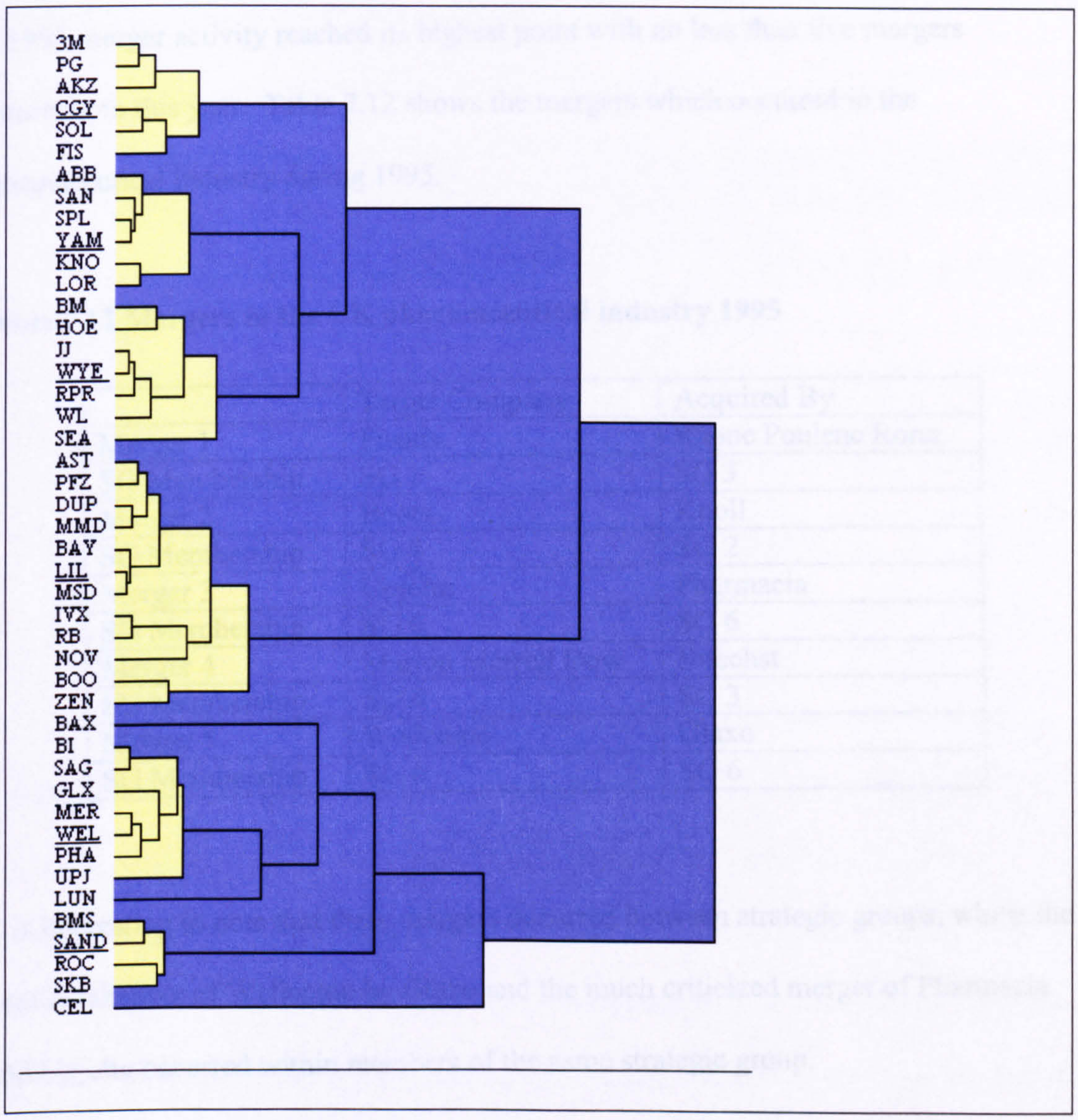
External validation of the strategic groups was then tested by the Kruskal Wallis one way analysis of variance test. The results of this test are provided in table 7.11.

Table 7.11 Kruskal Wallis test of external validity of 1995 strategic groups

	HSALES	RSALES	TADV	TOPRTAS	TOTPROM
Chi-Square	22.556	16.768	6.657	17.250	7.663
df	8.000	8.000	8.000	8.000	8.000
Asymp. Sig.	**0.004**	**0.033**	0.574	**0.028**	0.467
	TOTSALES	UDET	SHARE	RSAL	
Chi-Square	17.193	9.421	17.193	23.165	
df	8.000	8.000	8.000	8.000	
Asymp. Sig.	**0.028**	0.308	**0.028**	**0.003**	

Here six of the nine measures achieve significance at the 5% level or better and are highlighted in bold. The remaining three measures did not differ significantly between groups. These nine measures represent performance as measured by hospital sales, retail sales, top retail therapy area sales and market share. Scope decisions are measured by RSAL. This measure represents the percentage of business derived from the retail sector. Resource decisions include promotional investments, as measured by total promotional expenditure, advertising expenditure and the number of detailing units. The external validity of these strategic groups is therefore confirmed. The strategic groups for 1995 are illustrated in the following Dendrogram, shown in figure 7.5, where groups comprising more than one firm are shaded and the exemplar for each group is underlined.

Figure 7.5 Dendrogram of strategic groups in the UK pharmaceutical industry 1995



7.6 Mergers in 1995

In 1995 merger activity reached its highest point with no less than five mergers occurring in this year. Table 7.12 shows the mergers which occurred in the pharmaceutical industry during 1995.

Table 7 12 Mergers in the UK pharmaceutical industry 1995

	Target Company	Acquired By
Merger 1	Fisons	Rhone Poulenc Rorer
SG Membership	SG 1	SG 3
Merger 2	Boots	Knoll
SG Membership	SG 4	SG 2
Merger 3	Upjohn	Pharmacia
SG Membership	SG 6	SG 6
Merger 4	Marion Merrell Dow	Hoechst
SG Membership	SG 4	SG 3
Merger 5	Wellcome	Glaxo
SG Membership	SG 6	SG 6

It is interesting to note that three mergers occurred between strategic groups, whilst the hostile takeover of Wellcome by Glaxo and the much criticized merger of Pharmacia and Upjohn occurred within members of the same strategic group.

7.7 Strategic Group Membership in 1996

Following a wave of mergers the structure of the UK industry in 1996 changed slightly and only 8 strategic groups were identified in 1996. The groups are shown in table 7.13.

Table 7.13 Strategic Groups 1996

Strategic Group	Ward's Method	K Means
SG 1:	3M RB KNO PG SEA SOL	3M RB KNO PG SEA SOL AKZ
SG 2:	AKZ BAY CGY MER ZEN	BAY CGY MER ZEN SAG BMS SKB WL RPR
SG 3:	AST DUP BI SAG BM IVX LIL PFZ MSD NOV	AST DUP BI IVX LIL PFZ NOV
SG 4:	CEL	CEL
SG 5:	ABB SAN SPL YAM LUN	ABB SAN SPL YAM LUN
SG 6:	BAX	BAX ROC
SG 7:	BMS SKB WL RPR JJ WYE HMR PHU ROC GW LOR	BM JJ HMR PHU GW LOR
SG 8:	SAND	MSD WYE SAND

A good degree of change is apparent comparing the original hierarchical solution provided by Ward's method with the adjustment applied by the K means algorithm. Clusters four and five are identical between the two solutions, one of which is a singleton group comprising Celltech, which is essentially a niche biotechnology company. There is a good deal of agreement between the two cluster solutions with cluster one consisting largely of the industrial conglomerates, to which Akzo Nobel is added by the K means method. Despite this agreement however, there is a good deal of readjustment with nine companies reclassified. This may indicate a general readjustment of strategic positions. The movement of Roche into the same group as Baxter is surprising, but this analysis precedes Roche's takeover of Boehringer Mannheim in 1997, which may in part explain the shift.

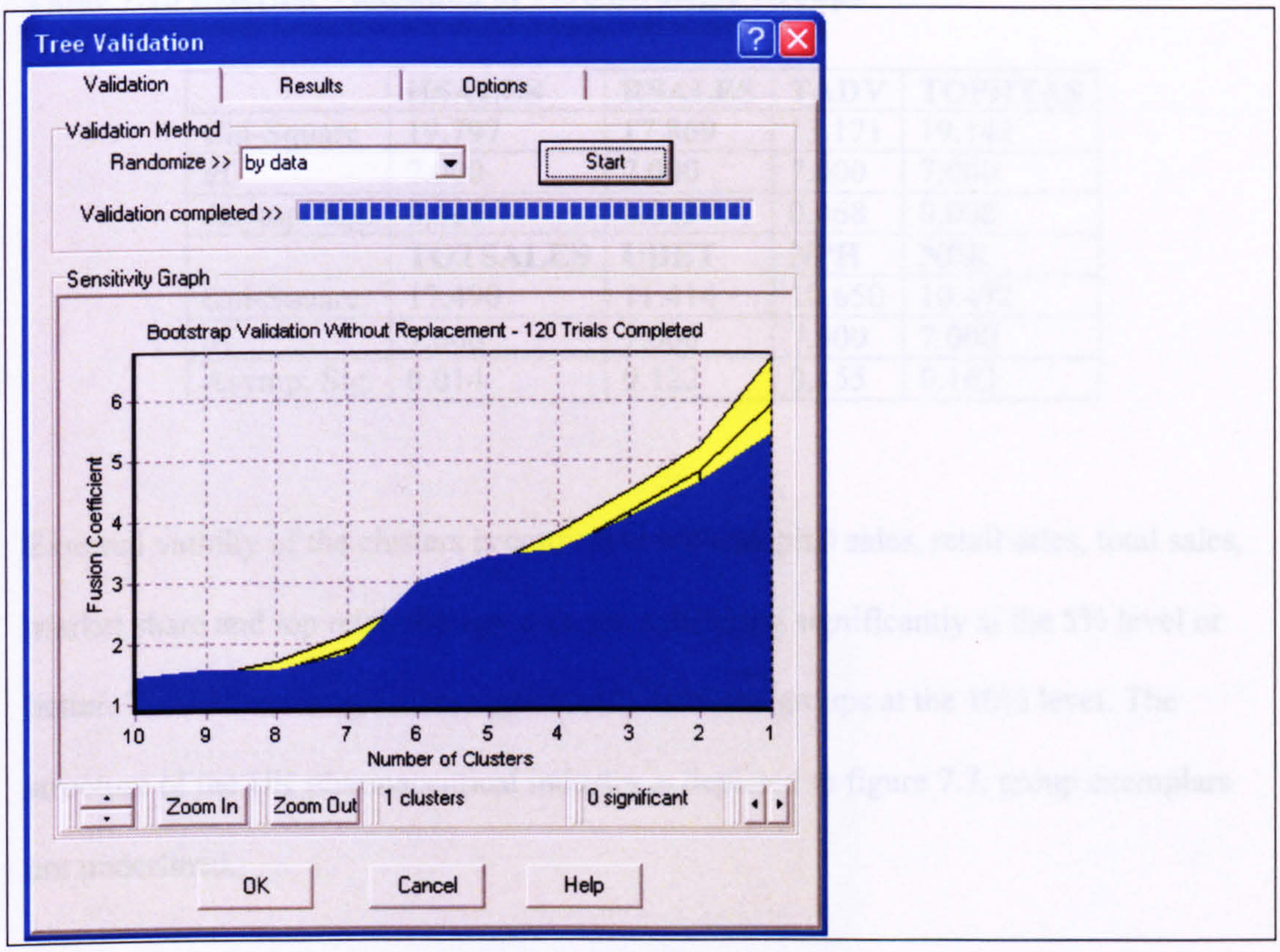
Internal validity of this cluster solution was confirmed using the Upper Tail significance test, which indicated that seven clusters was the largest number of clusters to differ significantly at the 5% level; see table 7.14.

Table 7.14 Upper Tail Significance Test showing the correct number of clusters 1996

Partition	Deviate	t-Statistic
2 clusters	2.98	18.61
3 clusters	2.77	17.33
4 clusters	2.05	12.81
5 clusters	1.9	11.88
6 clusters	1.7	10.62
7 clusters	1.39	8.67
8 clusters	0.53	3.32

The presence of a "natural structure" within the data was confirmed by bootstrap validation, see figure 7.6. This is not a strong result. The presence of some structure within the data is indicated, but it is not as marked as in some other years. A stronger result was obtained when the bootstrap validation was applied to the proximity data used to construct the clusters, see Appendix B.

Figure 7 6 Bootstrap Validation of 1996 Data



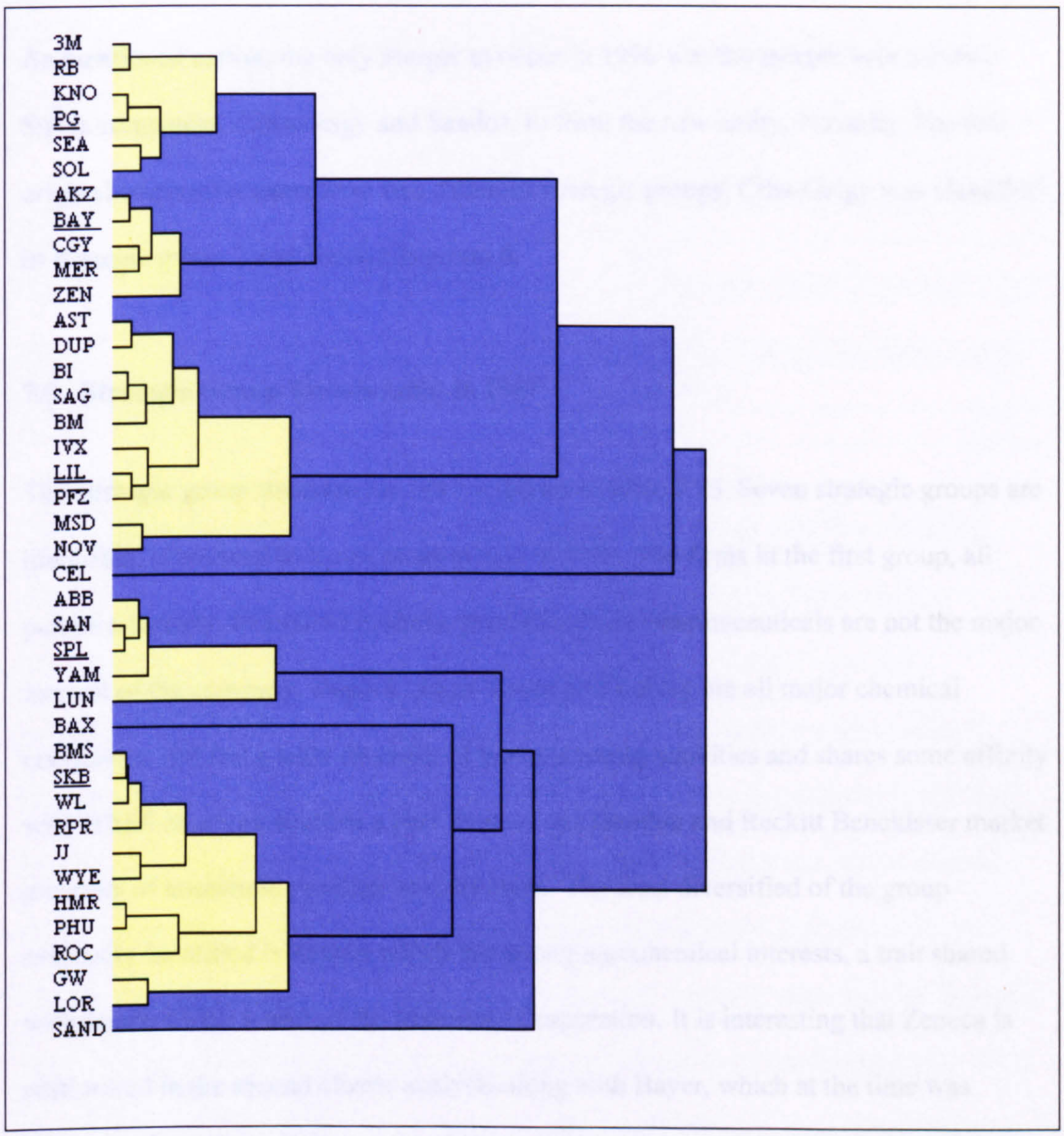
External validity of the strategic groups was then tested by the Kruskal Wallis one way analysis of variance test. The variables used were hospital sales [HSALS], retail sales [RSALS], total advertising spend [TADV], top retail therapy area sales [TOPRT], total promotion [TOTPRO], number of details [UDET], sales of new products into hospital [NPH] and sales of new products into the community [NPR]. The results are shown in table 7.15.

Table 7.15 External Validation of 1996 Strategic Groups

	HSALES	RSALES	TADV	TOPRTAS
Chi-Square	19.797	17.869	13.171	19.142
df	7.000	7.000	7.000	7.000
Asymp. Sig.	0.006	0.013	0.068	0.008
	TOTSALES	**UDET**	**NPH**	**NPR**
Chi-Square	17.490	11.414	10.650	10.472
df	7.000	7.000	7.000	7.000
Asymp. Sig.	0.014	0.122	0.155	0.163

External validity of the clusters is confirmed with hospital sales, retail sales, total sales, market share and top retail therapy area sales differing significantly at the 5% level or better. Total advertising differs significantly between groups at the 10% level. The structure of the UK pharmaceutical industry is depicted in figure 7.7, group exemplars are underlined.

Figure 7.7 Dendrogram of strategic groups within the UK pharmaceutical industry 1996



7.8 Merger Activity in 1996

As mentioned earlier, the only merger to occur in 1996 was the merger between two Swiss companies, Ciba-Geigy and Sandoz, to form the new entity, Novartis. The two original companies came from two different strategic groups, Ciba-Geigy was classified in strategic group 2 and Sandoz in group 8.

7.9 Strategic Group Membership in 1997

The strategic group structure for 1997 is shown in table 7.16. Seven strategic groups are identified, in contrast to the eight identified in 1996. The firms in the first group, all pursue a broadly diversified business portfolio where pharmaceuticals are not the major interest of the company. Dupont, Akzo, Bayer and Solvay are all major chemical companies. 3M has a wide diversity of manufacturing activities and shares some affinity with BASF of whom Knoll is a part. Procter and Gamble and Reckitt Benckisser market a variety of household products to consumers. The least diversified of the group originally identified is Zeneca which has strong agrochemical interests, a trait shared with Searle which is part of the Monsanto Corporation. It is interesting that Zeneca is reallocated in the second cluster analysis along with Bayer, which at the time was investing heavily in Lipobay their cholesterol lowering agent.

Table 7.16 Strategic Group Membership in 1997

Strategic Group	Ward's Method	K Means
SG 1:	3M PG RB SEA SOL KNO AKZ BAY ZEN DUP	3M PG RB SEA SOL KNO AKZ DUP
SG 2:	ABB EIS MSD YAM BM SAN WYE SPL AST LOR IVX NOV PFZ SHI	ABB EIS MSD YAM BM SAN WYE SPL AST LOR IVX NOV PFZ SHI
SG 3:	TAK	TAK
SG 4:	BAX	BAX
SG 5:	BI WL BMS JJ SKB GW NVA LIL	BI WL BMS JJ SKB GW NVA LIL RPR
SG 6:	HMR RPR LUN SAG MER PHU ROC	BAY ZEN HMR LUN SAG MER PHU ROC
SG 7:	CEL	CEL

The general agreement between these two solutions is excellent with five out of the seven strategic groups identical between the two cluster analyses. There are two changes, Zeneca and Bayer are moved from strategic group 1, the diversified conglomerates, into group six which consists of companies more strongly oriented toward pharmaceuticals. Rhone Poulenc Rorer is moved from group six to group five which consists of companies with a very strong pharmaceutical focus across a broad range of product areas. In 1997 three new companies entered the industry. Eisai and Takeda are Japanese companies which set up "de novo", largely sales and distribution, operations in the UK. Both companies are focused around only two therapy areas. Eisai is positioned within group 2, which consists largely of pharmaceutical "specialists". Takeda in contrast forms a third singleton group alongside Baxter and Celltech, both of which pursue niche strategies. Shire, the third new entrant, also focuses on clearly defined pharmaceutical segments and like Eisai is positioned within strategic group 2. Outlier analysis indicates that Shire, Lilly and Hoechst Marion Roussell are positioned at the outer fringes of strategic groups 2, 5 and 6 respectively. The presence of Shire, a new entrant, on the fringe supports the presence of inner and outer positions within

strategic groups, because new entrants may be expected to enter at the lowest barrier to entry. From this point the company may gather information and experience and progress (Caves & Porter, 1977). The notion that group 2 is protected by lower entry barriers is also supported by the fact that Eisai, another new entrant, is positioned here, although perhaps more closely aligned to the core strategy exemplified by Pfizer.

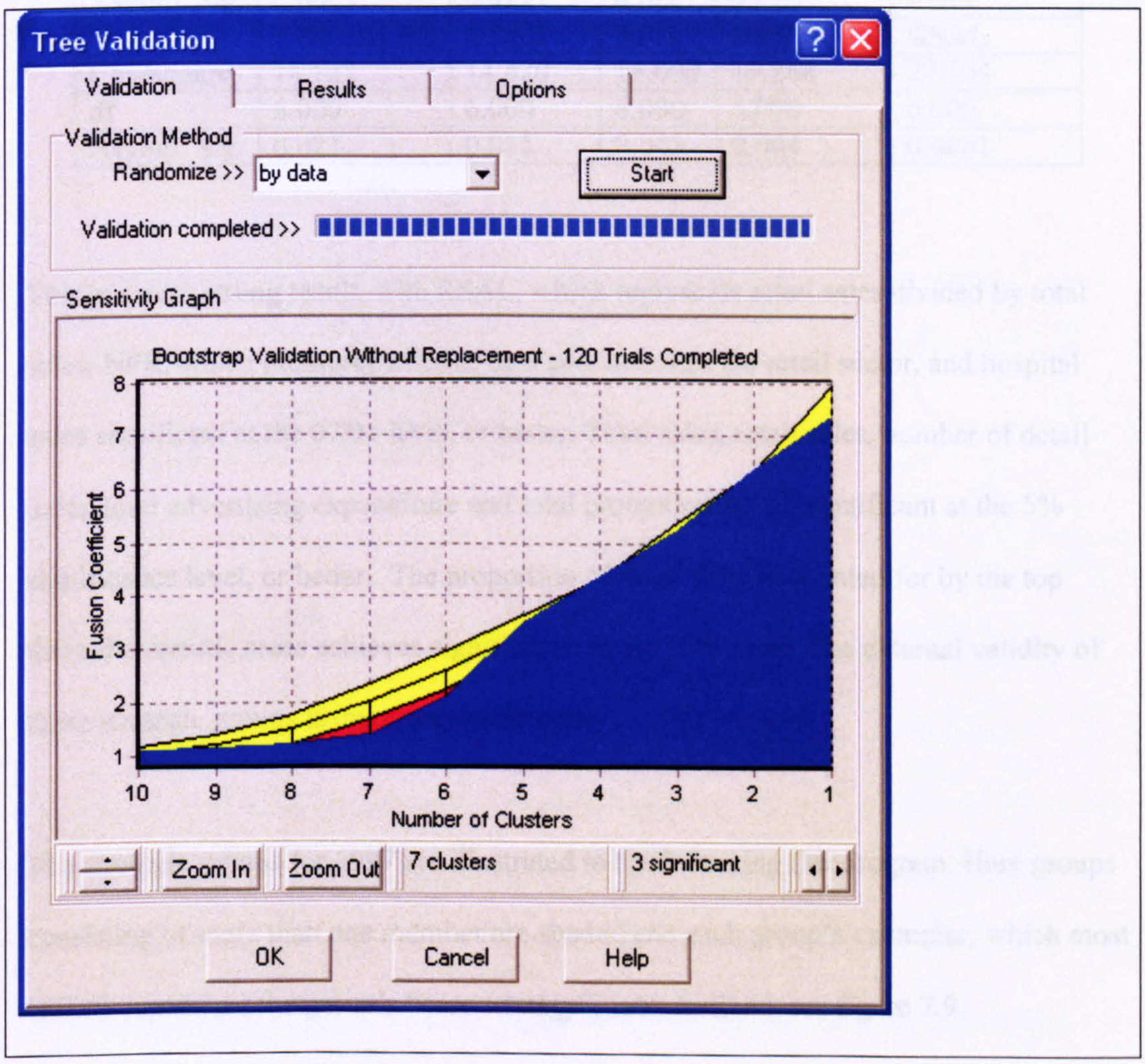
Internal group validity for this cluster solution was confirmed using an Upper Tail significance test, which indicates that a seven cluster solution was the largest number of clusters that differed significantly at the 5% significance level. The results of this test are illustrated in table 7.17.

Table 7.17 Upper Tail Significance Test showing the correct number of clusters 1997

Partition	Deviate	t-Statistic
2 clusters	3.57	22.88
3 clusters	3.02	19.36
4 clusters	2.39	15.33
5 clusters	1.89	12.09
6 clusters	1.4	8.98
7 clusters	0.62	3.98

The presence of a "natural structure" within the data was confirmed by bootstrap validation, see figure 7.8.

Figure 7.8 Validation of a Natural Structure 1997



The above figure shows that the 7 cluster solution departs most significantly from random but that 3 of the total partitions differ significantly at the 5% level.

External validation of the strategic groups was then confirmed using the Kruskal Wallis One Way Analysis of Variance Test, as before the results of this test are shown in table 7.18.

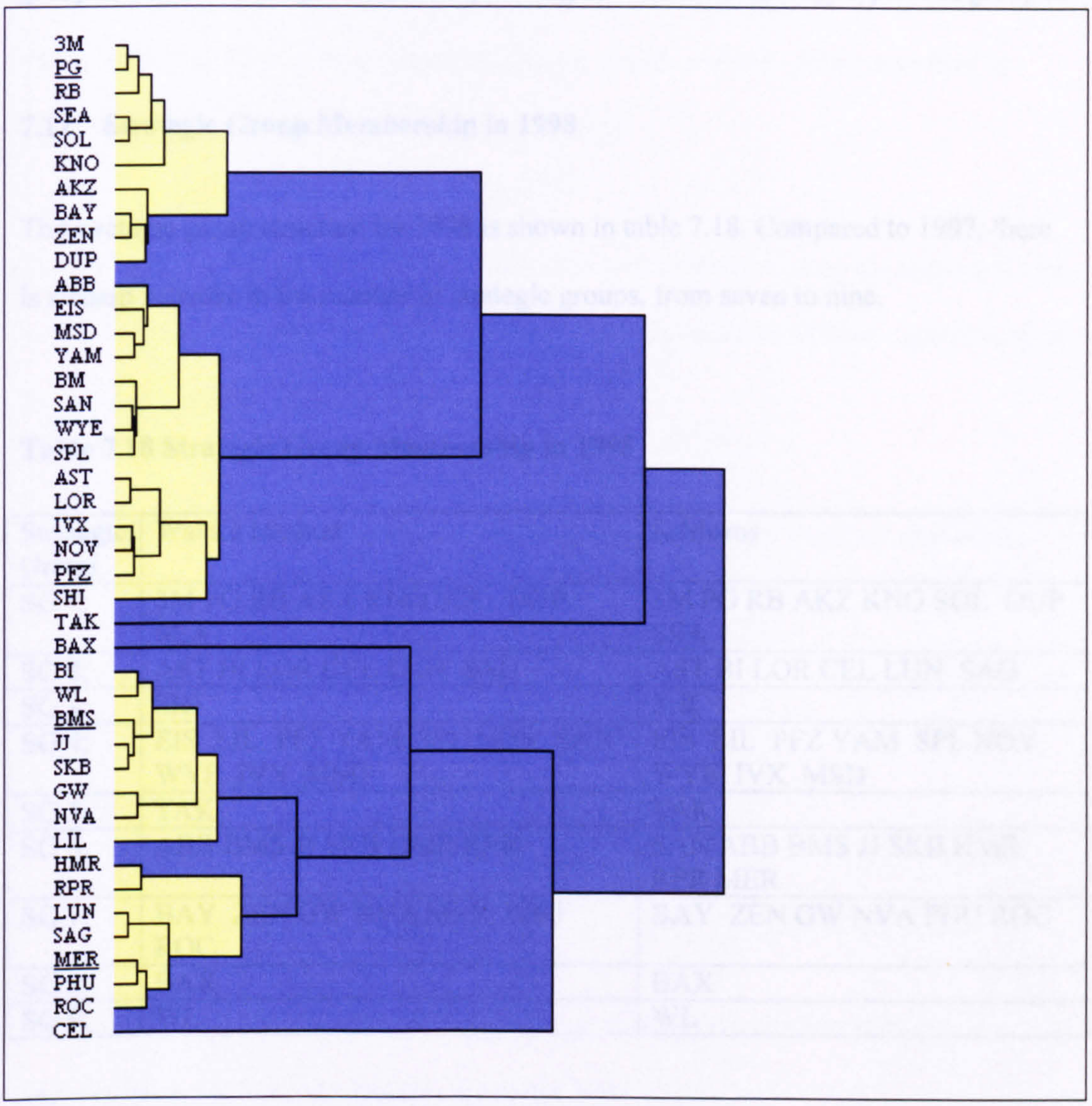
Table 7.18 Kruskal Wallis test of external validity of 1997 Strategic Groups

	HSALES	RSALES	TADV	TOPRTAS	TOTPROM
Chi-Square	25.261	14.933	14.973	11.593	15.427
df	6.000	6.000	6.000	6.000	6.000
Asymp. Sig.	0.0003	0.021	0.020	0.072	0.017
	TOTSALES	**UDET**	**NPH**	**NPR**	**RSAL**
Chi-Square	14.922	14.420	13.000	19.268	27.104
df	6.000	6.000	6.000	6.000	6.000
Asymp. Sig.	0.021	0.025	0.043	0.004	0.0001

This is a very strong result, with RSAL, which represents retail sales divided by total sales, NPR, which measures sales of new products into the retail sector, and hospital sales significant at the 0.001 level, or better. Total sales, retail sales, number of detail units, total advertising expenditure and total promotion are all significant at the 5% significance level, or better. The proportion of retail sales accounted for by the top three therapeutic areas achieves significance at the 10% level. The external validity of these strategic groups is therefore confirmed.

The strategic groups for 1997 are illustrated in the following Dendrogram. Here groups consisting of more than one member are shaded and each group's exemplar, which most closely represents the group's "core strategy", is underlined; see figure 7.9.

Figure 7.9 Dendrogram of 1997 strategic group structure



7.10 Mergers in 1997

During 1997 only one merger took place. This was the acquisition of Boehringer Mannheim by Roche. The principal logic appeared to be that both companies were very strong in diagnostic products, although Boehringer Mannheim also had significant pharmaceutical activities that were subsumed into the Roche portfolio. As in the majority of previous mergers, described earlier in this chapter, the merger occurred

between strategic groups -Roche the acquiring company was a member of strategic group 6, while Boehringer Mannheim, the target, followed a strategy typical of group 2.

7.11 Strategic Group Membership in 1998

The strategic group structure for 1998 is shown in table 7.18. Compared to 1997, there is a sharp increase in the number of strategic groups, from seven to nine.

Table 7.18 Strategic Group Membership in 1998

Strategic Group	Ward's Method	K Means
SG 1:	3M PG RB AKZ KNO SOL DUP SEA	3M PG RB AKZ KNO SOL DUP SEA
SG 2:	AST BI LOR CEL LUN SAG	AST BI LOR CEL LUN SAG
SG 3:	SHI	SHI
SG 4:	EIS LIL PFZ YAM SPL NOV SAN WYE IVX MSD	EIS LIL PFZ YAM SPL NOV WYE IVX MSD
SG 5:	TAK	TAK
SG 6:	ABB BMS JJ SKB HMR RPR	SAN ABB BMS JJ SKB HMR RPR MER
SG 7:	BAY ZEN GW NVA MER PHU ROC	BAY ZEN GW NVA PHU ROC
SG 8:	BAX	BAX
SG 9:	WL	WL

The agreement between these two cluster analysis solutions is again very good. Clusters one, two, three, five, eight and nine are identical. The two differences are the reallocation of Sanofi Winthrop from group 4 to 6, and E Merck from group 7 to 6. An interesting observation is that Warner Lambert now forms a singleton group. This appears to be the result of the launch of Lipitor, a blockbuster product that lowers cholesterol. Lipitor went on to become one of the world's biggest selling pharmaceutical products; see Chapter 4 for a fuller discussion on the effect of blockbuster products on pharmaceutical companies. Examination of group outliers

indicated that Dupont, Pharmacia Upjohn and Roche were positioned on the periphery of their respective strategic groups. The position of Roche may in part be explained by the recent acquisition of Boehringer Mannheim, which probably took some time to digest and may have led to a slight shift in strategy.

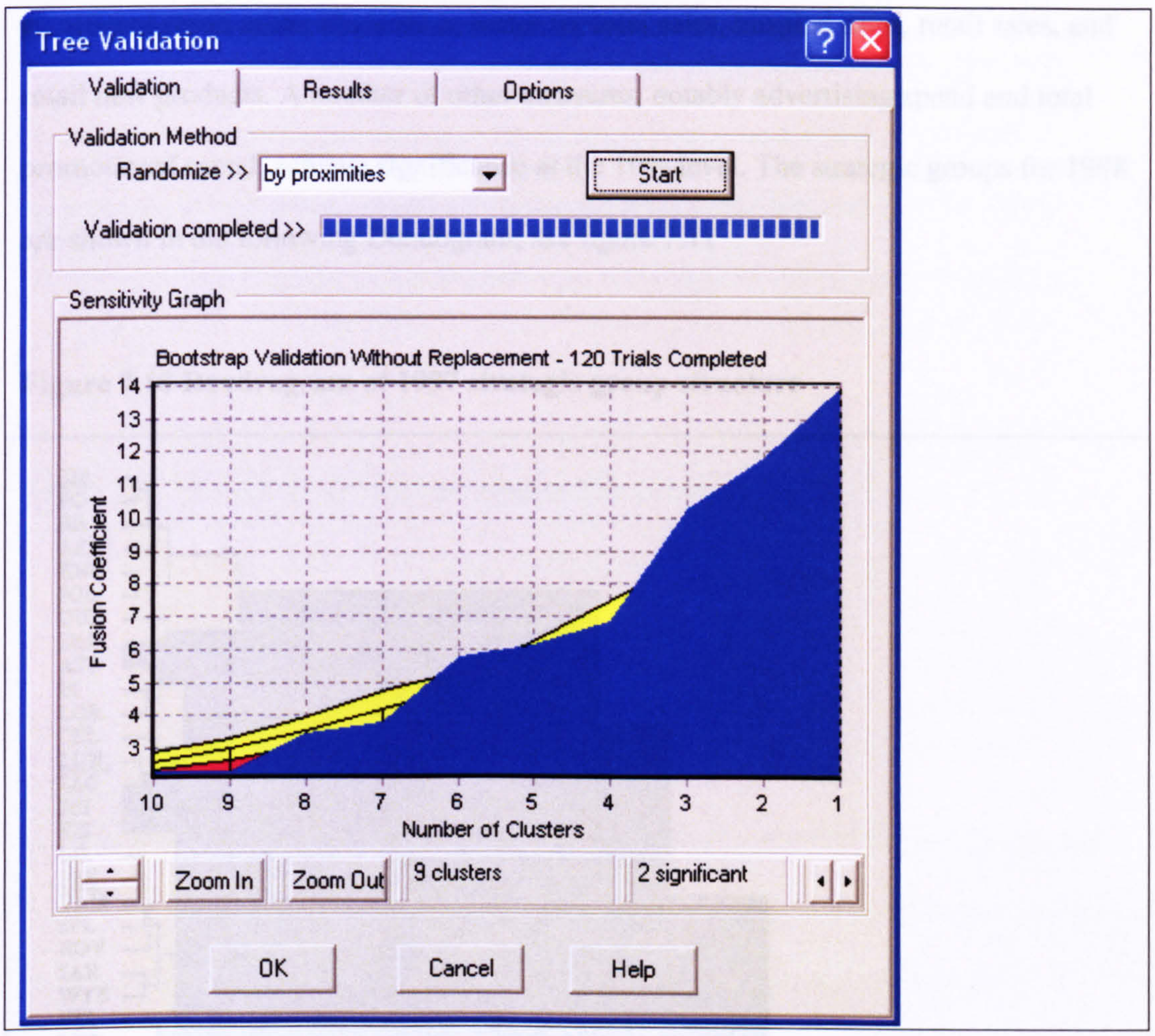
Internal group validity of a nine cluster solution was confirmed using the upper tail test, which indicated that this was the largest number of clusters that differed significantly at the 5% level. These results are shown in table 7.19.

Table 7.19 Upper Tail Significance Test showing the correct number of clusters 1998

Partition	Deviate	t-Statistic
2 clusters	3.54	22.39
3 clusters	2.9	18.36
4 clusters	2.43	15.4
5 clusters	1.44	9.09
6 clusters	1.22	7.72
7 clusters	1.11	7.03
8 clusters	0.53	3.34
9 clusters	0.42	2.63

The presence of a natural structure within the data was again confirmed by a bootstrapping validation technique, see figure 7.10

Figure 7.9 Bootstrap Validation of 1998 Data



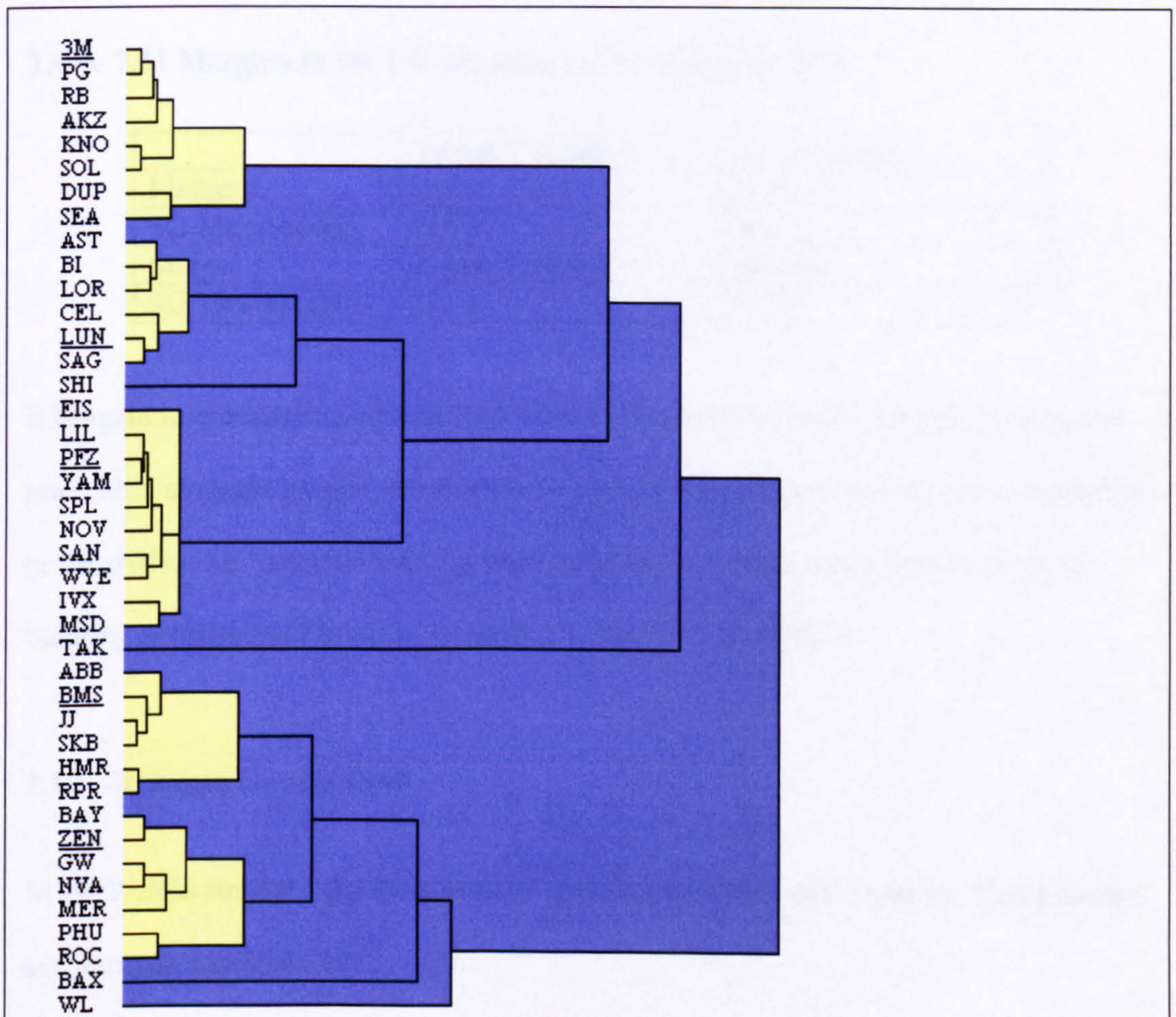
External validation of the nine strategic groups was then tested using the Kruskal Wallis one way analysis of variance test. These results are shown in table 7.20.

Table 7.20 Kruskal Wallis test of external validity of 1998 Strategic Groups

	HSALES	**RSALES**	**TADV**	**TOPRTAS**	**TOTPROM**
Chi-Square	28.370	16.586	13.961	14.014	13.550
df	8.000	8.000	8.000	8.000	8.000
Asymp. Sig.	0.0004	0.035	0.083	0.081	0.094
	TOTSALES	**UDET**	**NPH**	**NPR**	**RSAL**
Chi-Square	17.577	12.434	11.207	18.265	24.658
df	8.000	8.000	8.000	8.000	8.000
Asymp. Sig.	0.025	0.133	0.190	0.019	0.002

This result is not as strong as for 1997, but external validity is confirmed by a significant result at the 5% level or better for total sales, hospital sales, retail sales, and retail new products. A number of other measures, notably advertising spend and total promotional spend, achieve significance at the 10% level. The strategic groups for 1998 are shown in the following Dendogram; see figure 7.11

Figure 7.10 Dendrogram of 1997 strategic group structure



7.12 Mergers in 1998

Two mergers occurred in 1998. The first between the Swedish company Astra and Zeneca a UK company resulted in Astra Zeneca. The second joined two French companies, Sanofi Winthrop and Lorex Synthelabo, which together formed Sanofi Synthelabo. The strategic group membership relevant to these mergers, is shown in table 7.21.

Table 7.21 Mergers in the UK pharmaceutical industry 1998

	Target Company	Acquired By
Merger 1	Astra	Zeneca
SG Membership	SG 2	SG 7
Merger 2	Lorex Synthelabo	Sanofi
SG Membership	SG 2	SG 6

It is again interesting to note that both mergers occurred between strategic groups and not within strategic groups; an observation, which may suggest that resource acquisition or diversification, acted here as a primary motive for merger rather than synergy or building economies of scale in marketing, research or production.

7.13 Strategic Groups 1999

In 1999 eight strategic groups existed in the UK pharmaceutical industry. These groups are illustrated in table 7.22.

Table 7.22 Strategic Group Membership in 1999

Strategic Group	Ward's Method	K Means
SG 1:	3M PG RB KNO SOL AKZO BAY	3M PG RB KNO SOL AKZO BAY
SG 2:	EIS TAK	EIS TAK
SG 3:	ABB JJ SKB BMS MER IVX LIL SHI SPL WYE NOV WL YAM	ABB JJ SKB BMS IVX LIL SHI SPL WYE NOV WL YAM
SG 4:	AZ BI SS NVA CELL LUN SAG	MER AZ BI NVA CELL LUN SAG
SG 5:	DUP SEA HMR RPR	DUP SEA HMR RPR
SG 6:	BAX	BAX
SG 7:	GW ROC PU	GW ROC PU
SG 8:	MSD PFZ	SS MSD PFZ

Once again there is excellent agreement between the two clustering solutions. Groups one, two, five, six and seven are identical. Only two companies are reclassified by the k means algorithm, E Merck moves from strategic group 3 to 4 and Sanofi Synthelabo moves from group 4 to join MSD and Pfizer in strategic group 8. The pairing of MSD and Pfizer together is in agreement with a recent review of Merck Sharpe and Dohme, which concluded that Pfizer was the benchmark competitor of MSD against whom the company measured its research and marketing activities (Hawthorne, 2003).

Outlier analysis indicated that Abbott, Celltech and Dupont were situated towards the periphery of their strategic group. This result is not surprising for Celltech, a niche competitor, which frequently features as a singleton group throughout this analysis.

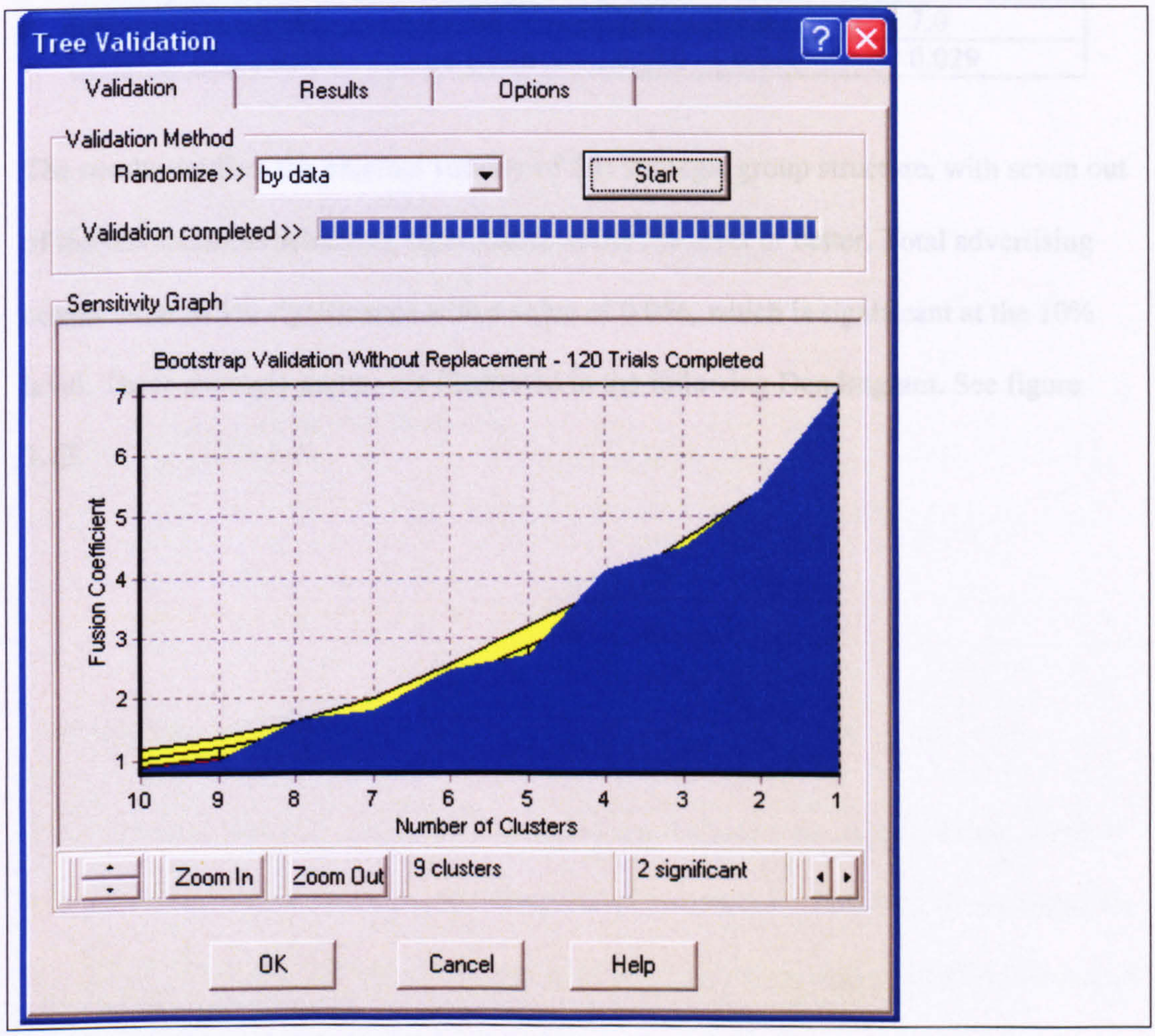
Internal group validity for this eight cluster solution was confirmed using the upper tail significance test; see table 7.23.

Table 7.23 Upper Tail Significance Test showing the correct number of clusters 1999

Partition	Deviate	t-Statistic
2 clusters	3.67	22.62
3 clusters	2.66	16.41
4 clusters	2.11	13
5 clusters	1.87	11.54
6 clusters	1.03	6.35
7 clusters	0.88	5.4
8 clusters	0.47	2.9

As before presence of a natural structure within the data set was confirmed by bootstrap validation; see figure 7.12.

Figure 7.11 Bootstrap Validation of 1999 Data



This bootstrap tree validation procedure reveals a strong natural structure within the data with the 9 cluster solution departing most significantly from random, two of the tree partitions differ significantly at the 5% level from the confidence level constructed around the mean of a random sample (Wishart, 2004).

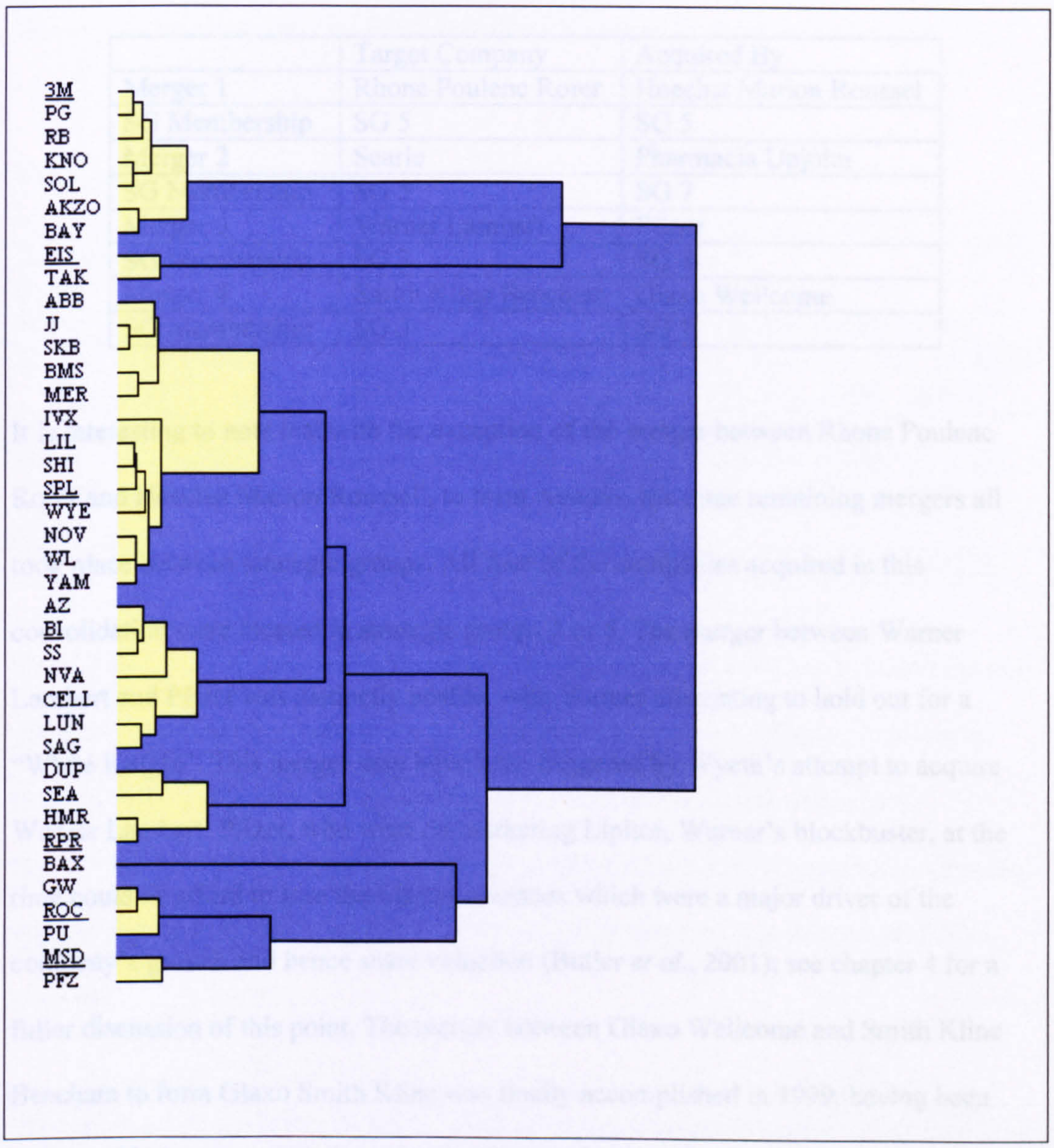
External validation was then tested using the Kruskal Wallis test; see table 7.24

Table 7.24 Kruskal Wallis test of external validity of 1999 Strategic Groups

	HSALES	**RSALES**	**TADV**	**TOPRTAS**	**TOTPROM**
Chi-Square	17.822	15.503	13.754	15.622	10.762
df	7.0	7.0	7.0	7.0	7.0
Asymp. Sig.	0.013	0.030	0.056	0.029	0.149
	TOTSALES	**UDET**	**NPH**	**NPR**	**RSAL**
Chi-Square	14.833	9.708	16.610	18.533	15.650
df	7.0	7.0	7.0	7.0	7.0
Asymp. Sig.	0.038	0.206	0.020	0.010	0.029

The results confirm the external validity of this strategic group structure, with seven out of the ten measures achieving significance at the 5% level or better. Total advertising comes close to 5% significance with a value of 0.056, which is significant at the 10% level. These strategic groups are illustrated in the following Dendrogram. See figure 7.13

Figure 7.12 Dendrogram of strategic groups in the UK pharmaceutical industry 1999



7.14 Mergers in 1999

1999 marks the second major upheaval during the ten year time period studied, 1993 - 2002. The first significant wave of consolidation occurred in 1995 when five companies merged. In 1999 four companies merged marking a new level of competition in terms of scale. These mergers are shown in table 7.25.

Table 7. 25 Mergers in the UK pharmaceutical industry 1999

	Target Company	Acquired By
Merger 1	Rhone Poulenc Rorer	Hoechst Marion Roussel
SG Membership	SG 5	SG 5
Merger 2	Searle	Pharmacia Upjohn
SG Membership	SG 5	SG 7
Merger 3	Warner Lambert	Pfizer
SG Membership	SG 3	SG 8
Merger 4	Smith Kline Beecham	Glaxo Wellcome
SG Membership	SG 3	SG 7

It is interesting to note that with the exception of the merger between Rhone Poulenc Rorer and Hoechst Marion Roussell, to form Aventis, the three remaining mergers all took place between strategic groups. All four of the companies acquired in this consolidation were located in strategic groups 3 or 5. The merger between Warner Lambert and Pfizer was distinctly hostile, with Warner attempting to hold out for a "White Knight". This merger may have been triggered by Wyeth's attempt to acquire Warner Lambert. Pfizer, who were co-marketing Lipitor, Warner's blockbuster, at the time could ill afford to lose the Lipitor revenues which were a major driver of the company's growth and hence share valuation (Butler *et al.*, 2001); see chapter 4 for a fuller discussion of this point. The merger between Glaxo Wellcome and Smith Kline Beecham to form Glaxo Smith Kline was finally accomplished in 1999, having been attempted but not concluded previously. One explanation for these mergers to create a number of mega companies is to achieve scale in sales and marketing within the US market, which was rapidly emerging as the principal driver of pharmaceutical profits, (see chapter 4).

7.15 Strategic Groups 2000

In 2000 there was a sharp decline in the number of strategic groups, from eight in 1999 down to six in the year 2000. These strategic groups are shown in table 7.26.

Table 7.26 Strategic Groups 2000

Strategic Group	Ward's Method	K Means
SG 1:	3M PG AKZO RB KNO SOL	3M PG AKZO RB KNO SOL
SG 2:	EIS IVX MSD LIL SHI SS NOV PFZ YAM SPL WYE	EIS IVX MSD LIL SHI SS NOV PFZ YAM SPL WYE ABB JJ
SG 3:	TAK	TAK
SG 4:	ABB BMS JJ MER NVA ROC BI SAG LUN CEL	BMS MER NVA ROC BI SAG LUN CEL
SG 5:	BAX	BAX
SG 6:	AVE PHR AZ BAY DUP GSK	AVE PHR AZ BAY DUP GSK

These two groupings are extremely close. Groups 1, 3, 5 and 6 are identical and the only reallocations that take place are the reassignment of Abbott and Johnson & Johnson from strategic group 4 to strategic group 2. Takeda and Baxter are once again represented as singletons indicating that these companies pursue distinct niche strategies that are deployed very differently from the rest of the industry's pattern of strategic choices.

The presence of six outliers in the year 2000 perhaps indicates a degree of turbulence or uncertainty in the market. Abbott, Lundbeck, Celltech, Aventis, Dupont and Glaxo Smith Kline are all positioned towards the periphery of their groups. Celltech has been discussed previously and this company's strategy appears to vacillate between wholly dissimilar to and not entirely congruent with the group to which it is closest. As mentioned earlier this company is a niche player with little similarity to the other companies included in this analysis.

Aventis and Glaxo Smith Kline both merged in the previous period and a degree of reorientation is perhaps likely during the integration process. Dupont merged during 2000, which may explain a shift in strategic position.

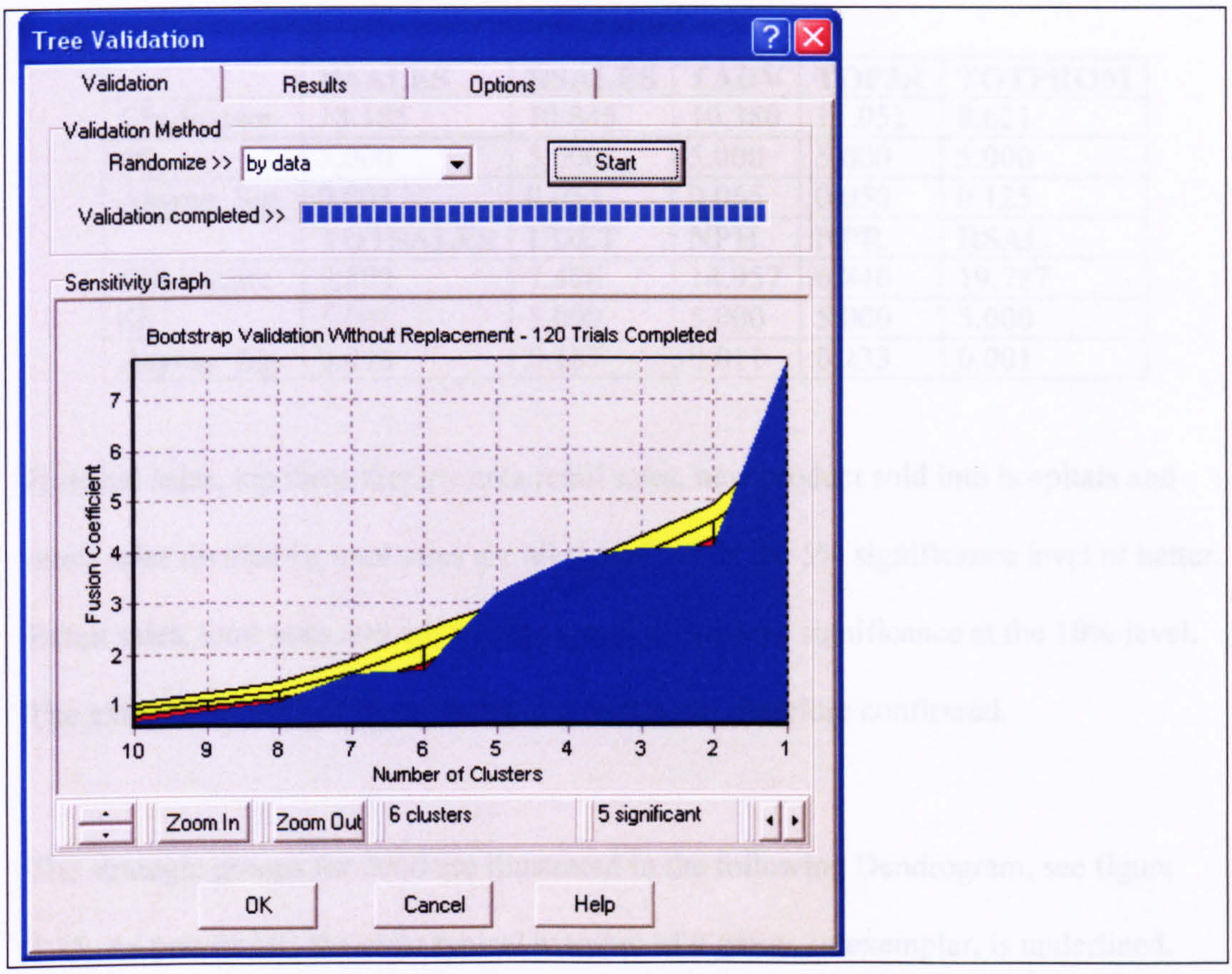
Internal validity of this clustering solution was achieved by utilizing the upper tail test which confirmed that the six cluster solution was the largest number of groups significant at the 5% level. This result is shown in table 7.27.

Table 7.27 Upper Tail Significance Test showing the correct number of clusters 2000

Partition	Deviate	t-Statistic
2 clusters	4.01	23.4
3 clusters	1.84	10.76
4 clusters	1.81	10.56
5 clusters	1.69	9.86
6 clusters	1.29	7.52

The presence of natural structure within the data set was confirmed by means of bootstrap validation, see figure 7.14.

Figure 7.13 Bootstrap Validation of 2000 Data



The bootstrap tree validation procedure reveals a strong natural structure within the data consisting with the 6 cluster solution departing most significantly from random, five of the tree partitions differ significantly at the 5% level from the confidence level constructed around the mean of a random sample.

External validity of the six strategic groups was confirmed through application of the Kruskal Wallis test to a set of strategy and performance measures not included in the cluster analysis. These results are shown in table 7.28.

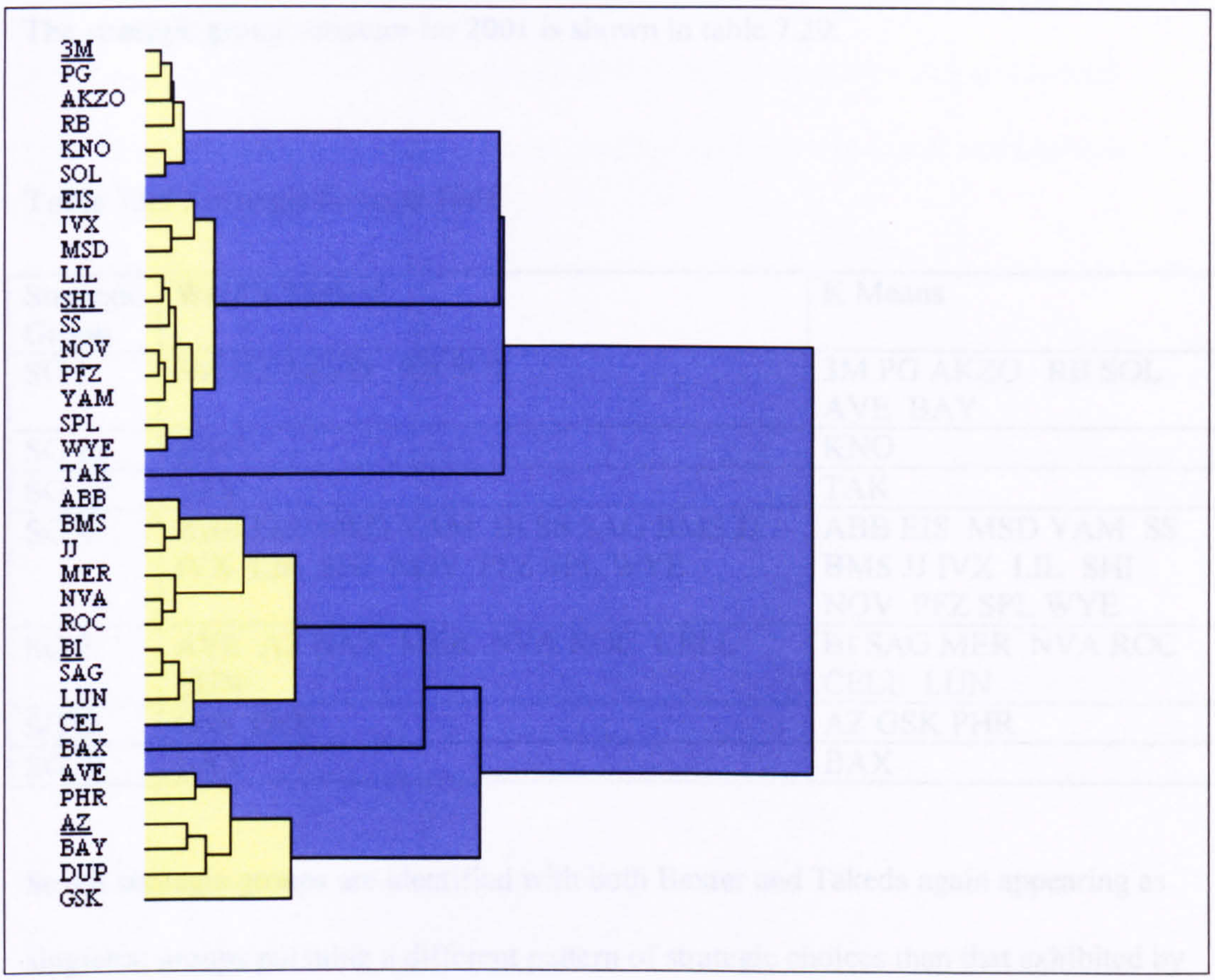
Table 7.28 Kruskal Wallis test of external validity of 2000 Strategic Groups

	HSALES	RSALES	TADV	TOP3R	TOTPROM
Chi-Square	18.185	10.845	10.380	11.052	8.621
df	5.000	5.000	5.000	5.000	5.000
Asymp. Sig.	0.003	0.055	0.065	0.050	0.125
	TOTSALES	**UDET**	**NPH**	**NPR**	**RSAL**
Chi-Square	9.899	7.486	14.957	6.840	19.787
df	5.000	5.000	5.000	5.000	5.000
Asymp. Sig.	0.078	0.187	0.011	0.233	0.001

Hospital sales, top three therapy area retail sales, new product sold into hospitals and retail sales divided by total sales are all significant at the 5% significance level or better. Retail sales, total sales and advertising spend all achieve significance at the 10% level. The external validity of these strategic groupings is therefore confirmed.

The strategic groups for 2000 are illustrated in the following Dendrogram, see figure 7.15. As previously, the most typical member of a group, or exemplar, is underlined.

Figure 7.14 Dendrogram of strategic groups in the UK pharmaceutical industry 2000



7.16 Mergers in 2000

During 2000 one merger took place. Bristol Myers Squibb acquired the pharmaceutical interests of Dupont. This merger took place between strategic groups, with Bristol Myers initially located in strategic group 4, and Dupont positioned in strategic group 6.

7.17 Strategic group membership 2001

The strategic group structure for 2001 is shown in table 7.29.

Table 7.29 Strategic Groups 2001

Strategic Group	Ward's Method	K Means
SG 1:	3M PG AKZO RB SOL	3M PG AKZO RB SOL AVE BAY
SG 2:	KNO	KNO
SG 3:	TAK	TAK
SG 4:	ABB EIS MSD YAM BI SS SAG BMS JJ IVX LIL SHI NOV PFZ SPL WYE	ABB EIS MSD YAM SS BMS JJ IVX LIL SHI NOV PFZ SPL WYE
SG 5:	AVE AZ BAY MER NVA ROC CELL LUN	BI SAG MER NVA ROC CELL LUN
SG 6:	GSK PHR	AZ GSK PHR
SG 7:	BAX	BAX

Seven strategic groups are identified with both Baxter and Takeda again appearing as singleton groups pursuing a different pattern of strategic choices than that exhibited by the rest of the industry. The two solutions are not as close as previously with a number of adjustments made from the original hierarchical solution obtained by Ward's method by the k means analysis. Groups two, three and six are identical but all are populated by only one member. The movement of Knoll into a singleton group may be due to the firm's merger with Abbott, which occurred in 2001. It is interesting to note that Abbott was an outlier in the 2000 analysis which may indicate a shift in position prior to the merger announcement. Schering AG is moved from strategic group 4 to 5, Aventis and Bayer from group 4 to 1, Boehringer Ingelheim from group 4 to 5 and Astra Zeneca from group 5 to strategic group 6.

Outlier analysis indicates that Abbott, Celltech and Aventis are positioned at the edge of their cluster. Abbott, as mentioned above, acquired Knoll the pharmaceutical interests of

BASF during 2001. Celltech has been discussed earlier in this chapter and the same observations apply. The position of Aventis as an outlier may reflect ongoing integration. It was not until 2002 that the divestment of agrochemicals and animal nutrition, to leave a "pure play" pharmaceutical company, was completed (Aventis, 2002).

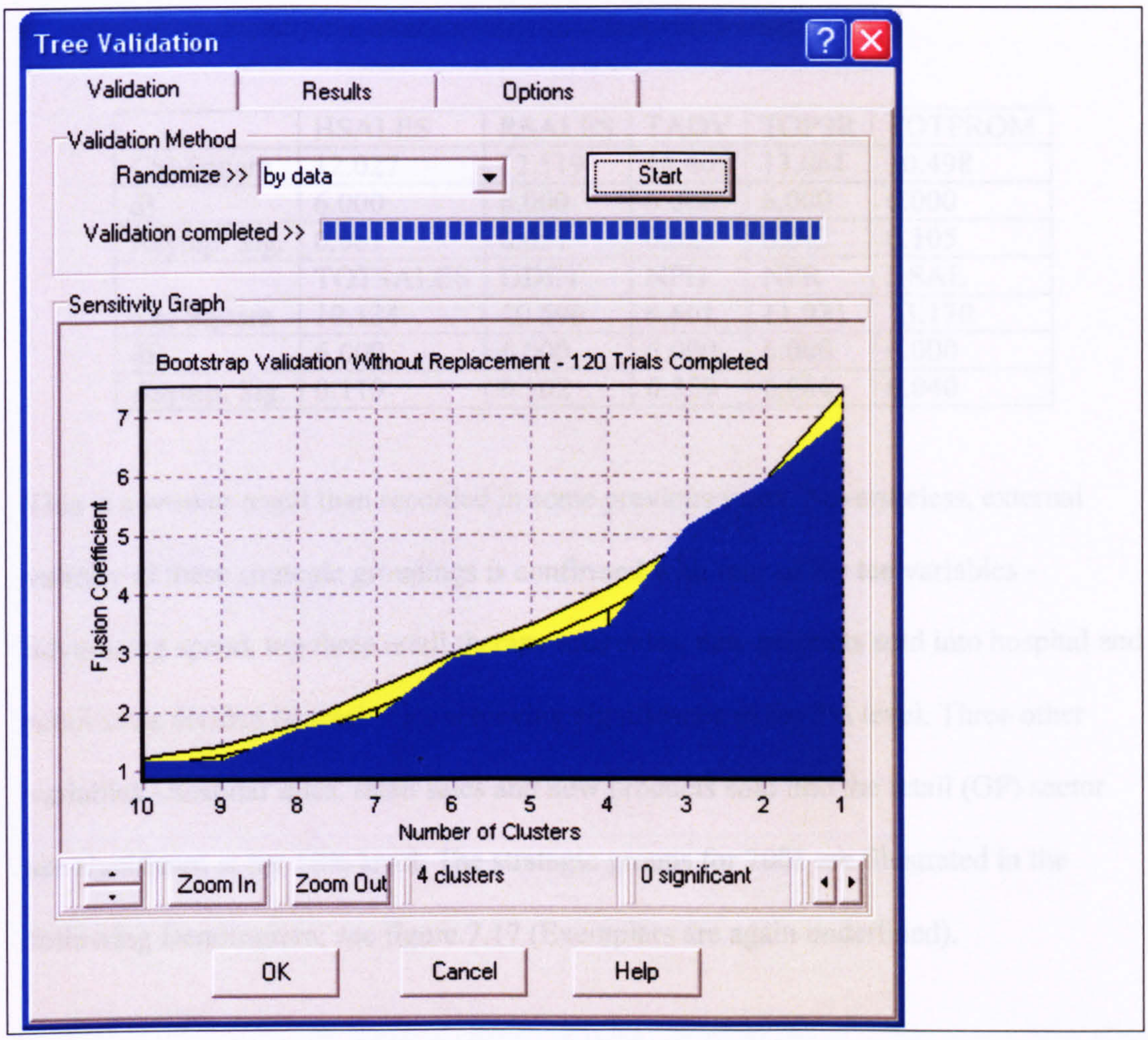
Internal cluster validity was determined using the upper tail test, which confirmed that a seven cluster solution represented the largest number of significantly different clusters at the 5% level; see table 7.30.

Table 7.30 Upper Tail Significance Test showing the correct number of clusters 2001

Partition	Deviate	t-Statistic
2 clusters	3.91	22.46
3 clusters	1.92	11.04
4 clusters	1.84	10.57
5 clusters	1.34	7.68
6 clusters	1.08	6.21
7 clusters	0.85	4.88

The presence of natural structure within the data was confirmed by bootstrap validation; see figure 7.16. This result is not particularly strong when compared to some of the other years studied but does confirm presence of a degree of natural structure. When bootstrapping was applied to the proximities within the similarity matrix rather than to the raw z scored data a stronger result was obtained; see appendix B.

Figure 7.15 Bootstrap Validation of 2001 Data



The bootstrap tree validation procedure reveals a relatively weak natural structure within the data with the 4 cluster solution departing most significantly from random.

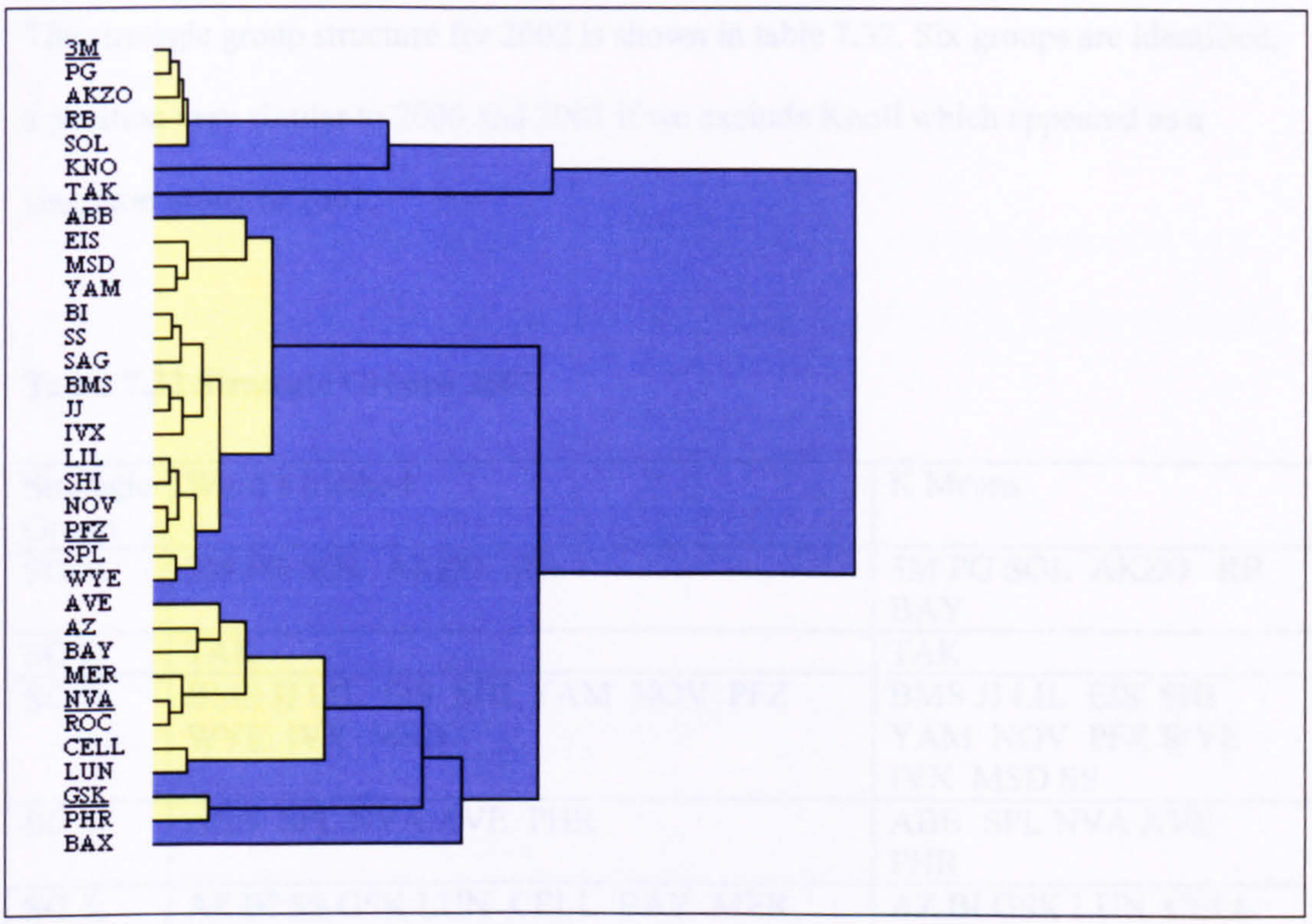
External validation of the strategic groups was then tested by application of the Kruskal Wallis one way analysis test to a set of strategic and performance variables not included in the cluster analysis; see table 7.31.

Table 7.31 Kruskal Wallis test of external validity of 2001 Strategic Groups

	HSALES	RSALES	TADV	TOP3R	TOTPROM
Chi-Square	12.027	12.519	14.467	13.061	10.498
df	6.000	6.000	6.000	6.000	6.000
Asymp. Sig.	0.061	0.051	0.025	0.042	0.105
	TOTSALES	UDET	NPH	NPR	RSAL
Chi-Square	10.134	10.590	6.601	11.931	13.170
df	6.000	6.000	6.000	6.000	6.000
Asymp. Sig.	0.119	0.102	0.359	0.064	0.040

This is a weaker result than recorded in some previous years. Nevertheless, external validity of these strategic groupings is confirmed with four of the ten variables - advertising spend, top three retail therapy area sales, new products sold into hospital and retail sales divided by total sales achieving significance at the 5% level. Three other variables - hospital sales, retail sales and new products sold into the retail (GP) sector are significant at the 10% level. The strategic groups for 2001 are illustrated in the following Dendrogram; see figure 7.17 (Exemplars are again underlined).

Figure 7.16 Dendrogram of strategic groups in the UK pharmaceutical industry 2001



7.18 Mergers in 2001

During 2001 one merger occurred within the companies included in this study. This was the sale of Knoll to Abbott as BASF divested its pharmaceutical operation. This merger occurred between strategic groups, Knoll is classified within strategic group 2 and Abbott is a member of group 4.

7.19 Strategic Group Membership in 2002

The strategic group structure for 2002 is shown in table 7.32. Six groups are identified, a position very similar to 2000 and 2001 if we exclude Knoll which appeared as a singleton group in 2001.

Table 7.32 Strategic Groups 2002

Strategic Group	Ward's Method	K Means
SG 1:	3M PG SOL AKZO RB	3M PG SOL AKZO RB BAY
SG 2:	TAK	TAK
SG 3:	BMS JJ LIL EIS SHI YAM NOV PFZ WYE IVX MSD	BMS JJ LIL EIS SHI YAM NOV PFZ WYE IVX MSD SS
SG 4:	ABB SPL NVA AVE PHR	ABB SPL NVA AVE PHR
SG 5:	AZ BI SS GSK LUN CELL BAY MER ROC SAG	AZ BI GSK LUN CELL MER ROC SAG
SG 6:	BAX	BAX

The two cluster analyses are in strong agreement with only two reallocations taking place. Bayer moves from group 5 to group 1 and Sanofi Synthelabo from group 5 to 3. Strategic groups 2, 4 and 6 are identical between the two solutions. Once again Takeda and Baxter represent singleton groups.

Outlier analysis identifies six companies - Abbott, Novartis, Lundbeck, Celltech, Bayer and E Merck - positioned towards the fringe of their respective groups. Celltech has been discussed earlier in this chapter. Abbott acquired the Knoll pharmaceutical business in the previous year and may therefore have been engaged in integration. Bayer suffered a blow in 2001 when Lipobay, the company's leading product, was withdrawn from the market due to side effects and this probably explains the company's shift back

into strategic group 1 the "diversified conglomerates", during 2001, where it remained in 2002. Such a dramatic change of fortunes is likely to herald a shift in strategic priorities.

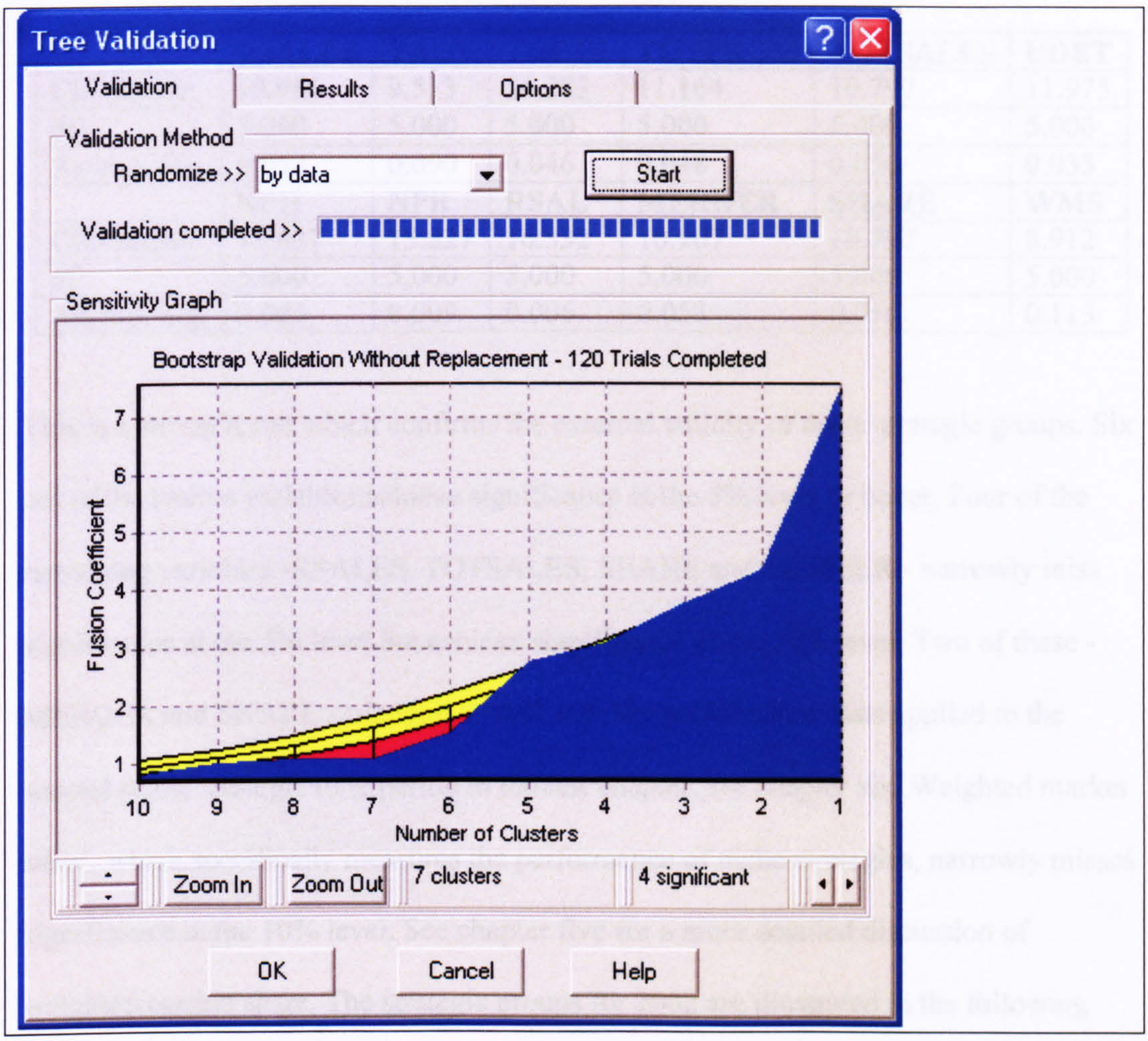
Internal group validity was confirmed with the upper tail test, which confirmed the presence of six discrete strategic groups that differed significantly at the 5% level; see table 7.33.

Table 7.33 Upper Tail Significance Test showing the correct number of clusters 2002

Partition	Deviate	t-Statistic
2 clusters	3.97	22.46
3 clusters	2.06	11.68
4 clusters	1.7	9.63
5 clusters	1.28	7.27
6 clusters	1.07	6.02

The presence of a degree of natural structure in the data set was confirmed by a bootstrap validation technique; see figure 7.18.

Figure 7.17 Bootstrap Validation of 2002 Data



This bootstrap tree validation procedure reveals a strong natural structure within the data which differs most significantly from random at the 7 cluster solution, four of the tree partitions significantly at the 5% level from the confidence level constructed around the mean of a random sample.

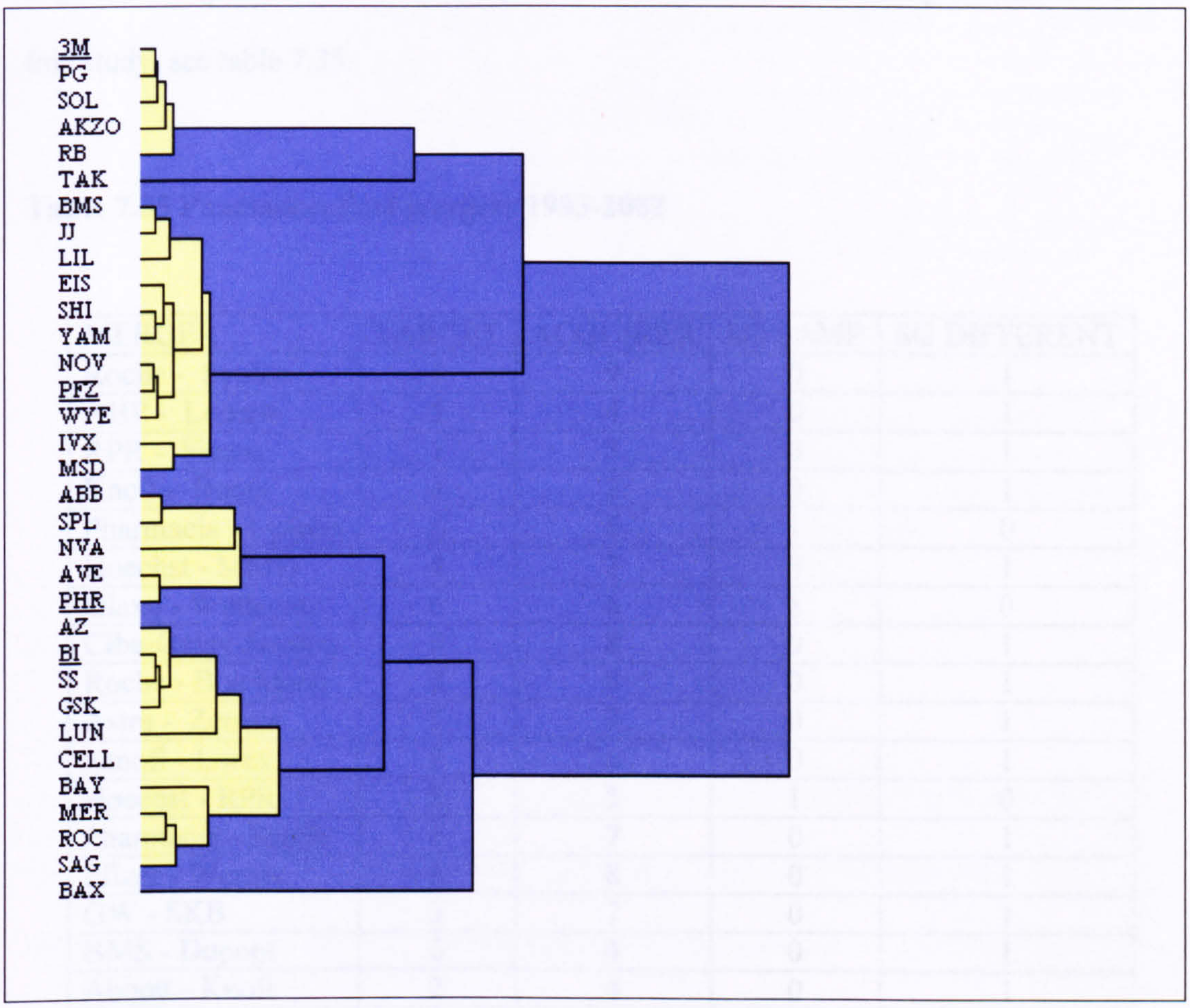
External validity of the strategic groups was then tested by applying the Kruskal Wallis one way analysis of variance test to twelve strategic and performance variables not included in the cluster analysis. The results of this test are shown in table 7.34.

Table 7.34 Kruskal Wallis test of external validity of 2001 Strategic Groups

	RSALES	TADV	TOP3R	TOTPROM	TOTSALES	UDET
Chi-Square	10.966	9.513	11.283	11.164	10.797	11.975
df	5.000	5.000	5.000	5.000	5.000	5.000
Asymp. Sig.	0.052	0.090	0.046	0.048	0.056	0.035
	NPH	**NPR**	**RSAL**	**MERGER**	**SHARE**	**WMS**
Chi-Square	16.637	15.227	16.332	10.907	10.797	8.912
df	5.000	5.000	5.000	5.000	5.000	5.000
Asymp. Sig.	0.005	0.009	0.006	0.053	0.056	0.113

This is a strong result which confirms the external validity of these strategic groups. Six out of the twelve variables achieve significance at the 5% level or better. Four of the remaining variables -RSALES, TOTSALES, SHARE and MERGER - narrowly miss significance at the 5% level but achieve significance at the 10% level. Two of these - MERGER and SHARE - triangulate well with the performance tests applied to the second stable strategic time period in the last chapter; see chapter six. Weighted market share, which specifically measures the performance of niche strategies, narrowly misses significance at the 10% level. See chapter five for a more detailed discussion of weighted market share. The strategic groups for 2002 are illustrated in the following Dendrogram.

Figure 7.18 Dendrogram of strategic groups in the UK pharmaceutical industry 2002



7.20 Mergers in 2002.

In 2002 one merger occurred within the companies included in this study. Pfizer acquired Pharmacia Upjohn. This acquisition followed the same pattern observed for Warner Lambert, where having successfully co-marketed the company's leading product, in this case Celebrex, Pfizer launched a bid for the company. This acquisition occurred between strategic groups, Pfizer is in group 3 while Pharmacia is a member of group 4.

7.21 Mergers during the period 1993 – 2002.

Eighteen mergers occurred between pharmaceutical companies during the duration of this study; see table 7.35.

Table 7.35 Pharmaceutical mergers 1993-2002

MERGER	TARGET	ACQUIRER	SG SAME	SG DIFFERENT
Roche - Syntex	4	9	0	1
AHP - Lederle	5	4	0	1
RPR - Fisons	1	3	0	1
Knoll - Boots	4	2	0	1
Pharmacia - Upjohn	6	6	1	0
Hoechst - MMD	4	3	0	1
Glaxo - Wellcome	6	6	1	0
Ciba-Geigy Sandoz	2	8	0	1
Roche - Boe Mann	2	6	0	1
Astra - Zeneca	2	7	0	1
Sanofi - Lorex	2	6	0	1
Hoechst - RPR	5	5	1	0
Pharmacia - Searle	5	7	0	1
Pfizer - Warner	3	8	0	1
GW - SKB	3	7	0	1
BMS - Dupont	6	4	0	1
Abbott - Knoll	2	4	0	1
Pfizer - Pharmacia	4	3	0	1

It is interesting to note that of these eighteen mergers only three - Glaxo Wellcome, Pharmacia Upjohn and Hoechst Rhone Poulenc - occurred between companies within the same strategic group. This result is significant at the 0.001% level; see table 7.34.

Table 7.36 Fisher's Exact Test on Pharmaceutical Mergers Within or Between Strategic Groups

Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	18	1	0.000		
Continuity Correction	11.52	1	0.001		
Likelihood Ratio	16.2202	1	0.000		
Fisher's Exact Test				0.001	0.001
Linear-by-Linear Association	17	1	0.000		
N of Valid Cases	18				

Fisher's Exact test was employed due to the small numbers.

> "The Fisher exact probability test is an extremely useful nonparametric technique for analyzing discrete data (either nominal or ordinal) when the two independent samples are small in size. It is used when ...every subject in both groups obtains one of two possible scores"(Siegel, 1956. p96).

7.22 Dynamics between strategic groups

Previous research (Caves *et al.*, 1977; Porter, 1979) posits that firms will enter an industry via the lowest mobility barrier and seek to improve their market position through moving into the next most profitable strategic group. This premise is tested here by comparing strategic group membership between adjacent years, or stable time periods, and classifying firms into one of the following groups.

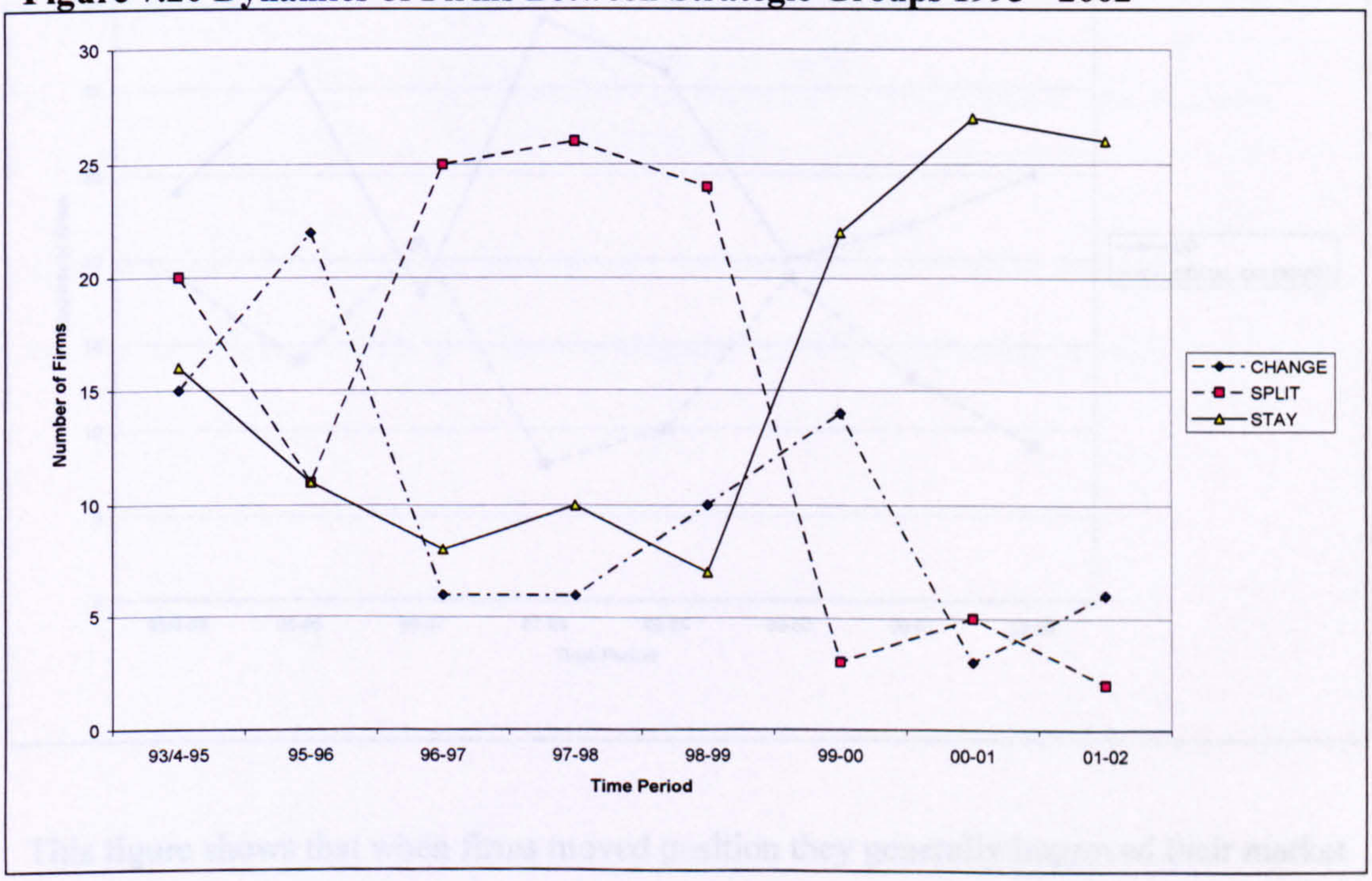
CHANGE; Denotes a single firm moving from one strategic group to another.

SPLIT: Denotes two or more firms moving into another strategic group.

STAY: Denotes a firm that remains in its original strategic group and does not change position.

Each firm was also classified as to whether this positional change marked a move into a more profitable group or into a strategic group that was either equal to or less profitable than the group previously occupied. The mean value of each strategic group in terms of total sales was taken as a proxy for profit so if the total sales for all members in the group was 500,000 and there were four group members the mean value was 125,000. (Market sales are a quite crude proxy for profit but at UK level data the corporate annual reports are not applicable and no UK level profit data is in the public domain) Therefore a firm moving from a strategic group where the average total sales across all group members was 150,000, moving to a group with average sales of 175,000 would be classified as a move to a more profitable group. Figure 7.20 shows the number of changes by category that occurred throughout the study period.

Figure 7.20 Dynamics of Firms Between Strategic Groups 1993 - 2002

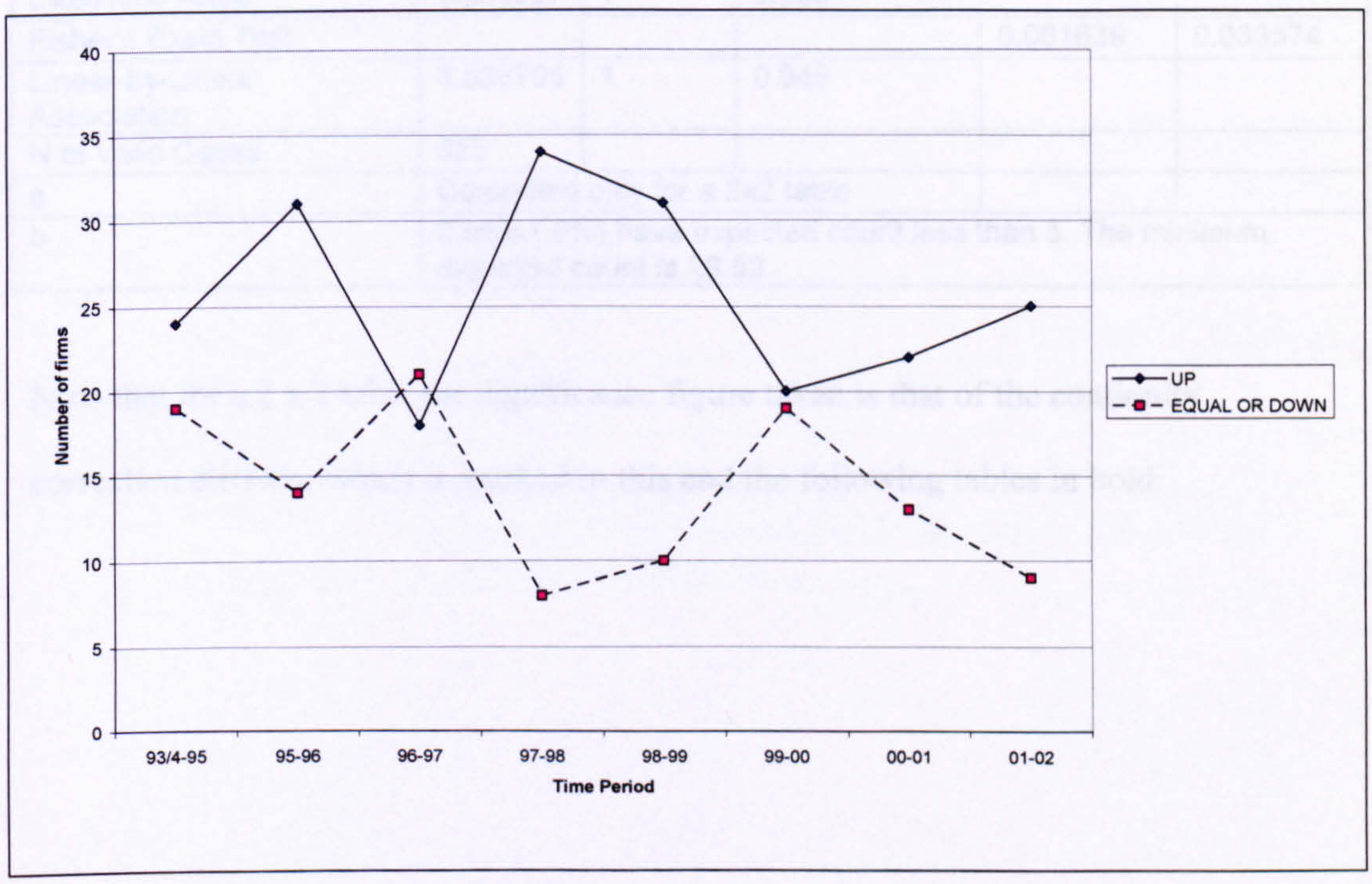


The above figure shows that the industry went through a marked period of change during the period 1993 – 2002. Initially this change was marked by a large number of

individual firm movements, but from 1996 onwards it was more common for groups of firms to break away from their current strategic group and to move in concert. It is interesting to note that from 1998 onwards the number of firms changing position decreased sharply. This result agrees with the break between stable strategic time periods discussed in the previous chapter (see also the discussion on external environmental variables in chapter 3).

Figure 7.21 shows the balance between those firms which moved to a more profitable market position, and those that did not.

Figure 7.21 Do Firms Moving Group Improve Their Market Position?



This figure shows that when firms moved position they generally improved their market position. Note that the number of firms which moved to a similarly performing or less well performing group only exceeded those improving their position in one time period

1996 – 1997, although the balance between more and less profitable moves was about equal in 1999 – 2000.

The changes that occurred between strategic groups across all years were tested using the Chi Squared statistic and the results are shown in the following tables, 7.24 to 7.29.

Table 7.37 Analysis of all cases where companies changed and improved position

CHANGE UP - ALL CASES					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.900782	1	0.048		
Continuity Correction(a)	3.392033	1	**0.066**		
Likelihood Ratio	3.830697	1	0.050		
Fisher's Exact Test				0.061639	0.033574
Linear-by-Linear Association	3.888705	1	0.049		
N of Valid Cases	323				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 29.59.				

Note that for a 2 x 2 table the significance figure taken is that of the continuity correction statistic, which is marked in this and the following tables in bold.

Table 7.38 Analysis of all cases where companies changed and moved to a less profitable position.

CHANGE = DOWN					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.574905	1	0.209		
Continuity Correction(a)	1.255238	1	**0.263**		
Likelihood Ratio	1.552239	1	0.213		
Fisher's Exact Test				0.227093	0.131577
Linear-by-Linear Association	1.570029	1	0.210		
N of Valid Cases	323				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 28.34.				

Table 7.39 Analysis of all cases where companies split and improved position

SPLIT UP					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.022466	1	0.881		
Continuity Correction(a)	0.000868	1	**0.977**		
Likelihood Ratio	0.022446	1	0.881		
Fisher's Exact Test				0.904498	0.487035
Linear-by-Linear Association	0.022397	1	0.881		
N of Valid Cases	323				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 42.38.				

Table 7.40 Analysis of all cases where companies split and moved to a less profitable position.

SPLIT = DOWN					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.118907	1	0.730		
Continuity Correction(a)	0.049834	1	**0.823**		
Likelihood Ratio	0.118639	1	0.731		
Fisher's Exact Test				0.807945	0.410439
Linear-by-Linear Association	0.118539	1	0.731		
N of Valid Cases	323				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 40.58.				

Table 7.41 Analysis of all cases where companies remained in the same strategic group and improved position

STAY UP					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.289642	1	0.130		
Continuity Correction(a)	1.945668	1	**0.163**		
Likelihood Ratio	2.309789	1	0.129		
Fisher's Exact Test				0.155761	0.081123
Linear-by-Linear Association	2.282553	1	0.131		
N of Valid Cases	323				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 46.40.				

Table 7.42 Analysis of all cases where companies remained in the same strategic group and profits deteriorated.

STAY = DOWN					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.054528	1	0.044		
Continuity Correction(a)	3.587845	1	**0.058**		
Likelihood Ratio	4.111345	1	0.043		
Fisher's Exact Test				0.055784	0.028522
Linear-by-Linear Association	4.041975	1	0.044		
N of Valid Cases	323				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 44.43.				

The above tables show that the number of companies changing strategic groups and improving their position was significant at the 10% level. The result for the combinations – changing to a lower position, split up, split down and stay up – were not statistically significant. Those companies that remained in their strategic group and during the next year performed in a similar way or whose position deteriorated was significant at the 10% level. These results for the entire data set across all years provide limited support for the theory proposed by Caves and Porter (1977), namely that firms which move from one strategic group to another generally improve their market position.

The changes that occurred between strategic groups during the period 1993 - 1997 were tested using the Chi Squared statistic and the results are shown in the following tables, 7.30 to 7.35. Again the relevant statistic is highlighted in bold.

Table 7.43 Analysis of cases between 1993 and 1997 where companies moved strategic group and improved position

CHANGE UP					
Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.08496	1	0.771		
Continuity Correction(a)	0.010963	1	**0.917**		
Likelihood Ratio	0.084861	1	0.771		
Fisher's Exact Test					0.457433
Linear-by-Linear Association	0.084316	1	0.772		
N of Valid Cases	132				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 19.22.				

Table 7.44 Analysis of cases between 1993 and 1997 where companies moved strategic group and profitability declined.

CHANGE = DOWN					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.361132	1	0.548		
Continuity Correction(a)	0.169806	1	**0.680**		
Likelihood Ratio	0.363162	1	0.547		
Fisher's Exact Test				0.576458	0.341525
Linear-by-Linear Association	0.358396	1	0.549		
N of Valid Cases	132				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 17.59.				

Table 7.45 Analysis of cases between 1993 and 1997 where companies split strategic group and improved position

SPLIT UP					
Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.117982	1	0.731		
Continuity Correction(a)	0.027681	1	**0.868**		
Likelihood Ratio	0.117926	1	0.731		
Fisher's Exact Test				0.859529	0.433611
Linear-by-Linear Association	0.117089	1	0.732		
N of Valid Cases	132				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 25.03.				

Table 7.46 Analysis of cases between 1993 and 1997 where companies split strategic group and either remained the same or their relative profitability deteriorated.

SPLIT = OR DOWN					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.560922	1	0.454		
Continuity Correction(a)	0.32473	1	**0.569**		
Likelihood Ratio	0.560027	1	0.454		
Fisher's Exact Test				0.478385	0.284115
Linear-by-Linear Association	0.556672	1	0.456		
N of Valid Cases	132				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 22.91.				

Table 7.47 Analysis of cases between 1993 and 1997 where companies remained in the same strategic group and improved position

STAY UP					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.019941	1	0.888		
Continuity Correction(a)	0	1	**1.000**		
Likelihood Ratio	0.019924	1	0.888		
Fisher's Exact Test					0.5214
Linear-by-Linear Association	0.01979	1	0.888		
N of Valid Cases	132				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 15.64.				

Table 7.48 Analysis of cases between 1993 and 1997 where companies remained in the same strategic group and their relative profitability declined or they remained the same as before.

STAY = DOWN					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.864348	1	0.353		
Continuity Correction(a)	0.531702	1	**0.466**		
Likelihood Ratio	0.875951	1	0.349		
Fisher's Exact Test				0.424456	0.233966
Linear-by-Linear Association	0.8578	1	0.354		
N of Valid Cases	132				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 14.32.				

None of the results illustrated in tables 7.30 to 7.35 achieve statistical significance. The results for the same analysis for the time period 1998 – 2002 are shown in tables 7.36 to 7.41.

Table 7.49 Analysis of cases between 1998 and 2002 where companies changed strategic group and improved position

CHANGE UP					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.260539	1	0.039		
Continuity Correction(a)	3.489296	1	**0.062**		
Likelihood Ratio	4.06792	1	0.044		
Fisher's Exact Test					0.032884
Linear-by-Linear Association	4.238232	1	0.040		
N of Valid Cases	191				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 11.74.				

Table 7.50 Analysis of cases between 1998 and 2002 where companies changed strategic group and either remained the same or their relative profitability declined

CHANGE = DOWN					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.260539	1	0.039		
Continuity Correction(a)	3.489296	1	**0.062**		
Likelihood Ratio	4.06792	1	0.044		
Fisher's Exact Test				0.049727	0.032884
Linear-by-Linear Association	4.238232	1	0.040		
N of Valid Cases	191				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 11.74.				

Table 7.51 Analysis of cases between 1998 and 2002 where companies split strategic group and improved position

SPLIT UP					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.267868	1	0.605		
Continuity Correction(a)	0.121708	1	**0.727**		
Likelihood Ratio	0.270263	1	0.603		
Fisher's Exact Test				0.736036	0.366399
Linear-by-Linear Association	0.266465	1	0.606		
N of Valid Cases	191				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 18.53.				

Table 7.52 Analysis of cases between 1998 and 2002 where companies split strategic group and their relative profitability remained the same or declined.

SPLIT = DOWN					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.267868	1	0.605		
Continuity Correction(a)	0.121708	1	**0.727**		
Likelihood Ratio	0.270263	1	0.603		
Fisher's Exact Test				0.736036	0.366399
Linear-by-Linear Association	0.266465	1	0.606		
N of Valid Cases	191				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 18.53.				

Table 7.53 Analysis of cases between 1998 and 2002 where companies remained in their strategic group and improved position

STAY UP					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.918091	1	0.166		
Continuity Correction(a)	1.508579	1	**0.219**		
Likelihood Ratio	1.927526	1	0.165		
Fisher's Exact Test				0.209939	0.109528
Linear-by-Linear Association	1.908049	1	0.167		
N of Valid Cases	191				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 28.42.				

Table 7.54 Analysis of cases between 1998 and 2002 where companies changed strategic group and their relative profitability remained the same or declined.

STAY = DOWN					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.918091	1	0.166		
Continuity Correction(a)	1.508579	1	**0.219**		
Likelihood Ratio	1.927526	1	0.165		
Fisher's Exact Test				0.209939	0.109528
Linear-by-Linear Association	1.908049	1	0.167		
N of Valid Cases	191				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 28.42.				

The results for change in either direction are significant at the 10% level. All the other results presented in these six tables fail to achieve statistical significance. The difference between this time period, 1998 – 2002, as compared to the previous time period, again supports the findings presented earlier, that the operating conditions are different for the pharmaceutical industry across these two time periods.

Finally, total change was tested by combining the results for split and change. These results for the ten year period, 1993 – 2002, are presented in tables 7.42 to 7.45 below.

Table 7.55 Analysis of all cases (combining change and split) where companies remained in the same strategic group and their relative profitability improved

STAY UP					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.289642	1	0.130		
Continuity Correction(a)	1.945668	1	**0.163**		
Likelihood Ratio	2.309789	1	0.129		
Fisher's Exact Test				0.155761	0.081123
Linear-by-Linear Association	2.282553	1	0.131		
N of Valid Cases	323				
a	Computed only for a 2x2 table				
b	0 cells (.0%) have expected count less than 5. The minimum expected count is 46.40.				

Table 7.56 Analysis of all cases (combining change and split) where companies remained in the same strategic group and their relative profitability remained the same or declined

STAY = DOWN					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.054528	1	0.044		
Continuity Correction(a)	3.587845	1	**0.058**		
Likelihood Ratio	4.111345	1	0.043		
Fisher's Exact Test				0.055784	0.028522
Linear-by-Linear Association	4.041975	1	0.044		
N of Valid Cases	323				
A	Computed only for a 2x2 table				
B	0 cells (.0%) have expected count less than 5. The minimum expected count is 44.43.				

Table 7.57 Analysis of all cases (combining change and split) where companies changed strategic group and improved position

CHANGE UP					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.619677	1	0.057		
Continuity Correction(a)	3.182992	1	**0.074**		
Likelihood Ratio	3.663218	1	0.056		
Fisher's Exact Test				0.059322	0.036659
Linear-by-Linear Association	3.608471	1	0.057		
N of Valid Cases	323				
A	Computed only for a 2x2 table				
B	0 cells (.0%) have expected count less than 5. The minimum expected count is 46.03.				

Table 7.58 Analysis of all cases (combining change and split) where companies changed strategic group and their relative profitability remained the same or declined

CHANGE = DOWN					
Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.115198	1	0.146		
Continuity Correction(a)	1.781634	1	**0.182**		
Likelihood Ratio	2.135461	1	0.144		
Fisher's Exact Test				0.153231	0.090563
Linear-by-Linear Association	2.108649	1	0.146		
N of Valid Cases	323				
A	Computed only for a 2x2 table				
B	0 cells (.0%) have expected count less than 5. The minimum expected count is 44.08.				

These results show a statistically significant result at the 10% level for firms that hold position and either maintain or move down in relative profitability and those which change position and improve their market position. The remaining two combinations - change and lower or equal profitability and stay and move up in profitability – did not show a statistically significant relationship.

7.23 Conclusions

During the ten years included within this study, the pharmaceutical industry was subject to a high degree of turbulence as eighteen mergers shaped the new industry structure. It was shown in the previous chapter that merger status between strategic groups appears to be a significant strategic variable and one which was excluded from previous strategic group research. The research presented in this chapter demonstrates that mergers represent an important strategic option within the pharmaceutical industry. Furthermore, mergers do not appear to occur randomly across strategic groups but occur preferentially between, rather than within strategic groups. The eighteen mergers that occurred between the firms included in this study occurred within nine of the ten years studied. Although merger activity was concentrated within two waves of consolidation, centred on 1995 and 1999, only in one year, 1993, were no mergers recorded. This degree of turbulence in the industry means that a good deal of the industry dynamics, which strategic group analysis can illustrate, may be lost if mergers are excluded from a strategic group analysis and years are consolidated within stable strategic time periods. This research does, however, support the earlier finding that two distinct stable time periods existed within the industry during the ten years studied. The first time period, 1993 – 1997, was notably more turbulent, in terms of firms moving market position, than the second time period from 1998- 2002. An analysis carried out on the performance implications of firms' movements between groups, found limited support for the theory that firms move from a lower to a higher performing strategic group, at least as measured by sales.

The number of strategic groups declined over the period from nine in 1993-1994 down to six in 2002. This result reflects an effect of the mergers, which effectively reduced

the number of firms present in the industry and consolidated strategic choices. In addition, as the external environmental changes outlined in chapter three progressed, companies learned from each other's actions and their own experiences. This led to firms gravitating around established ways of competing.

Examination of the dynamics of the strategic groups and the firms within them support the presence of an inner core of members following the typical strategy for that group closely and an outer group of fringe members. The latter appear either not wholly committed to the group strategy e.g. Celltech, or are in the process of a strategic shift or are consolidating their position after a major event such as a merger e.g. Roche, or the withdrawal of a major product e.g. Bayer. In either case outlier analysis appears to be a useful technique to study these within-group shifts in position.

When changes between groups occur they can simply involve one firm moving between groups e.g. Warner Lambert in 1999, or more frequently a group may cleave into two or more distinct splinters of two or more members which follow a similar strategy, but different to the earlier strategy adopted by the strategic group. Groups of specific firms frequently appear together in the same strategic group and these groupings appear very stable over a number of years, for example the grouping of 3M, Procter & Gamble, Akzo Nobel, Reckitt Benkisser and Solvay within the diversified conglomerates. Such stable groups of strongly linked firms may form "anchor points" around which industry structure changes and the industry's competitive dynamics revolve. Firms that are closer to the anchor may find it more difficult to shift position and hence it may be expected that the closer a firm is to one of these anchor points the slower the change. Industry dynamics therefore appear to be fluid, but these changes appear to occur more rapidly

away from the strategic positions marked out by stable strategic groups around which such dynamics revolve.

Other strongly associated firms are Yamanouchi, Schering Plough, Abbott or Merck Sharpe & Dohme, Pfizer and Glaxo and Pharmacia. These groups act as consolidated strategic positions that form the "seed points" around which strategic groupings emerge. However, the dynamics of these groupings across the years could not be followed in detail without deconstructing merged firms within the industry and reconstructing the industry structure that existed during the year in question.

This study suggests that a number of discrete strategic positions occurred within the UK pharmaceutical industry during the period 1993 - 2002. At the stable end of a continuum is the diversified conglomerate group typified by 3M, whose members have limited exposure to pharmaceuticals. Examination of the Dendrograms indicates that this is invariably the strategic group which is identified first by the clustering process. A second common group consists of companies like Yamanouchi, Schering Plough and Eisai. These companies are focused upon pharmaceuticals, largely within the general practitioner segment. A third common group of more focused segment specialists appears populated by companies like Lundbeck, Schering AG and Boehringer Ingelheim. While at the two extremes of the market there are the niche players, such as Celltech or Baxter, and the merging "super heavyweights". Some of these heavyweights display a strong hospital presence - typified by Glaxo, Pharmacia, Aventis or Roche - others are more GP focused competitors, like MSD, Pfizer and Astra Zeneca.

In concluding this chapter, the number of industry positions, as illustrated by strategic groups, appears over time to have become consolidated around a smaller number of viable positions in UK pharmaceuticals. A major driver of this process appears to have been merger and acquisition, a process largely excluded from previous pharmaceutical-based strategic group studies. These mergers were largely conducted between companies in different strategic groups, an observation that may suggest a motive to strengthen their new product pipeline by acquiring the research of another firm e.g. Pfizer's acquisition of Warner Lambert, or risk reduction through spreading activities across a broader range of products e.g. Pfizer's acquisition of Pharmacia.

Strategic groups appear commonly to consist of subsets of companies whose moves closely mirror each other, as illustrated by smaller groups of associated companies that appear to move in concert. Within a strategic group there also appears to be an inner group closely following the core strategy and an outer group, which either appears less committed to the group's "typical" pattern of strategic choices or is in the process of conducting some sort of strategic shift. Here, outlier analysis appears useful to identify groups on the fringe of strategic groupings. It may also be that if the distance between group members can be taken as a proxy for commitment to the group strategy, some strategic groups are denser than others. These reflect a strong common commitment to a core strategic position. Other more diffuse positions may be more ephemeral and therefore easier to penetrate, i.e. have lower entry and exit barriers than others. This point may be illustrated by the observation that both Shire and Eisai joined the same strategic group on their entry into the UK pharmaceutical industry.

This chapter presents the research based around two main themes, namely industry dynamics and mergers within the UK pharmaceutical industry. The results show that industry positions may change from year to year. This implies that strategic groups are not necessarily an entirely stable element of intra-industry structure within a given time period. The inclusion of merged firms within the dataset allowed this dynamic to be seen. This observation goes against the idea that all mobility barriers represent relatively permanent structures and supports the idea, expressed in chapter 5, that some mobility barriers are more difficult to breach than others. Rather company positions, and strategic groups change as strategic investments are adjusted in order to capitalize upon emerging opportunities.

Such a degree of industry turbulence is not unknown in earlier strategic group research, see for example Fiegenbaum's study of the US insurance industry (Fiegenbaum, 1987) or Oster (1982). However, a rather more turbulent picture for the pharmaceutical industry has been identified than found in previous strategic group studies – Cool (1985) for example identified stable strategic time periods (SSTPs) of 3 to 7 years duration, Martens (1988) of 4 years duration and Bogner (1991) from 4 to 7 years. But these studies did not include merged firms, a decision which in effect "smoothed" out some of the underlying industry dynamics.

The findings reported in this chapter therefore suggest that the pharmaceutical industry may be more turbulent than previously reported in studies of pharmaceuticals in the US.

A second finding for further strategic group research is that these results do not appear to support the model proposed by Mehra & Floyd (1998), that strategic groups tend to occur in stable industries with strong product differentiation. In effect the results

suggest that industries do change their character and that it is important for the researcher to allow such changes to be accommodated within the research design. Aside from mergers which are a legitimate and significant strategic option, new entrants (such as in UK pharmaceuticals Eisai, Shire and Takeda in 1997), are also important elements of industry structure.

The results also indicate that strategic groups are not equally stable – some are more volatile than others. Industry structure therefore may be depicted as a constellation where strategic groups represent clusters of stars and where distance from the centre implies a greater degree of freedom where movement and group shifts largely occur. All strategic groups therefore do not appear equally stable and the research suggests that some may change little from year to year – such as SG1 in UK pharmaceuticals consisting of the diversified corporations 3M, Procter & Gamble, Reckitt Benkisser, Akzo Nobel, Solvay act as anchor points around which other strategic group positions move. Thus, just as strategic groups have an inner and outer group of firms, so the industry consists of an inner collection of strategic groups and an outer grouping where firms are more liable to shift position more frequently.

Emerging strategic groups may start from one or two firms, which pursuing a different strategy, act as "seed positions", where if the strategy is successful it attracts imitation and the group grows in importance and relative strength (Porter, 1976;1979).

These positional shifts appeared more common in the first half of the study period, where from 1998 onwards the number of firms in UK pharmaceuticals changing position decreased rapidly. This may reflect the "damping" effect of mergers or alternatively could be due to firms gravitating to and consolidating around successful

market positions. The role of mergers and their relationship with strategic groups may therefore be a worthwhile area for future study.

Implications for strategy which emerge from this research are the value of strategic groups as a means to map industry dynamics, where outlier analysis may provide a useful signal to a change in future strategic intent. As illustrated, for example, by the positional shift observed by Roche in 1996 or Abbott in 2000, immediately prior to their acquisition of Boehringer Mannheim, and Knoll, respectively. It is also interesting to observe that of the eighteen mergers which occurred in the duration of this study, only three occurred between members of the same strategic group and that these were generally regarded as some of the industries least successful mergers (Lehman 2000).

The observation that of these eighteen, fifteen mergers were between members of different strategic groups also implies that the motive for the mergers was primarily acquisition of new products to bolster flagging product pipelines rather than, as often reported, to gain synergies in research (Henderson, 2000).

In the next chapter the relationship between strategic groups - *how you compete* - and competitive groups - *where you compete* - is explored.

CHAPTER 8

THE RELATIONSHIP BETWEEN COMPETITIVE GROUPS AND STRATEGIC GROUPS WITHIN THE UK PHARMACEUTICAL INDUSTRY

8.1 Introduction

The previous two chapters of this thesis have been concerned with the identification of strategic groups in the UK pharmaceutical industry. Strategic groups classify firms according to the pattern of investment decisions that each firm makes. (See Chapter 2 for a fuller discussion on the strategic group concept.) In contrast, the aim of this chapter is to identify *competitive groups* within the UK pharmaceutical industry. The difference between strategic groups and competitive groups is that strategic group membership relates to the strategic choices deployed i.e. the *how* of strategy, while competitive groups relates to *where* the strategy is deployed i.e. *the choice of market segments* in which the firm has chosen to compete.

In chapter four, reference was made to the fact that while all pharmaceutical firms compete for time in front of the doctor, the true locus of competition occurs where one remedy directly replaces another. Thus competition within the pharmaceutical industry is strongly related to which markets a firm competes within. Managers frequently construct mental maps of their industry based upon those firms which they perceive as direct competitors. (see chapter 2 for a detailed discussion of cognitive groups.)

The therapy areas that a firm chooses to compete in are particularly important in the pharmaceutical industry, for a number of reasons. First, to research a new drug is both a very costly and time consuming process, where each additional area of therapeutic research has both a very significant entry cost, to climb the learning curve and be able to

contribute to leading-edge science, and a relatively low spillover to other areas of the company's research. As discussed earlier, even the largest firms struggle to compete in more than six or seven of the 16 therapy areas and there is evidence to suggest that beyond six therapeutic areas the law of diminishing returns sets in (Henderson *et al.*, 1994). (See chapter 4 for a fuller discussion).

Second, according to Porter (1979; 1980) it may be expected that firms which compete for the same customers, but which deploy different strategies, will be more likely to engage in damaging competition because they are less likely to understand the rival firm's signals and motives. If, however, competing firms belong to the same strategic group they are more likely to understand each others motives and reach an accommodation rather than compete on price (Porter, 1976; Porter, 1979; Porter, 1980). In contrast, firms which compete for different customers are likely to be spared many aspects of direct competition because the therapeutic group structure of the pharmaceutical market effectively restricts competition. The combination of strategic group and competitive group membership, therefore, aids our understanding of industry competition.

Previous strategic group research in the pharmaceutical industry concentrates upon the number and relative importance of IMS therapeutic areas as a point of distinction between firms (Bogner, 1991; Cool, 1985; Martens, 1988). These 16 therapeutic areas are examined in the next section of this chapter.

An alternative approach is to examine the relationships between the firm's sub-therapy area choices, because these represent the true locus of competition, as explained earlier (see chapter 4). This is where one product directly displaces another. To examine this

phenomenon requires examination of 277 sub-therapeutic areas so that firms that directly compete can be identified.

To carry out both of these analyses, the source data was the IMS database which, as discussed in the previous chapter, groups firms together as they are currently configured i.e. as if the mergers (detailed in the previous chapter) had never occurred.

8.2 Competitive groups based upon IMS therapy areas.

8.2.1 Stable Strategic Time Periods.

In order to ascertain if stable strategic time periods relevant to competitive groups were present in the data set, the method used to ascertain SSTPs in the two previous chapters was adopted. The matrices compared for each year consisted of thirty three firms each measured in terms of that year's sales within each of sixteen therapeutic area variables, detailed below. The firms' included within this research are shown in table 8.1, and the therapeutic area variables in table 8.2.

Table 8. 1 Companies used to identify competitive groups

ABBREVIATION	COMPANY
3M	Minnesota Mining and Manufacturing
ABB	Abbott Laboratories
AKZ	Akzo Nobel
AVE	Aventis
AZ	Astra Zeneca
BAX	Baxter Healthcare
BAY	Bayer
BI	Boehringer Ingelheim
BMS	Bristol Myers Squibb
CEL	Celltech
EIS	Eisai
GSK	Glaxo Smith Kline
IVX	Ivax Pharmaceuticals
JJ	Johnson & Johnson
LIL	Lilly Laboratories
LUN	Lundbeck
MER	E Merck
MSD	Merck Sharpe & Dohme
NOV	Novo Pharmaceuticals
NVA	Novartis
PFZ	Pfizer
PG	Procter & Gamble
PHA	Pharmacia
RB	Reckitt Benkisser
ROC	Roche
SAG	Schering AG
SHI	Shire Pharmaceuticals
SOL	Solvay
SP	Schering Plough
SS	Sanofi Synthelabo
TAK	Takeda
WYE	Wyeth
YAM	Yamanouchi Pharmaceuticals

Table 8 2 IMS Therapeutic Areas[43]

CODE	ANATOMICAL CLASSIFICATION
A	Alimentary tract and metabolism
B	Blood and blood forming organs
C	Cardiovascular system
D	Dermatologicals
G	Genito-urinary system and sex hormones
H	Systemic hormonal preparations
J	Systemic antibiotics
K	Hospital solutions
L	Antineoplastic and immunomodulating agents
M	Musculo-skeletal system
N	Central nervous system
P	Parasitology
R	Respiratory system
S	Sensory organs
T	Diagnostic agents
V	Various

The test for stable strategic time periods involved testing each year's matrices, consisting of 33 companies by 16 variables against the next year's matrices, using Box's M test. In the event that no change was found, the matrices for the two years were averaged and then compared against the next year. The result of this analysis is shown in table 8.3.

Table 8. 3 Test for stable strategic time periods

	93 vs 94	94 vs 95	95 vs 96	96 vs 97	97 vs 98	98 vs 99
N	33 .	33	33	33	33	33
Box's M	34.9	173.466	102.852	51.998	35.494	32.07
F	0.188	0.934	0.554	0.28	0.191	0.173
df1	136	136	136	136	136	136
df2	12648.85	12648.85	12648.85	12648.845	12648.845	12648.85
Sig.	1.000	0.696	1.000	1	1.000	1.000
	99 vs 00	**00 vs 01**	**01 vs 02**	**93 vs Av 94-02**	**02 vs Av 93-01**	
Box's M	33	33	33	33	33	
N	44.679	63.558	88.489	225.834	192.295	
F	0.241	0.342	0.477	1.201	1.035	
df1	136	136	136	136	136	
df2	12648.85	12648.85	12648.85	11870.645	12648.845	
Sig.	1.000	1.000	1.000	0.056	0.372	

[43] Source - (IMS, 1999) pages 1-21

No significant breaks were found between years within the dataset. This is perhaps not a surprising result given that the decision to research a new therapeutic area is not taken lightly and given the dearth of new chemical entities (see chapter 4 for a discussion of this point), competitive groups are not expected to change as frequently as strategic choices. This is because it takes considerable time to build a position in a new therapy area given that new chemical entities take on average some ten to twelve years to reach the market, and that licensed products are invariably offered to companies with an established track record in that area.

8.2.2 Identification of competitive groups

Therapy area sales for each company were used to separate companies into competitive groups. The method adopted differed from that used to cluster strategic groups in chapters 6 and 7 above, in two main ways. First, the similarity coefficient used to group companies into clusters was Pearson's product moment correlation coefficient, not the Euclidean distance metric. This is to show patterns based upon similarities in the shape of companies' therapeutic profiles rather than pure size differences. This choice was made because for competitive groups the point of interest is whether a company is active within that therapy area or not. Not the size of their investment in that market per se.

> "The correlation coefficient is frequently described as a shape measurement, in that it is insensitive to differences in the magnitude of variables used to compute the coefficient" (Aldenderfer *et al.*, 1984. p 23).

The second stage is that this similarity matrix was then clustered using Ward's method utilizing Euclidean distance. This approach is outlined by Aldenderfer and Blashfield.

> "The basic strategy is ...that proposed by Guertin (1966), in which correlation is used to create homogeneous groups based on shape, and each shape group is then divided with a distance measure into subgroups with similar size and dispersion characteristics"(Aldenderfer *et al.*, 1984. p 26).

Here, the clustering into competitive groups is based upon data for the year 2002 because, as described in the previous section, no significant differences were found between years. The result of clustering into competitive groups is shown in Table 8. 4

Table 8.4 Competitive groups in the UK pharmaceutical industry

Competitive Group	Constituent Firms
CG: 1	3M IVX GSK BI SP
CG: 2	ABB ROC BAX PG
CG: 3	JJ LUN LIL SS NVA PHA
CG: 4	AKZ YAM SAG
CG: 5	AZ EIS SHI WYE SOL NOV RB
CG: 6	AVE BMS PFZ MSD CEL TAK BAY MER

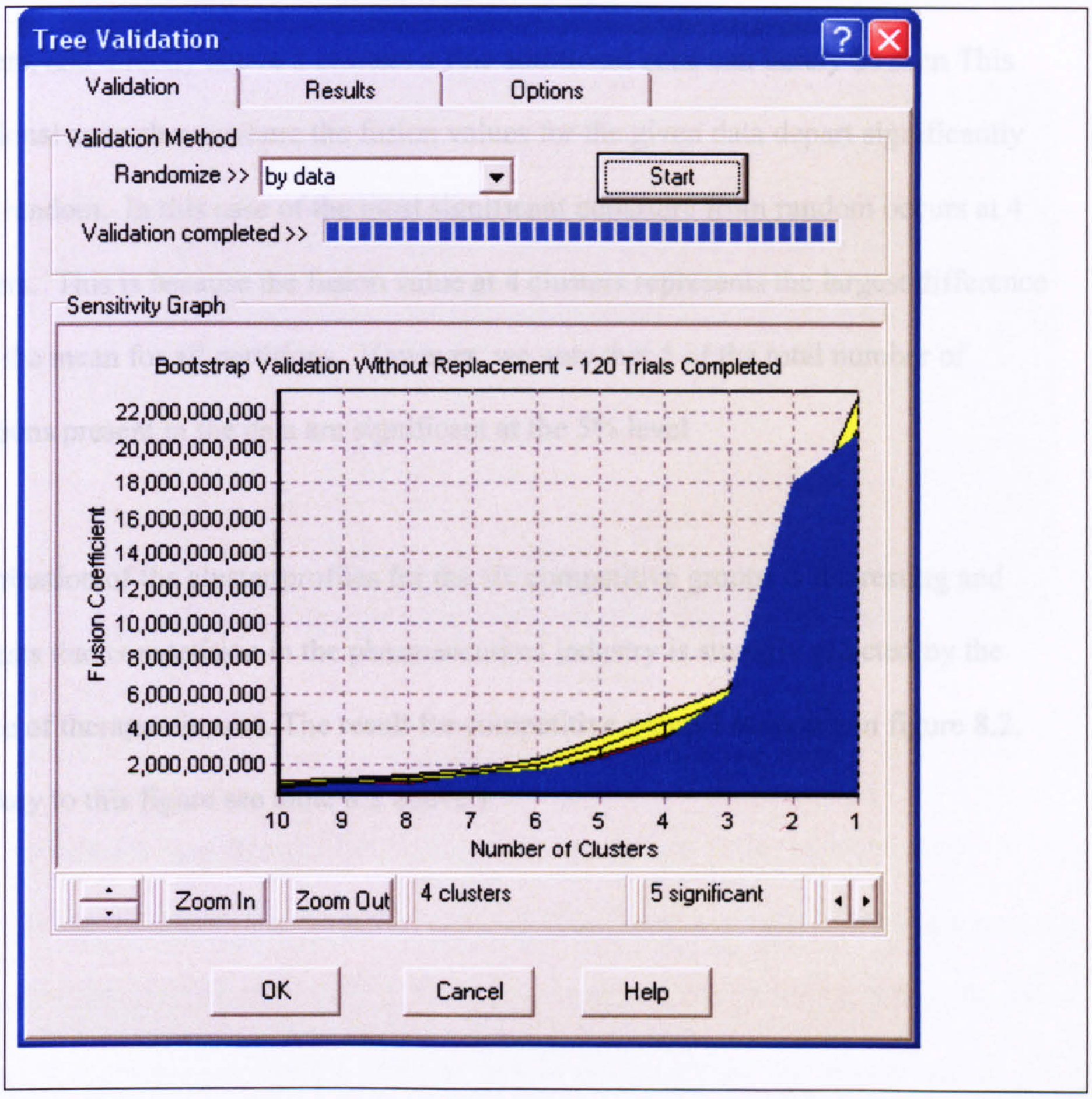
The internal validity of this cluster solution was confirmed utilizing the upper tail significance test. These results are presented in table 8.5.

Table 8.5 Upper tail significance test on competitive groups

Partition	Deviate	t-Statistic
2 clusters	3.45	19.49
3 clusters	2.64	14.91
4 clusters	2.15	12.19
5 clusters	1.18	6.7
6 clusters	0.83	4.71

The presence of a natural structure within the data was confirmed by bootstrap validation, see figure 8.1.

Figure 8.1 Validation of Natural Structure

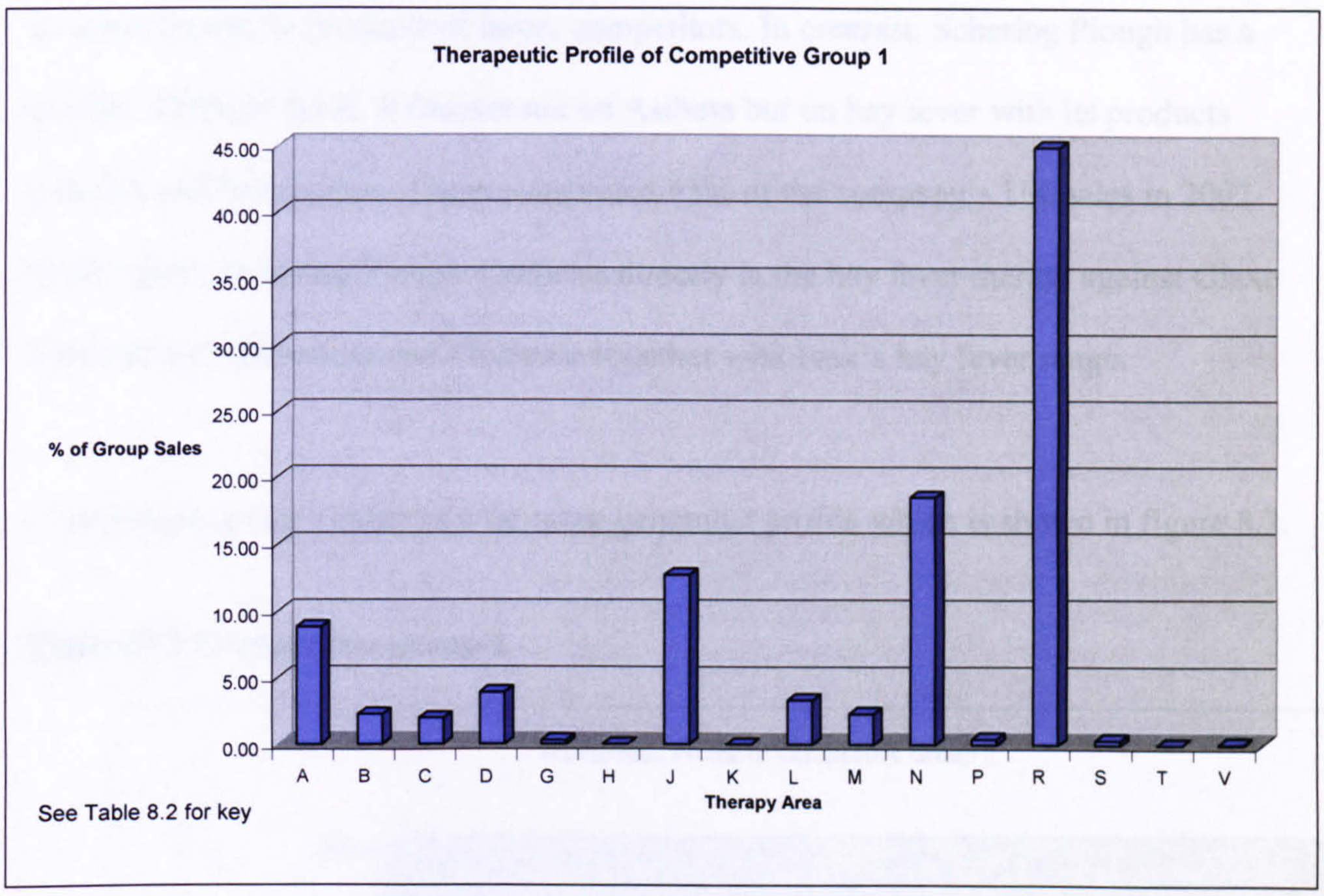


This bootstrapping process, provides a test for structure within the data set. It compares a tree obtained for a given dataset with the family of trees generated by random permutation of the same data or the associated proximity matrix. The solid at the bottom of the graph shows the fusion values corresponding to the actual data as presented. The band above, encompassed by the next two lines above the first solid line shows the fusion values corresponding to the actual data as presented. The most outer line marks a band that shows the range of fusion values obtained from 120 trials of randomising the data; in this confidence interval, . Here, the central line represents the mean of the

fusion values for each number of clusters, obtained from the random trials. The width of this second band is therefore, 1 standard deviation about the mean. Between 5 and 4 clusters, and directly above 8 clusters a fine additional zone can barely be seen This additional zone shows where the fusion values for the given data depart significantly from random. In this case of the most significant departure from random occurs at 4 clusters. This is because the fusion value at 4 clusters represents the largest difference from the mean for all partitions. However, we note that 5 of the total number of partitions present in the data are significant at the 5% level

Examination of the cluster profiles for the six competitive groups is interesting and suggests that competition in the pharmaceutical industry is strongly affected by the choice of therapeutic area. The result for competitive group 1 is shown in figure 8.2. (For key to this figure see table 8.2 above.)

Figure 8.2 Competitive Group 1

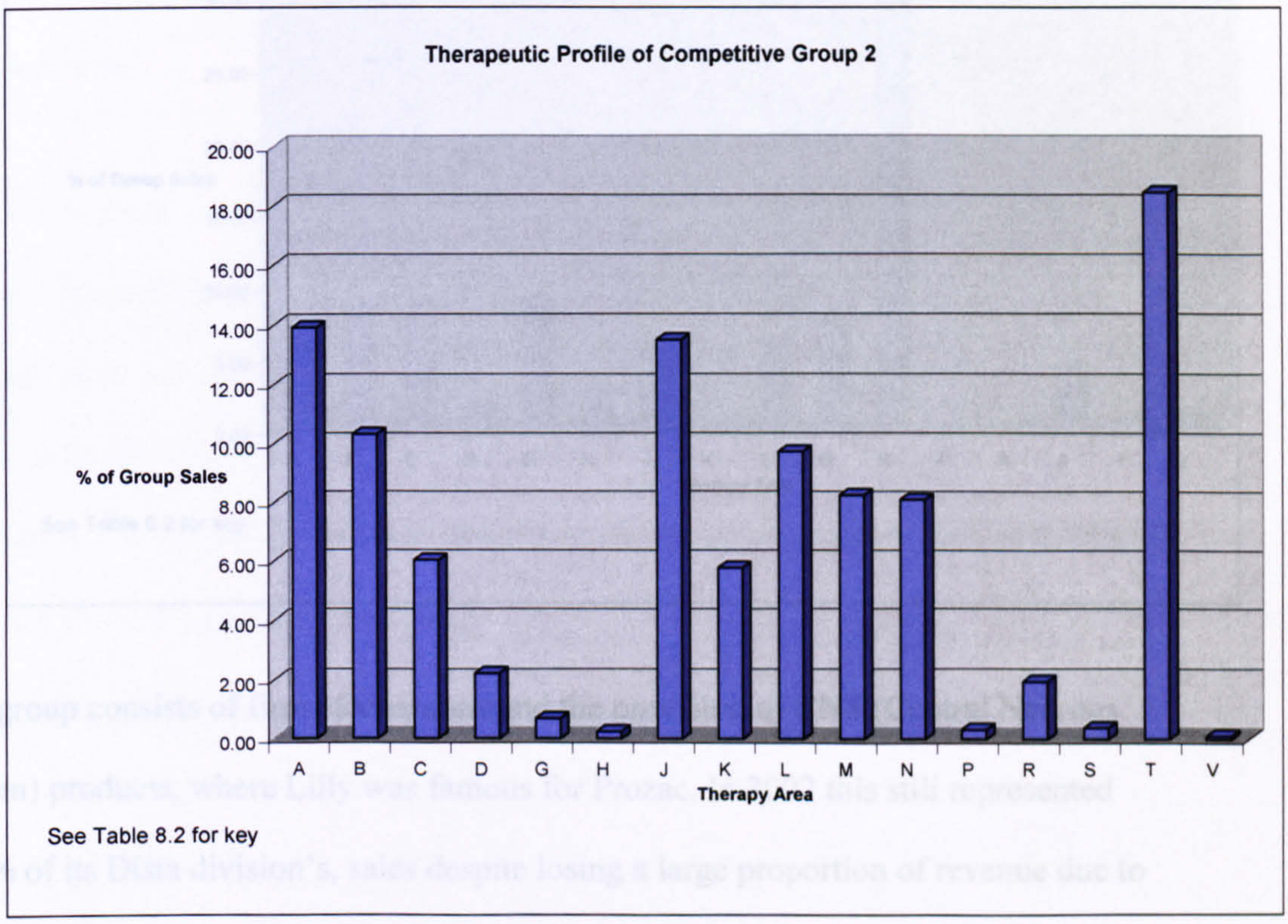


This group has a clear therapeutic profile concentrated upon sales of respiratory products (R), as shown by the cluster means for competitive group 1. Strong support for this position is provided by Glaxo Smith Kline, which has an extremely strong franchise in respiratory medicine, worth £ 448.5 million in the UK alone. For this company Seretide drove sales in 2002 representing 24.9% of respiratory sales and growing at 51% per annum (IMS, 2002). On a smaller scale, 3M won an award for the design of its asthma inhaler Qvar, which represented 31.6% of its UK sales, growing at 37% a year. Another company Ivax markets branded generic products based upon novel inhaler designs where 55.7% of the company's UK sales come from Beclazone, an inhaled steroid for Asthma (IMS, 2002). By contrast, Boehringer Ingelheim has a strong tradition of respiratory medicines including Duovent, Oxivent and Spiriva.

All of these companies are direct competitors, although the Boehringer products also act as complements to products of larger competitors. In contrast, Schering Plough has a slightly different focus. It focuses not on Asthma but on hay fever with its products Clarityn and Neoclarityn. These constituted 43% of the company's UK sales in 2002 (IMS, 2002). Schering Plough competes directly in the hay fever market against Glaxo Smith Kline's Beconase and Flixonase together with Ivax's hay fever range.

Competitive group 2 exhibits a far more generalist profile which is shown in figure 8.3.

Figure 8.3 Competitive group 2

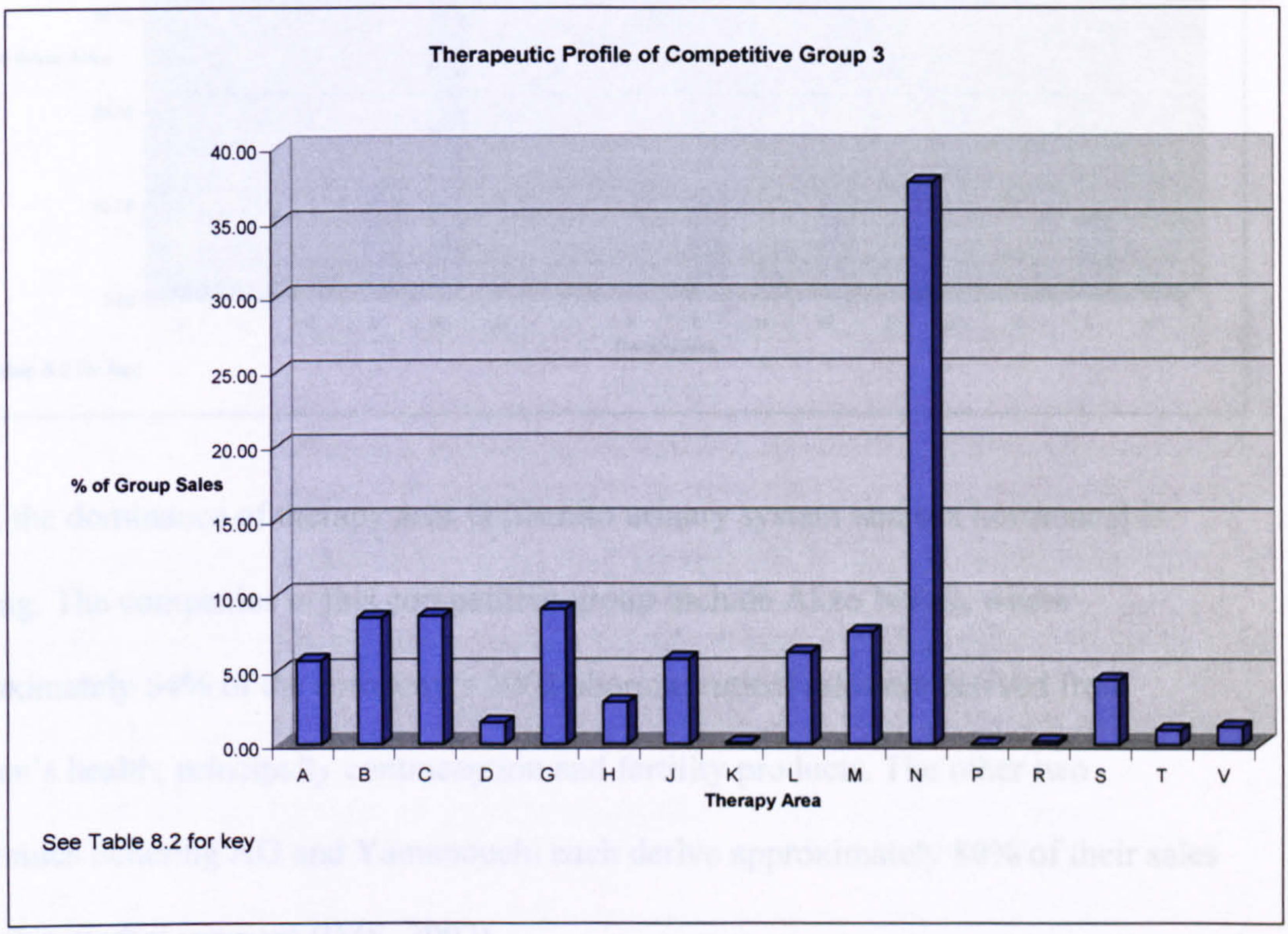


Here, there is a much broader base of activity with diagnostic agents [therapy area T] the largest group, accounting for on average only 18% of sales. This position is supported by a strong presence across a large number of therapeutic areas. Roche is a strong competitor typical of this group with its broad focus on Diagnostics, which was

strengthened by the acquisition of Boehringer Mannheim in 1997, together with Xenical its product for obesity, which represented 30% of UK sales in 2002, and its range of specialist hospital products. Abbott, on the other hand, is a strong contender in Alimentary, Diagnostic and Antibiotic products.

Competitive group 3 is illustrated in figure 8.4.

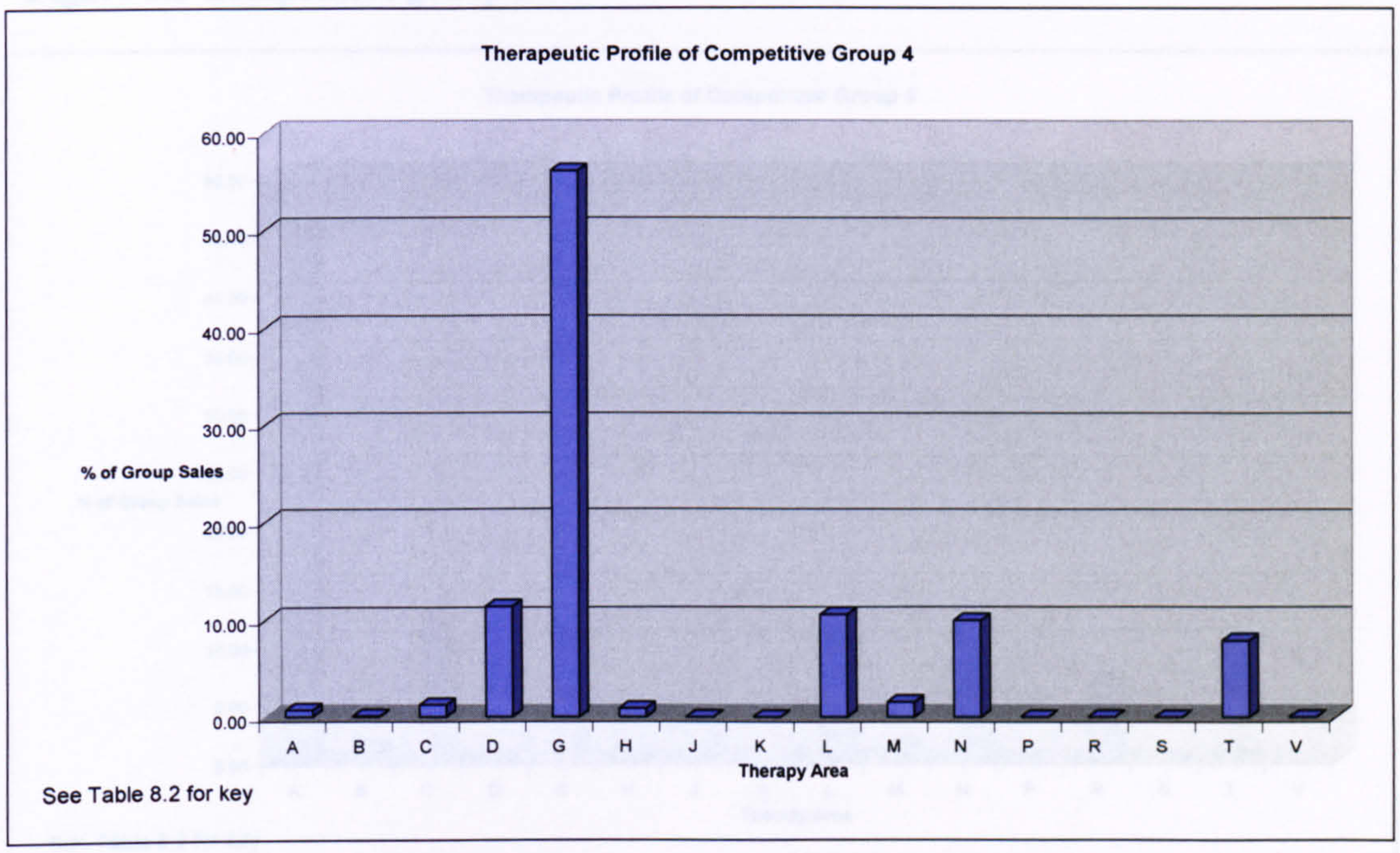
Figure 8.4 Competitive Group 3



This group consists of firms focused around the provision of CNS (Central Nervous System) products, where Lilly was famous for Prozac. In 2002 this still represented 67.7% of its Dista division's, sales despite losing a large proportion of revenue due to patent expiry.

Competitive group four is shown in Figure 8.4.

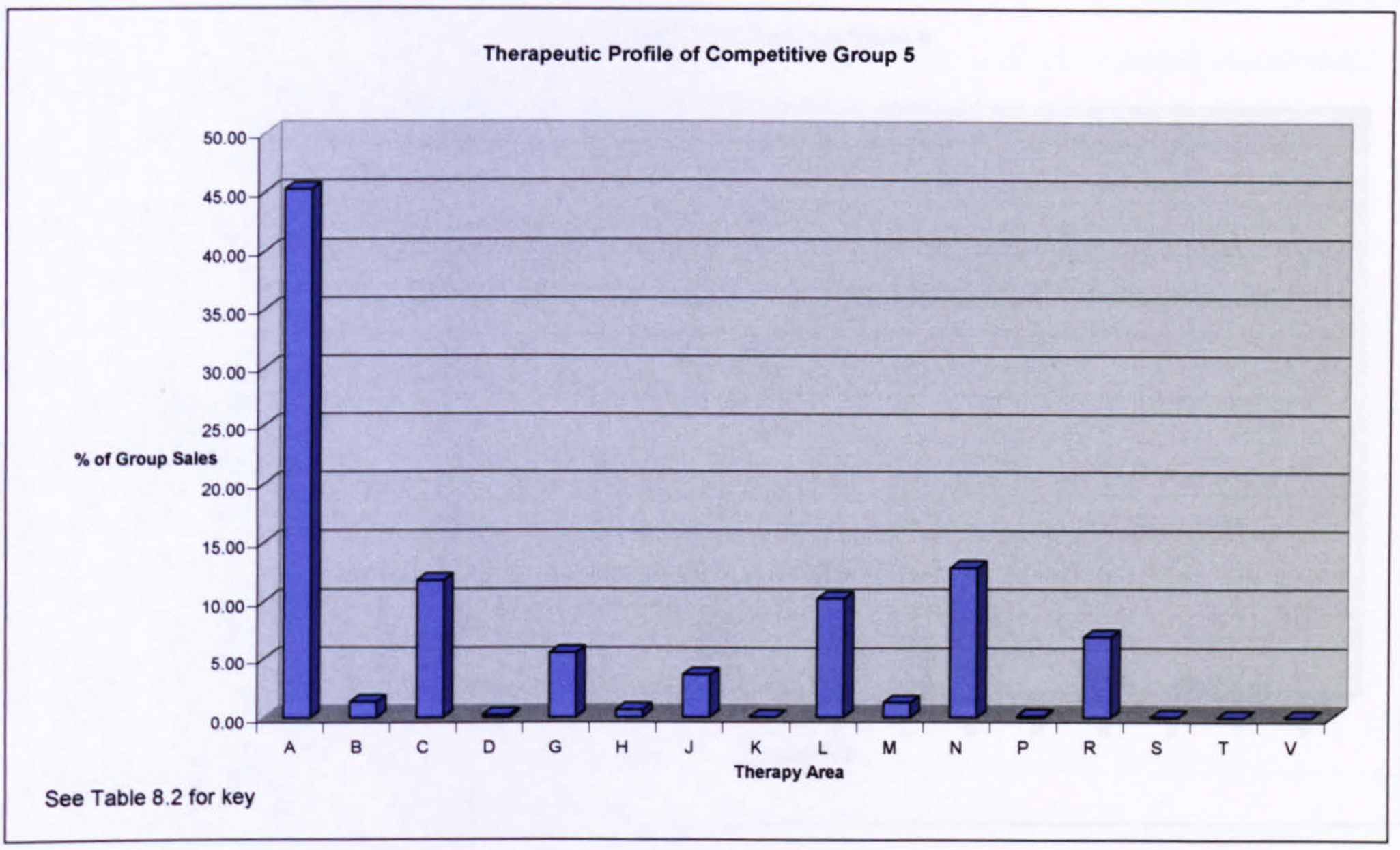
Figure 8.4 Competitive Group 4



Here, the dominance of therapy area G [Genito urinary system and sex hormones] is striking. The companies in this competitive group include Akzo Nobel, where approximately 64% of the company's 2002 pharmaceutical sales are derived from women's health, principally contraception and fertility products. The other two companies Schering AG and Yamanouchi each derive approximately 80% of their sales from this market segment (IMS, 2002).

Competitive group five is shown in figure Figure 8.5.

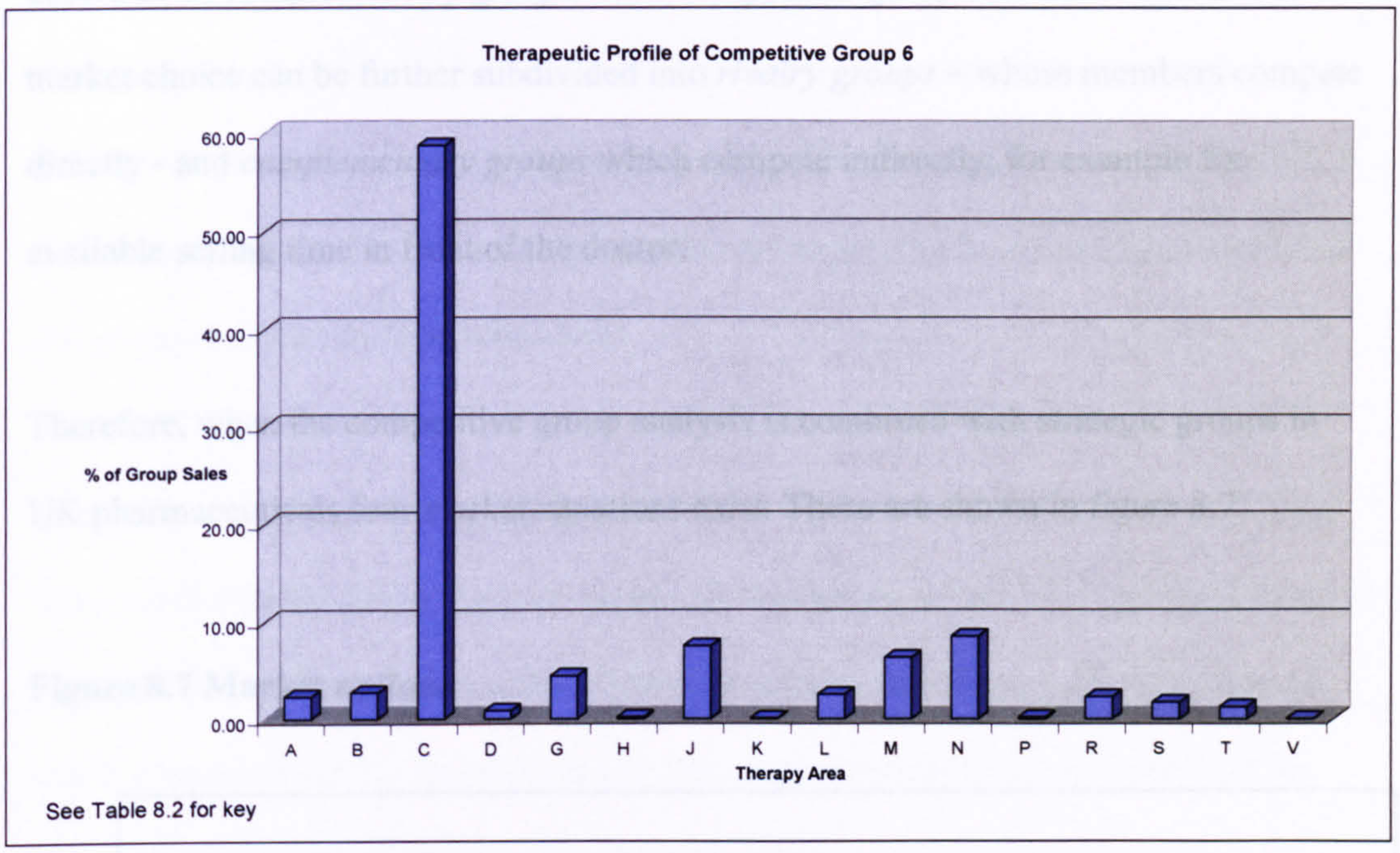
Figure 8.5 Competitive group 5



Here, the dominance of products for alimentary complaints is striking, accounting for 45% of mean sales. Companies in this group include Wyeth, which derives 50% of its sales from Zoton a proton pump inhibitor for ulcers and oesophageal reflux, and Solvay where 45% of its sales are derived from products like Colofac for irritable bowel syndrome.

Competitive group six is shown in figure 8.6.

Figure 8.6 Competitive Group 6



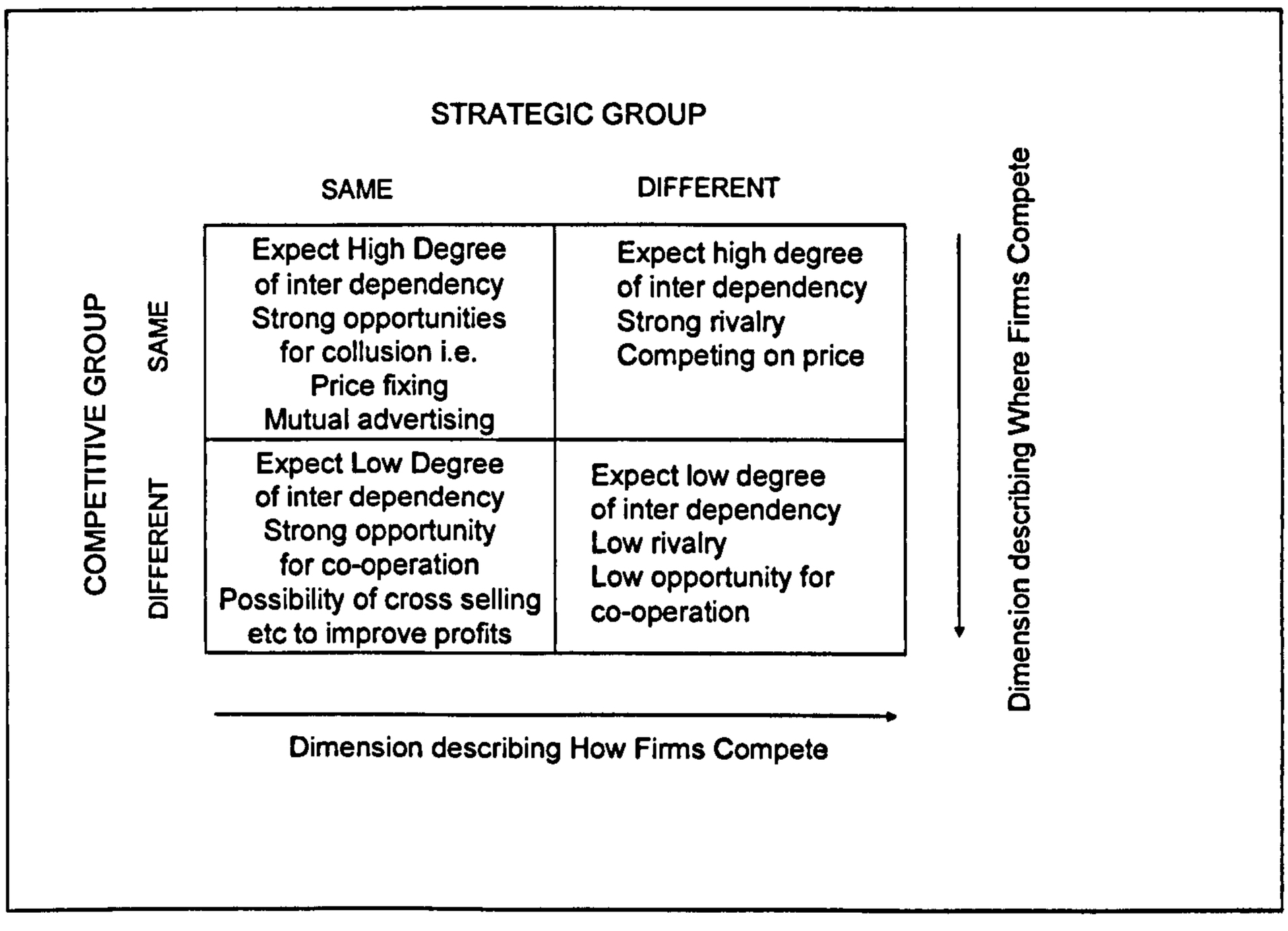
Cardiovascular medicine (C) is the largest single market within the UK pharmaceutical industry and competitive group six contains the industry specialists in this area. This is a highly competitive market dominated by the large US firms, notably Bristol Myers Squibb, Merck Sharpe and Dohme, and Pfizer. These three firms derive in excess of 70%, 64% and 74% of their revenues, respectively, from sales of cardiovascular products (IMS, 2002).

Competitive group membership seen from the perspective of the therapy classes competed within, includes two classes of companies: those that compete directly for the same type of customers offering directly substitutable products and those companies which compete in the same market addressing the same group of customers but offering non-competing products, i.e. a product for ulcers such as Zoton and a product for constipation such as Relaxit. The former class of companies' are rival groups, while the

second class of companies offer opportunities for direct co-operation and may be described as complementary groups. Thus competitive groups described in terms of market choice can be further subdivided into *rivalry groups* – whose members compete directly - and *complementary groups* which compete indirectly, for example for available selling time in front of the doctor.

Therefore, when the competitive group analysis is combined with strategic groups in UK pharmaceuticals four market situations exist. These are shown in figure 8.7.

Figure 8.7 Market options



8.2.3 Identification of complementary and rivalry groups

To distinguish direct rivals from complementary groups, it is necessary to explore market choices at the sub-therapy level, e.g. class A2B anti-ulcerants as against class A alimentary products. Here, the top 75 sub-therapy areas which account for over 92% of UK pharmaceutical sales are clustered.

Analyzing each competitive group separately across the top 75 sub- therapy areas was chosen rather than taking all groups across all sub therapy areas. This was done to avoid the impact of confounding variables. With 277 separate sub therapy groups, many of which contain extremely sparse data, the chance of skewing the analysis through the inclusion of extraneous variables may be high.

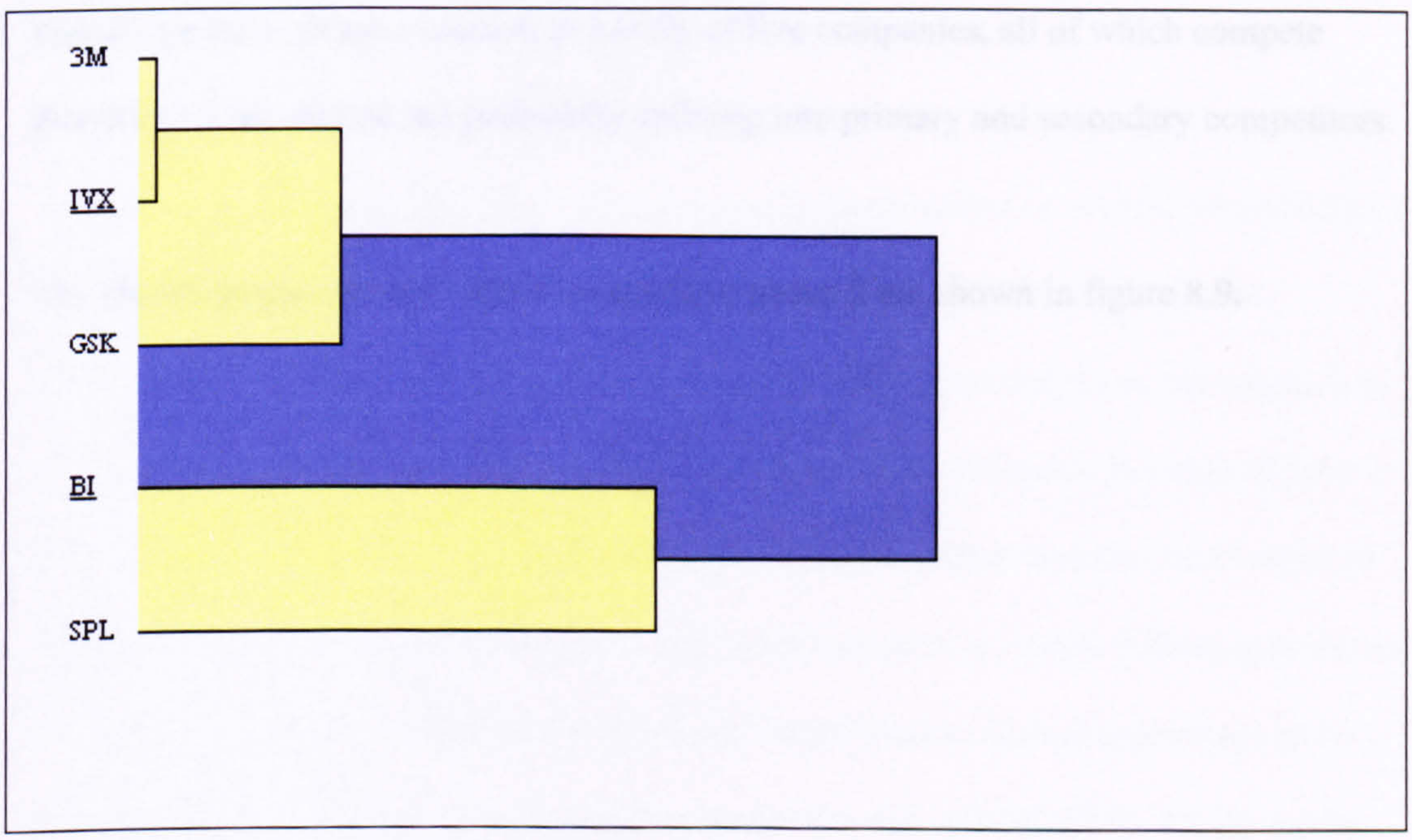
8.2.4 Identification of rivalry groups within each competitive group

As discussed above, competitive groups based on therapy areas classify firms in terms of *where* they compete but do not allow the division of firms into rivalry groups. Rivalry groups are defined here as those companies which offer direct substitutes and whose fortunes are directly inter-related, i.e. the market success of one member firm impacts upon the market success of another member firm. Firms occupying different rivalry groups or competing in sole niches have the potential to complement each other's activities through co-marketing or other forms of co-operation, which may be expected to reduce promotional costs.

Porter's theory of intra-industry competition (see chapter 2 for a fuller discussion) predicts that firms in the same strategic group and addressing the same customer group

should outperform those firms in different strategic groups but the same customer base. This is because they will better understand each other's modus operandi and signals thus increasing the chance of some degree of co-operative or collusive activity. In contrast, firms within the same rivalry group, which compete on different terms, i.e. are members of different strategic groups are more likely to engage in strong competitive rivalry and compete away margins or undertake damaging price competition (Porter, 1976; Porter, 1979). Similarly, firms in the same strategic group but different rivalry group may be expected to co-operate more freely. This is because each firm will see their external environment in similar ways, attempt to compete in similar ways and address common customer groups. Mutual understanding of opportunities for low risk but high payoff co-operative activities may therefore be more likely to be explored. The rivalry groups present within competitive group 1 are shown in figure 8.8.

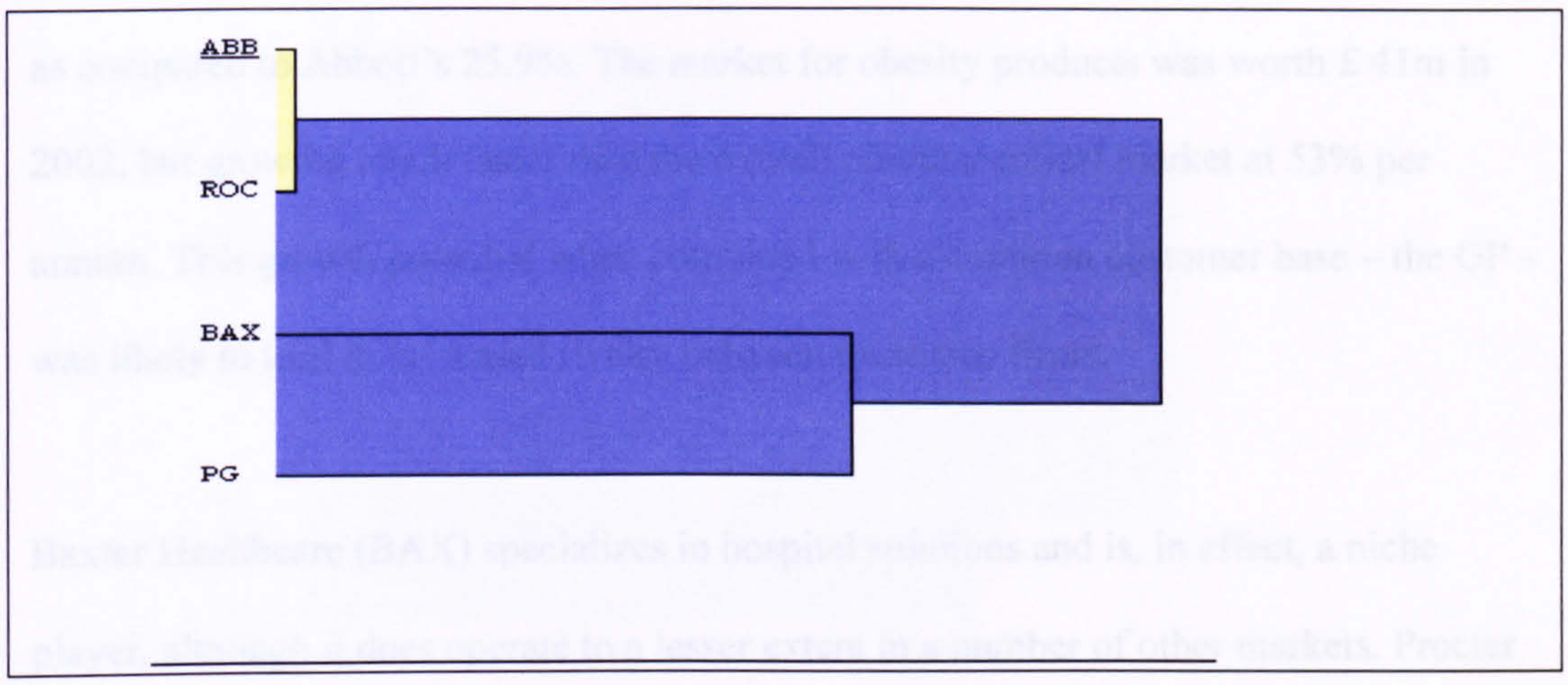
Figure 8. 8 Rivalry within competitive group 1



It is clear that there is a concentration around inhaler treatments for Asthma marketed by Glaxo Smith Kline (GSK), Ivax (IVX) and 3M, which hold shares in R3A the B2 stimulants market of 67.3%,10.2% and 3.1% respectively is clear. GSK and Ivax also compete in R3D the corticoid market with shares of 54% and 15.3%, respectively (IMS, 2002). The position of Schering Plough (SPL) is interesting and reflects the importance of the Asthma market as compared to the hay fever market, which is where Schering directs attention, and where GSK and Ivax also compete. To put this into perspective, the UK market value of R3A, B2 stimulants is £230m, R3D the corticoid market is worth £289m. This gives a combined value for the Asthma treatment market in excess of £500 million per annum, as compared to the UK hay fever market, which is worth £47m. Boehringer Ingelheim (BI) competes with Schering in hay fever preparations with shares of 1.8% and 20.1%, respectively but the principal commercial interest of Boehringer is in R3G, the anticholinergic and B2 stimulant market, where it holds an 88.1% market share. This interlinking of respiratory interests does, however, suggest that competitive group 1 consists primarily of five companies, all of which compete directly to some degree but potentially splitting into primary and secondary competitors.

The rivalry groups present within competitive group 2 are shown in figure 8.9.

Figure 8.9 Rivalry within competitive group 2



Competitive group 2 is interesting because both Abbott (ABB) and Roche (ROC) have broad product portfolios, the result to some extent of acquisition of products through merger. Abbott purchased the Knoll pharmaceutical interests of BASF, which were the product of the earlier acquisition of Boots Pharmaceuticals (see chapter 7 for further details). Roche acquired Syntex and Boehringer Mannheim during the time period addressed by this research.

The similarity of these portfolios brings the companies together in several related areas, but direct competition between them is limited because they address related but different market niches. These companies are, therefore, in several areas not so much as direct rivals as complements. Competition will occur more indirectly in terms of time in front of the doctor and for cash limited hospital budgets. Abbott has similar interests to Roche in several therapeutic areas, principally diagnostic tests, where Abbott specializes in pregnancy tests and Roche in diabetes tests. In antibiotics, Abbott specializes in J1F, Macrolides, where it had a 58.6% market share at the end of 2002 (IMS, 2002). Roche specializes in J5C and HIV Anti-Virals, where it competes directly with Abbott

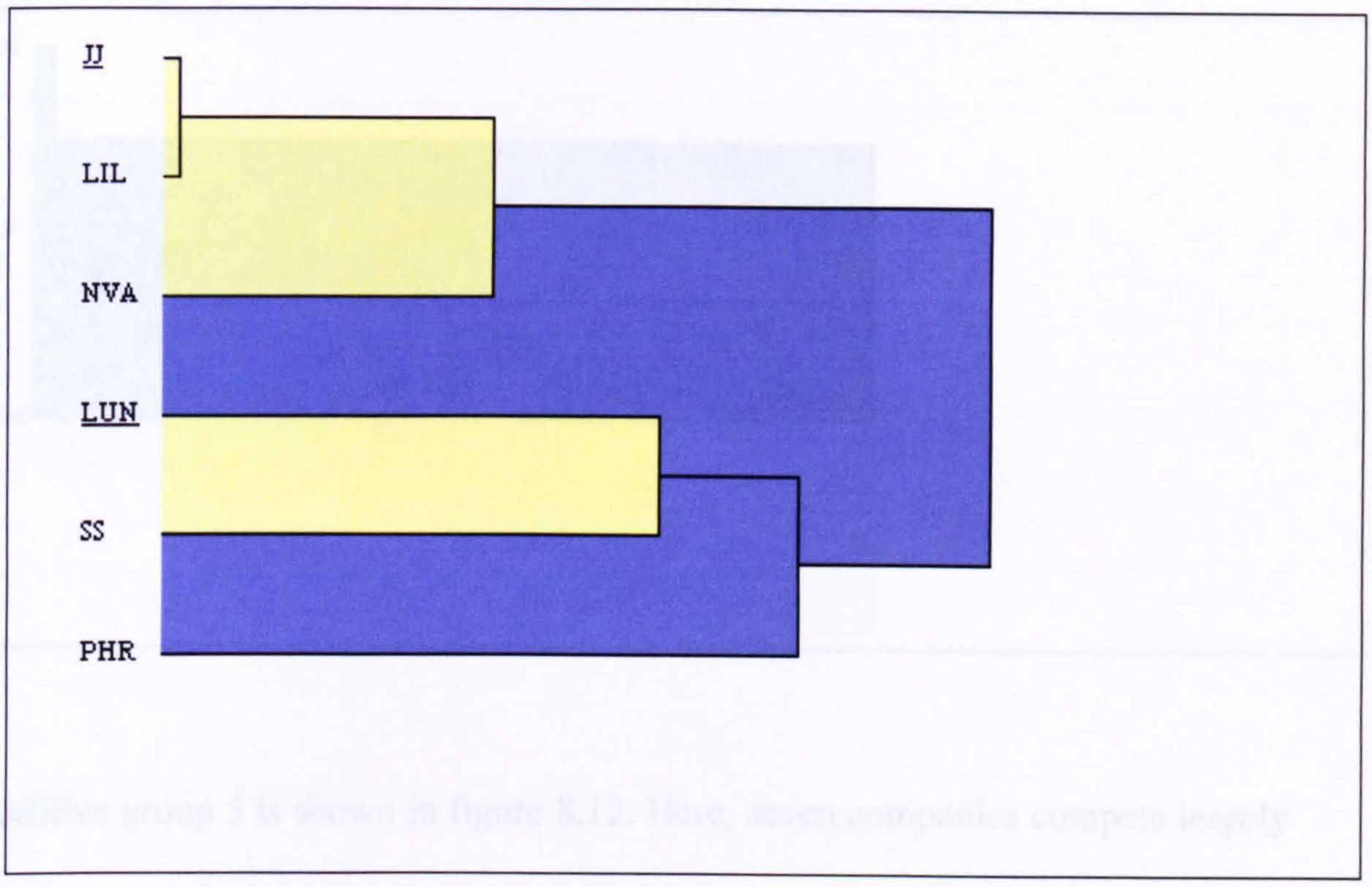
particularly in the hospital market. These two firms are also direct and strong competitors in A8A, the anti-obesity market, where Roche holds a 74.1% market share as compared to Abbott's 25.9%. The market for obesity products was worth £ 41m in 2002, but growing much faster than the overall pharmaceutical market at 53% per annum. This growth potential when combined with a common customer base – the GP - was likely to lead to increased rivalry between these two firms.

Baxter Healthcare (BAX) specializes in hospital solutions and is, in effect, a niche player, although it does operate to a lesser extent in a number of other markets. Procter and Gamble (PG) has limited pharmaceutical interests across a number of therapy areas but derives almost 60% of its revenues from M5B, Bone Calcium Regulators, where it has a 34.4% share. Roche also has a minor interest in this market but the product is not actively promoted.

The groups present in competitive group 3 are illustrated in figure 8.10.

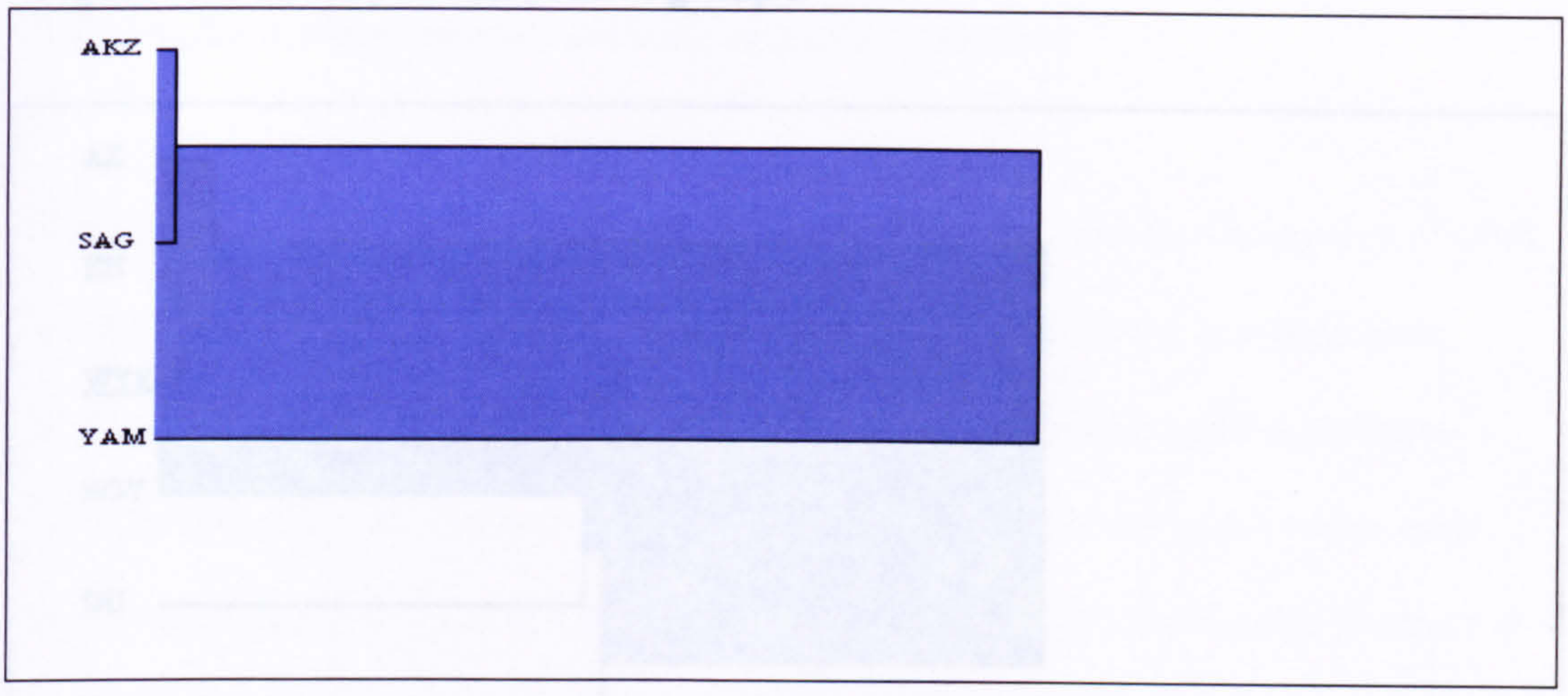
The six companies included here all have strong interests in the central nervous system therapy area. Johnson & Johnson (JJ) competes head to head with Lilly (LIL) in N5A, the antipsychotic market, with a 27% and 48.6% share respectively. Lundbeck (LUN), Novartis (NVA), Sanofi Synthelabo (SS) and Pharmacia (PHR) all have minor interests in this market. In excess of 90% of Lundbeck's revenues stem from N6A, anti-depressants, where Sanofi Synthelabo, Novartis and Pharmacia all have a minor interest. Pharmacia has strong interests in N7B, anti-smoking products. The general picture, therefore, is of a set of interests in related markets with a few points of direct competition.

Figure 8.10 Rivalry groups in competitive group 3



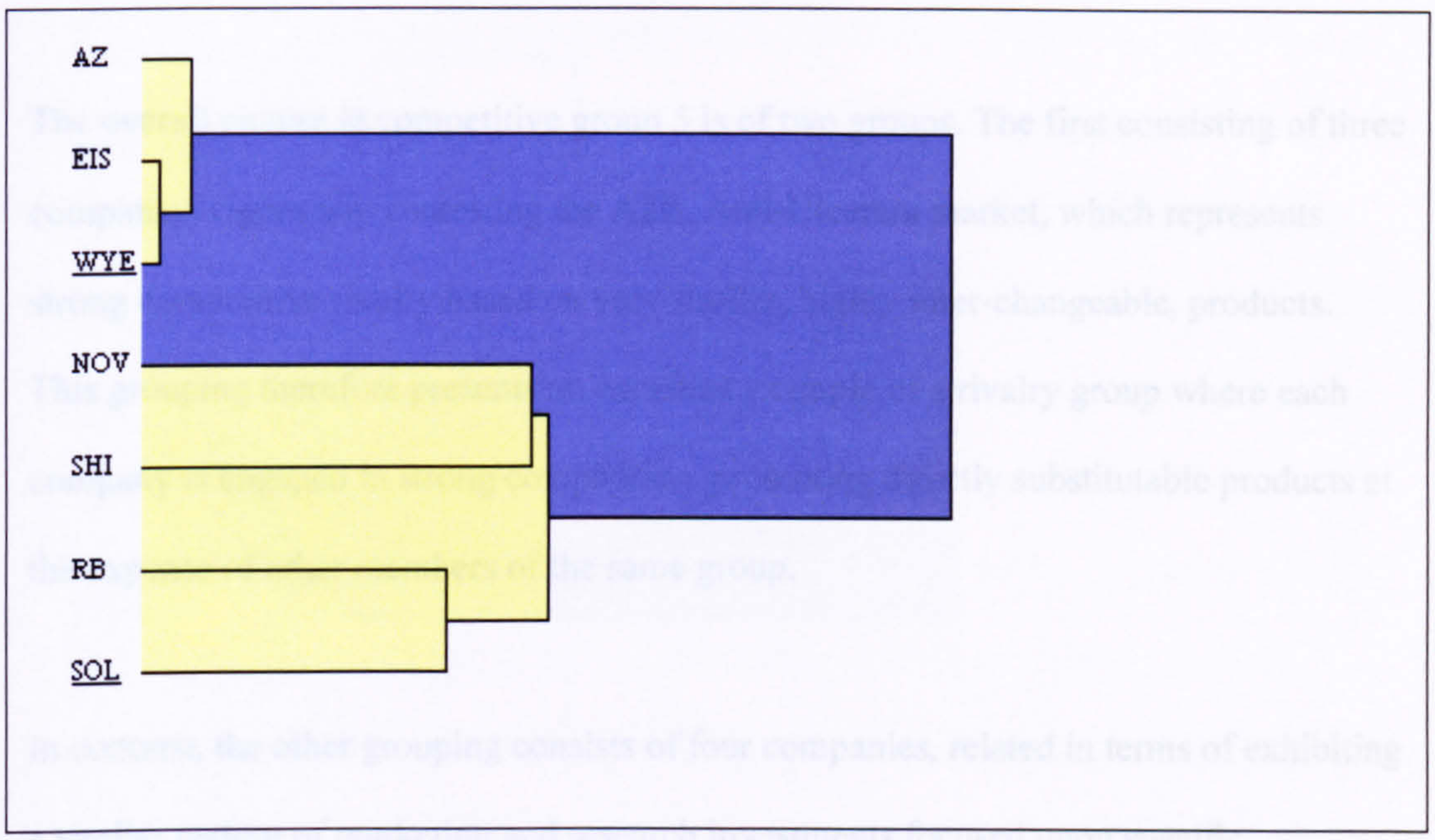
Competitive group 4 is shown in figure 8.11. This group consists of only three companies, Akzo Nobel (AKZ), Schering AG (SAG) and Yamanouchi (YAM). These companies' fortunes are strongly linked to products for women's health. Akzo and Schering both compete head to head in G3A, the contraceptive pill market, with shares of 12.9% and 46.2%, respectively (IMS, 2002). Akzo also has a strong interest in G3H, other sex hormones, where it has a 74.7% market share. Yamanouchi competes mainly in G4B, other urological preparations, where it has a 19.8% share. This accounts for 78.5% of the company's revenue. The impression here is of three companies each addressing specific opportunities in women's healthcare but where the main locus of competition is the rivalry between Akzo and Schering AG for a share of the contraceptive pill market.

Figure 8.11 Rivalry groups in competitive group 4



Competitive group 5 is shown in figure 8.12. Here, seven companies compete largely clustered around the lucrative alimentary market. Astra Zeneca (AZ), Wyeth (WYE) and Eisai (EIS) compete in the extremely lucrative but highly competitive A2B, anti-ulcerant segment, with shares of 34.1%, 6.9% and 41.2%, respectively. The fortunes of Losec, (marketed by Astra Zeneca) formerly the world's biggest selling prescription drug, are on the wane; but 34.1% of a UK market worth £522 million is still worth fighting over and despite patent expiry Losec still accounted for 26% of Astra Zeneca's revenue at the end of 2002 (IMS, 2002). The Wyeth share of the A2B segment represented 50% of the company's 2002 UK sales revenue, while 64% of Eisai's revenue came from Pariet a Proton Pump Inhibitor. These three companies were therefore locked in internecine warfare with Wyeth having wrestled market leadership away from Astra Zeneca through a price cutting strategy, a strategy adopted by Eisai when they entered the market.

Figure 8.12 Rivalry in competitive group 5



The remaining four companies Novo (NOV), Shire (SHI), Reckitt Benkisser (RB) and Solvay (SOL) address different areas of the alimentary market. Novo is a specialist in A10C, the human insulin analogue market, where in 2002 it held a 64.9% share representing two thirds of company revenue in 2002. Shire concentrates on A12A, calcium supplements, and its 74.2% market share equated to almost half company revenue. Reckitt held a 71.8% share of A2A, the antacid market, which together with a 32.9% share in A6A, the laxatives market, accounted for over 90% of company revenue. Solvay also competes to a limited degree in A6A, with a 4.4% share, which equates to 4.6% of its revenue (IMS, 2002). Solvay's primary interest in the alimentary market is, however, in A9A, the digestives including enzymes segment. Here it has a dominant 89.7% market share which equated to 26.2% of company revenue (IMS, 2002). The company's second most important alimentary market in 2002 was A3A,

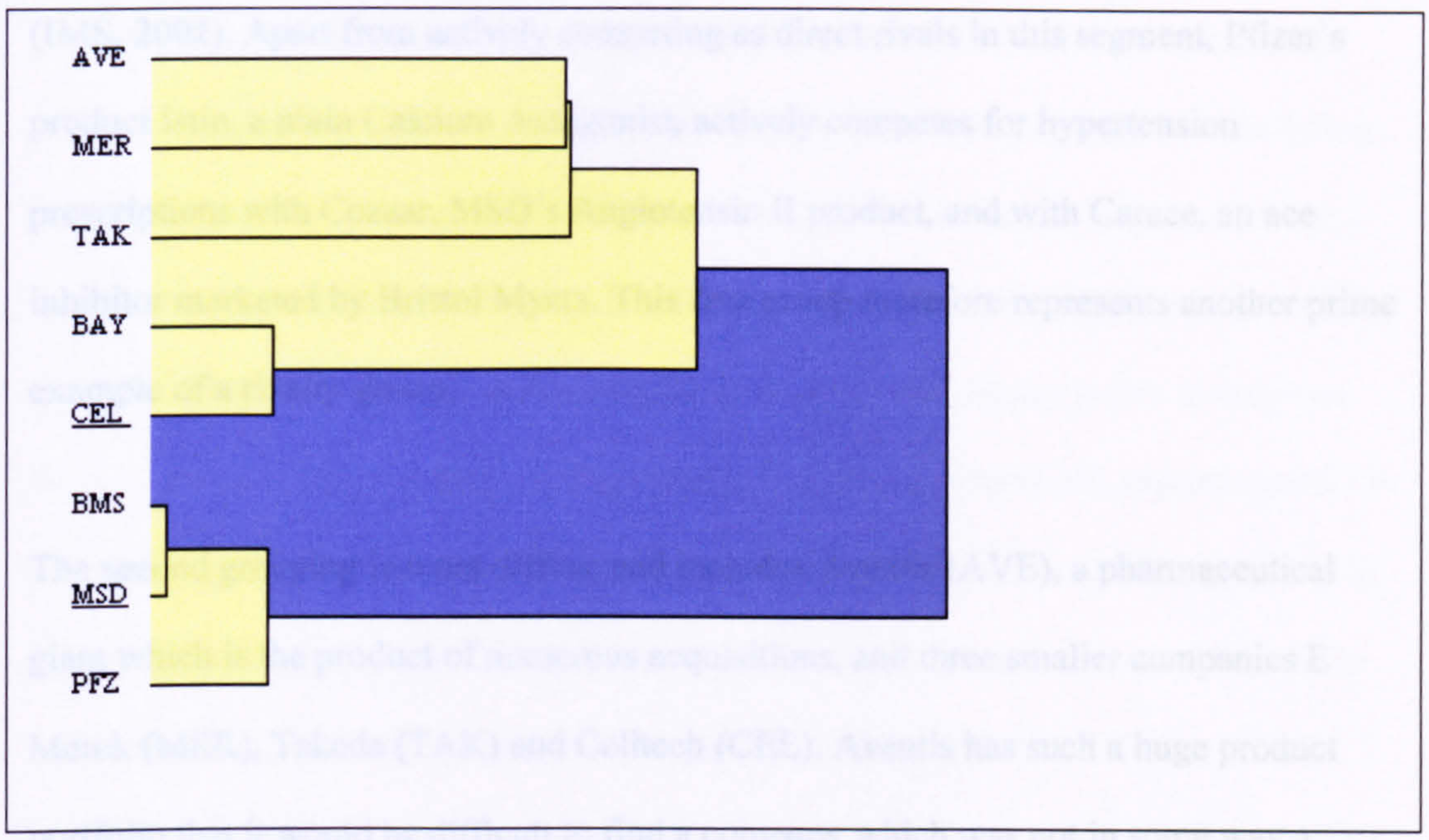
Anti-Spasmodics and Anti-Cholinergics plain, where Solvay was the market leader with a 30.8% share, which equated to 13.5% of company revenue.

The overall picture in competitive group 5 is of two groups. The first consisting of three companies vigorously contesting the A2B, Anti-Ulcerant market, which represents strong competitive rivalry based on very similar, highly inter-changeable, products. This grouping therefore presents an excellent example of a rivalry group where each company is engaged in strong competition, promoting directly substitutable products at the expense of other members of the same group.

In contrast, the other grouping consists of four companies, related in terms of exhibiting a similar pattern of marketing and research investments focused upon specific Alimentary segments. These companies should have potential scope for marketing co-operation, as each is a specialist within its chosen segments and there appears to be little overlap or direct rivalry. This group of four companies presents a good example of a complementary group, where all address a common customer base within related but essentially non-competing markets, each offering a range of similar but complementary products.

Figure 8.13 illustrates rivalry groups within competitive group 6.

Figure 8.13 Rivalry groups in competitive group six



In competitive group 6 there are two main groupings. The first is a tight group consisting of three companies Bristol Myers Squibb (BMS), Merck Sharpe and Dohme (MSD) and Pfizer (PFZ). It is interesting to note again the pairing of MSD and Pfizer, who have been referred to as direct rivals and benchmark competitors (Hawthorne, 2003). These three companies concentrate on the highly competitive and lucrative cardiovascular market, where each has an established franchise developed over the years based on successive products. Each company actively markets across a range of cardiovascular segments. MSD, for example, accounted for 54% of its 2002 UK revenues from sales of Zocor in C10A, and 10.8% from, a second cardiovascular sub-segment, C9C. Similarly, Pfizer obtained 35.8% of its sales from Lipitor in C10A, 25.6% from Istin in C8A and 12% from Cardura in C2A. Bristol Myers derived the bulk of its revenue, 61.5% from C10A and 8.5% from C9A. This is a complicated market where all three companies offer direct substitutes in C10A, the cholesterol and

triglyceride reducers. Here, MSD is the market leader with a 44.4% share of the £677m segment, closely followed by Pfizer with a 34.5% share and BMS with a 16% share (IMS, 2002). Apart from actively competing as direct rivals in this segment, Pfizer's product Istin, a plain Calcium Antagonist, actively competes for hypertension prescriptions with Cozaar, MSD's Angiotensin II product, and with Carace, an ace inhibitor marketed by Bristol Myers. This first group therefore represents another prime example of a rivalry group.

The second grouping is more diffuse and includes Aventis (AVE), a pharmaceutical giant which is the product of numerous acquisitions, and three smaller companies E Merck (MER), Takeda (TAK) and Celltech (CEL). Aventis has such a huge product portfolio that it would be difficult to find a company which was not in some way a competitor. But the company's largest product Tritace, is a cut price ace inhibitor, which represents 37.1% of revenue. Tritace had 30.5% market share of the ace inhibitor market in 2002. This puts Aventis in some direct contention with Bristol Myers. The other cardiovascular interests of Aventis include Ikorel, a specialist coronary care product, which held 99.9% share of the market, and Frumil, a combination diuretic, which held a 63.7% segment share, representing 4.6% of company revenue (IMS, 2002). E Merck is a German company with strong generic interests that is active in a range of cardiovascular products. For this company 24.6% of revenues in 2002 stemmed from Nitrolingual, a nitrate treatment for Angina [C1E], 9.2% of revenue from Praxilene, which held a 28.9% share of the cerebral and peripheral vasodilators segment [C4A], 6.4% from Slozem, which competed in the C8A Calcium Antagonist segment, and 30.3% from Cardicor a Beta Blocking agent, class C7A. None of these is a really innovative product but rather a me-too offering. A similar range of competing

branded generics is marketed by Celltech, where Coracten, representing 29% of company revenue, is a direct competitor to E Merck's Slozem, while Beta-Cardone competes directly with Cardicor. The level of promotion which these companies can afford to put behind their brands is a fraction of that invested by companies like Pfizer or MSD. Therefore, these group two companies represent a distinct second division competing across a range of cardiovascular segments promoting largely me too or older products. The exception is Takeda. Takeda is a Japanese company active in only two therapy areas. Sales of Amias, an Angiotensin II inhibitor, class C9C, represents 79.3% of company sales, equating to a 17.0% segment share. Takeda is a smaller company in the UK, which although backed by huge resources in Japan represents a step down in competitive terms compared to some heavyweight competitors like MSD or Pfizer. Despite disadvantages in size and reputation Takeda competes directly against MSD's Cozaar, which is market leader of the C9C segment. Similar comments to those expressed earlier regarding Aventis apply. Takeda is more of a specialist niche competitor with no interest in the huge, highly lucrative, cholesterol lowering segment, which at over £677 million and growing at 29% per annum was the primary focus of the first grouping within competitive group 6. (IMS, 2002).

The above analysis represents a useful perspective on a complex and multi faceted competitive picture. Competitive groups have been drawn from the pattern of therapeutic interests addressed by each firm, where the primary interests of these firms are brought to the fore. What this analysis does show, however, is that competitive groups can be effectively classified into rivalry groups, consisting of *direct rivals,* and *complementary groups* pursuing largely non-overlapping but related interests. In the next section of this chapter the aim is to explore the performance consequences of the

relationship between strategic groups, and competitive groups. In this analysis firms may fall into one of four categories (see figure 8.7 entitled market options earlier in this chapter). These categories are repeated here for convenience.

1. Same strategic group and the same competitive group. Here, Porter suggests stronger returns due to collusion or co-operation. Markets are inter-related but viewed from a similar perspective, and a common customer group (Porter, 1976; Porter, 1979).
2. Different strategic group and the same competitive group. The same inter-related markets and customer groups are addressed, but each company implements a different strategy and views the market from a different perspective. Theory predicts strong rivalry with frequent recourse to price competition and the erosion of margins (Porter, 1976; Porter, 1979).
3. Same strategic group but a different competitive group. The opportunities for co-operation are strong because companies address common customers with related but essentially non-competing products. Theory would predict co-operation between firms leading to cost savings through activities such as cross selling or co-marketing(Porter, 1976; Porter, 1979).
4. Different strategic group and a different competitive group. Here, the companies are operating at arm's length in largely unrelated markets. Little mutual understanding may exist between companies, but this is not a problem as the companies address different niches in a different way. They do not compete directly and theory would predict average returns (Porter, 1976)(Porter, 1979).

In summary, therefore, above average returns are to be expected for categories one and three because of savings in marketing and promotion costs. Average returns are expected for category four because each company is operating independently and interaction between the firms, if it exists, is low. The lowest returns or the highest promotional costs are predicted to occur in the case of category two companies, either because aggressive pricing reduces margins or because excessive promotional costs are associated with heightened non-price competition.

8.2.5 Analysis of competitive groups

The performance consequences of strategic groups are discussed in chapter 6. In this chapter to test the performance consequences of competitive group membership in UK pharmaceuticals, seven variables are compared between groups. These variables are described in table 8.6.

Table 8.6 Variables used to test competitive groups

Variable	Description
LIC	Licensed product UK sales/Total UK sales
COMARK	UK sales from co-marketed products/Total UK sales
SHARE	Share of the UK ethical pharmaceutical market
WMS	Weighted market share (see chapter 5 for further details)
EBIT	Earnings before interest and tax/Total world sales
EBITDA	Earnings before interest, tax, depreciation and amortisation/Total world sales
PRETAX	Pre tax profits/Total world sales

The relevance of these variables is that the first two measure, to some extent, the relationship between companies, although licensing arrangements are now less likely to be agreed locally (see chapter 4 for a further discussion). The remaining five variables all measure some aspect of performance, where share and weighted market share

represent UK sales performance measures. Corporate performance is measured by pretax profits, earnings before interest and tax [EBIT] and earnings before interest tax depreciation and amortization [EBITDA], all of which measure some aspect of raw earnings.

These variables were measured between competitive groups using the Kruskal Wallis one way analysis of variance test and the results are shown in table 8.7.

Table 8.7 Performance tests between competitive groups

	LIC	COMARK	SHARE	WMS
Chi Square	5.038	2.040	5.161	0.907
Df	5	5	5	5
Asymp sig	0.411	0.844	0.397	0.970
	EBIT	EBITDA	PRETAX	
Chi Square	9.402	5.918	9.260	
Df	5	5	5	
Asymp sig	0.094	0.314	0.099	

The results in general are quite weak. No significant relationship was found between UK performance, licensing and co-marketing activities. Nor was EBITDA found to differ significantly between groups. A difference was found to exist between groups in terms of the proportion of pre tax profit and EBIT. This difference was significant at the 10% level.

In order to test the validity of Porter's theory on intra-industry competition (Porter, 1979) applied to competitive group and strategic group membership the following hypotheses were tested.

H_0 The performance of firms within a competitive group will differ according to whether the firms are members of the same or different strategic group.

H_1 Performance will not differ between firms whether they are in the same or different strategic group.

The above, seven variables were compared between two groups of firms based upon the following simple classification.

1. Same strategic group and same competitive group.
2. Different strategic group and same competitive group.

The result of this analysis is shown in table 8.8.

Table 8.8 Performance consequences of strategic and competitive group membership

	LIC	COMARK	SHARE	WMS
Chi Square	0.252	3.205	6.189	2.333
Df	1	1	1	1
Asymp sig	0.616	0.073	0.013	0.127
	EBIT	EBITDA	PRETAX	
Chi Square	6.438	2.438	5.554	
Df	1	1	1	
Asymp sig	0.011	0.118	0.018	

These results indicate a performance relationship between strategic group and competitive group membership in terms of how you compete and where you compete. Three performance measures SHARE, EBIT and PRETAX are significant at the 5% significance level. EBITDA and WMS were found not to differ significantly between the two groups. The two variables measuring co-operation were also found not to differ significantly at the 5% level, but COMARK was found to be significant at the 10% level.

These results support the null hypothesis that strategic group membership when combined with competitive group membership has performance consequences. This in turn broadly supports Porter's theory of intra-industry competition. This posits that firms in different strategic groups competing in inter-related markets will perform less well than firms who are members of the same strategic group. The argument is that such firms are likely to read each other's signals more accurately and co-operate or collude rather than engage in destructive price competition (Porter, 1976; Porter, 1979).

8.2.6 Conclusions

If competitive groups delineate *where* firms compete, which in effect provides a more detailed calibration for the scope decision in Porter's generic strategies, described by the dimension 'broad' or 'narrow' market focus, then strategic groups, in turn provide further detail on Porter's second axis, described by the dimension 'differentiation' or 'low cost' strategies.

The analysis reported in this chapter set out, first, to show that scope choices of where firms compete, in terms of market choices, can be used to develop a meaningful classification of competitive groups. These competitive groups can then be combined with a strategic group classification to produce a more detailed analysis of competition within the UK pharmaceutical industry.

The first approach adopted was to classify firms according to their therapy choices using the 16 class anatomical classification in the IMS data base and adopted in previous strategic group studies of the pharmaceutical industry (Bogner, 1991; Bogner *et al.*, 1996; Cool, 1985; Cool *et al.*, 1987a; Martens, 1988).

Six different competitive groups were identified, most of which concentrated around a dominant market opportunity, for example, almost a half of the sales of competitive group 1's sales are derived from respiratory products. Competitive group 3 is clustered around central nervous system products, group 4 around female health, group 5 around alimentary products and group 6 around cardiovascular offerings. The exception to this pattern was found to be group 2. The member firms of this group appeared to adopt a

more generalist profile and are active across a broad range of markets. The main conclusion from this analysis is that the presence of these six different competitive profiles effectively segments competition within the UK pharmaceutical industry. Direct competition is dependent upon which therapy area is addressed i.e. to which competitor group you belong.

This analysis was useful in classifying firms broadly in terms of where they compete. But it lacked the detail necessary to distinguish between firms that compete *directly* from those that offer *unrelated or complementary products*. These firms still will compete indirectly, however, for example for the limited time available to see a doctor or for access to limited funds such as hospital budgets. To classify firms that offer direct substitutes it was necessary to identify these *rivalry groups*.

In order to classify firms into *rivalry groups*, i.e. firms which compete directly in such a way that the relative success of one means the relative failure of another, and *complementary groups*, which are firms that operate in the same market and address the same customers but do not directly compete, it was necessary to group firms within competitive groups according to the IMS sub therapy class. There are 277 sub therapy classes but in order to avoid confounding the cluster analysis by the introduction of many extraneous variables, each firm's sales within the top 75 sub therapy classes, which represents over 91% of total sales, was used.

The results indicated that generally each competitive group could be divided into two or sometimes three groupings of firms each clustered around a specific market opportunity. The UK pharmaceutical market is composed of a myriad of such clusters

and therefore a firm may engage simultaneously in a number of very different markets, acting as a rival to another specific firm in one market situation and yet provide complement products in another. To draw any detailed performance consequences from this classification would, therefore, by necessity, have to be based upon much more detailed market specific data, for example including marketing costs, manpower costs and profits by therapeutic segment, This data was not available for this research. The distinction between rivalry and complementary groups does, however, support the idea of cognitive groups, where researchers indicated that managers actively segment their market according to whom they perceive to be their firm's direct competitors (Porac *et al.*, 1989; Porac *et al.*, 1994).

The link between competitive groups and performance was not found to be strong, but two corporate performance variables, EBIT and PRETAX, achieved statistical significance at the 10% level. Clearly, the choice of market segments should affect market potential as some market segments in pharmaceuticals are larger and more lucrative than others: for example C10A, the cholesterol and triglyceride reducers segment, was worth a massive £ 677 million in 2002, growing at 56% per annum. Based upon the results reported in this thesis, market potential alone does not appear sufficient to explain differences in firm performance.

Through looking in turn at each competitive group and then dividing firms into two categories - those within the same strategic group as other firms and those that belong to different strategic groups - an attempt is made here to link the two dimensions originally posed in Porter's generic strategies, namely *where* you compete (competitive group) as

against *how* you compete (strategic group) (Porter, 1980). The results reported in this chapter indicate a link between these two combined choices and performance. Three of the five performance variables, SHARE, EBIT and PRETAX differed significantly at the 5% level or better. This is a result that broadly supports both the null hypothesis – that the performance of firms within a competitive group will differ according to whether the firms are members of the same or a different strategic group - and the outcome suggested by Porter's theory of intra-industry competition (Porter, 1976; Porter, 1979). The suggestion of co-operation, as proposed by Porter, is also but more weakly supported by the finding that the co-marketing variable differed significantly at the 10% level of significance (Porter, 1976; Porter, 1979). Some anecdotal evidence is also provided by the observation that Astra Zeneca, Wyeth and Eisai compete strongly on price within the A2B segment and belong to different strategic groups. A price cutting strategy appears, however, to be absent from the C10A segment, where Pfizer, Merck Sharpe & Dohme and Bristol Myers Squibb are engaged in competition and where all three companies are members of the same strategic group.

In conclusion, the results presented in this chapter suggest that the competitive group classification provides a useful and potentially informative dimension to understanding competition in the UK pharmaceutical industry. There is some evidence that competitive group choices have performance consequences. However, at the same time the UK pharmaceutical industry is a complex web of market relationships, and the situation would have been made more complex by the introduction of the plethora of mergers described in the previous chapter. Importantly, when competitive groups are combined with strategic group membership a clearer relationship between combined group membership and performance is discernable. Three of the five performance

measures were significantly different at the 5% level or better. These findings support both the null hypothesis - that the performance of firms within a competitive group will differ according to whether the firms are members of the same or a different strategic group - and the predictions posited by Porter (Porter, 1976; Porter, 1979).

The results present a new classification framework for firms which, allows both market and strategic priorities to be pinpointed. The use of Porter's generic strategies is now virtually universal within the strategy literature, but for firms in the pharmaceutical industry the division between low cost and differentiation is too blunt because the industry is primarily concerned with product differentiation. As Cool (1985) points out the "generic drugs" industry operates by very different rules to the research based industry and should therefore be viewed separately. Strategic groups describe *how* firms compete and arguably therefore provide a more calibrated alternative to Porter's low cost – differentiation axis.

Similarly to describe firms as to whether they compete on a broad industry basis or more selectively does not precisely reflect market choice in the pharmaceutical industry. This is an industry where competition is separated by therapeutic choice and where the locus of competition resides at the sub-therapy level, where one product directly substitutes for another. This is an industry where firms frequently compete in a variety of sub-segments and several therapeutic areas. Here, the competitive group dimension, *where* firms compete, allows a more detailed positioning of firms within the generic strategies template.

For example, through the use of this distinction it is possible to separate out in UK pharmaceuticals Astra Zeneca, Wyeth and Eisai as direct competitors within the alimentary market and distinct from the numerous other companies which potentially compete within this segment. Similarly a more detailed picture of complements and direct substitutes can be drawn from the competitive/strategic group matrix when applied to the more complex cardiovascular or respiratory markets.

The research reported in this chapter therefore contributes to theory by providing a more precise calibration of an established and valued strategy template. In addition, the theory which Porter originally proposed on intra-industry competition (Porter 1976; Porter 1979) has been empirically tested. In addition it is important to realize what is meant by competition in the pharmaceutical industry. Competition occurs at two levels. At a more general level through calling upon a largely common customer base, the general practitioner, firms compete for time in front of the doctor. The heavy organs of promotion employed via the major sales battalions of the heavyweight pharmaceutical companies effectively mop up available appointments. This deprives competitors of selling opportunities – the marketing "oxygen" necessary for growth. Also, at this more general level firms compete for available share of resources because if more is spent on cardiovascular medicine, for example, this impinges upon the remainder of the healthcare budget which has to be cut so many ways.

At a more precise level, direct competition occurs at the point of substitution where the doctor, having made a diagnosis, is then faced with a number of choices of remedies from which to choose. This is the true locus of competition within pharmaceuticals, where one remedy, substitutes directly for another. Here, the concept of rivalry groups captures this dimension, as distinct from the competitive grouping which may include

direct competitors alongside those firms which offer complements or unrelated products.

For those engaged in strategy formulation within the pharmaceutical industry, the strategic group/competitive group matrix provides the opportunity to simplify a complex and multi-faceted competitive picture, allowing a clearer view of the competitive dynamics. *Where* firms compete appears in performance terms to be highly correlated to *how* firms compete. The combination of strategic and competitive group analyses allows the strategist to more accurately predict the nature of competition within a given segment of the market. In UK pharmaceuticals an excellent example is provided by the internecine "price competition" present in the A2B segment between Astra and Wyeth, who each belong to different strategic groups and employ different strategies, as compared to the more benign competition between Pfizer and MSD, who are members of the same strategic group competing within the cholesterol lowering segment. Therefore, through such analysis a clearer view of both current and future market competition may be gleaned.

It is also possible through examining the strategic group/competitive group matrix to identify those companies that share a congruent view of the market but which offer either complements or unrelated products. These companies may offer excellent opportunities to exploit synergies, by reducing promotional costs and increasing market presence through co-operative activities such as cross-selling.

The next chapter considers further the results reported in this and the preceding two chapters. It discusses the findings of the research as a whole.

CHAPTER 9

DISCUSSION

9.1 Introduction

This chapter brings together the empirical research presented in the preceding 3 chapters.

The formal assumption that underlies strategic group theory is that these groups accurately represent choice of strategy within a given industry and that group membership has performance implications. The research presented in this thesis follows three separate but interconnected themes within the context of the UK pharmaceutical industry during the ten years 1993 to 2002.

The first of these themes, reported earlier in chapter 6, follows the approach established by Cool's benchmark study of the US pharmaceutical industry (Cool, 1985) and attempts to confirm Cool's findings that strategic groups *are* present within the UK pharmaceutical industry and that these groups *differ* with regard to performance.

The second theme explores the dynamics between firms and strategic groups, where the principle aim is to empirically test the theory proposed by Caves and Porter (1977), which states that firms moving between strategic groups move to a higher performing group. An additional aim of this part of the research was to explore the relationship between mergers and strategic groups. This research theme is reported in chapter 7.

The third and final research theme investigates the relationship between *how* firms compete, i.e. the strategic group to which they belong, and *where* firms compete i.e. their choice of markets. Therefore a more detailed exploration of Porter's "generic strategies" is undertaken, where the strategy dimension equates to low cost versus differentiation, and the market choice dimension to broad versus narrow market focus (Porter, 1980). A principal aim of this research is to empirically test Porter's theory of intra-industry performance (Porter, 1979). This third and final research theme is reported in chapter 8.

9.2 Research Theme 1 Strategic Groups in the UK Pharmaceutical Industry

The premise here is that if strategic groups accurately classify firms according to their strategy, then we may expect performance differences between strategic groups because, as shown in Chapter 4, the ethical pharmaceutical industry is high risk and high reward. Therefore the ability of companies to manage the risk effectively and profit from their operations, (in effect to formulate and implement effective strategies,) should have marked performance consequences. To date however, previous research has produced mixed results with regard to performance (Bogner, 1991; Cool, 1985; Cool *et al.*, 1988; Cool *et al.*, 1987b; Guedri, 1998; Martens, 1988; Voyer, 1993). Cool and Voyer reported significant performance differences but Bogner, Guedri and Martens failed to corroborate these findings. As discussed previously, (see Chapter 2 for a fuller discussion) comparison between these studies is difficult because of different samples, methods, choice of variables and performance measures employed.

The empirical results presented in chapter 6 aimed in part to redress this lack of comparators by employing and building upon a common approach used by a number of

previous researchers (Bogner, 1991; Cool, 1985; Martens, 1988). The key elements of this common approach are firstly, the establishment of stable strategic time periods. Secondly the use of a number of variables to represent strategy. These variables were then used to identify strategic groups present using Ward's method. Thirdly, performance was tested between groups using a number of measures. A key limitation of these earlier related approaches, adopted by (Cool, 1985; Martens, 1988; Fiegenbaum & Thomas, 1990; Bogner, 1991,) is that the method used to identify stable strategic time periods – Box's M test – requires that the firm sample remains constant throughout the duration of the study. This by necessity rules out merged firms and new entrants, such as the Japanese firms Eisai and Takeda.

Although these three previous researchers all followed a broadly similar approach there were however marked differences in both the number and choice of variables chosen to represent strategy. For the purpose of this research it was decided to most closely follow Cool (1985). This was for two main reasons. Firstly, because Cool's study is the most frequently cited in the literature and secondly because Cool chose a more comprehensive set of variables that represented scale, scope and resource decisions.

Despite this aim however, in practice, five of the fifteen variables chosen by Cool could not be included within this research. This was either because the variable was not applicable in the UK, (e.g. direct to consumer advertising and distribution strategy,) or because the relevant data was not available, which was the case for commodity generics and two of the research variables chosen by Cool. (See Chapter 5 for further details).

This discrepancy clearly illustrates the market specific nature of some strategy variables

and explains one of the reasons why strategic group studies may have yielded equivocal results.

Two stable strategic time periods (SSTP) were identified in this study. Each was five years in duration. The first ran from 1993 until 1997, and the second from 1998 to 2002. Here it is interesting to note that a number of the environmental variables identified as important in chapter 3, were markedly different between the two time periods. Firstly, the generic penetration of all six PACT therapy areas, except respiratory products, rose sharply post 1997, although generic usage of CNS and infection products rose more sharply than the other therapeutic categories. Secondly, post 1997 there was also a sharp increase in the market penetration of parallel imported products, particularly cardiovascular drugs. The rise of this specific category may well have been fuelled by the introduction of the National Service Framework for cardiovascular health. (See Chapter 3 for further details).

The duration of the stable strategic time periods identified are not dissimilar to those reported in previous research. See table 9.1 for further details.

Table 9.1 Duration of Stable Strategic Time Periods

	Cool 1985		Martens 1988		Bogner 1991	
	Time Period	Duration	Time Period	Duration	Time Period	Duration
SSTP1	1963 - 69	7 years	1981 - 84	4 years	Pre 1972	
SSTP2	1970 - 74	5 years	1985 - 88	4 years	1972 - 1975	4 years
SSTP3	1975 - 79	5 years			1975 - 1981	7 years
SSTP4	1980 - 82	3 years			1981 - 1984	4 years
SSTP5					1984 - 1988	5 years

The two stable strategic time periods each of five years duration identified in this research, agree closely to the length of SSTPs found in the previous research detailed in the above table. The implication of this finding is that strategic choices do not change rapidly which would be the predicted outcome from mobility barrier theory (Caves *et al.*, 1977)

Within these two stable time periods this research found that seven strategic groups were present within each time period. The number of strategic groups found in previous research, employing a similar method, is shown in table 9.2.

Table 9.2 Number of Strategic Groups in Stable Strategic Time Periods

	Cool 1985	Martens 1988	Bogner 1991
	Number of Strategic Groups	Number of Strategic Groups	Number of Strategic Groups
SSTP1	6	9	4
SSTP2	5	10	4
SSTP3	4		6
SSTP4	6		7
SSTP5			6

In this research a relatively stable structure of seven strategic groups within each SSTP were found, see table 9.3.

Table 9.3 Strategic Groups in the UK Pharmaceutical Industry

	SSTP1	SSTP2
Time Period	1993 – 1997	1998 - 2002
Number of strategic groups	7	7
SG1:	**3M RB AKZO SOL PG**	**3M RB AKZO SOL PG**
SG2:	**BAX**	**BAX**
SG3:	BI **SAG** MER **IVX NOV**	**IVX NOV SAG**
SG4:	**LUN**	**LUN** SPL YAM
SG5:	SPL YAM	PHR SS
SG6:	**JJ AVE** PHR NVA **ROC** AZ GSK	ABB BAY **JJ AVE** BI **ROC** MER
SG7:	BAY ABB **WYE BMS MSD LIL PFZ SS**	NVA AZ GSK **WYE BMS LIL MSD PFZ**

The above table compares the strategic group structure for the first SSTP with the second SSTP. (The set of results chosen to represent SSTP2 are those of standardized variable set one which performed best in terms of the external validity test, although the other clustering results did not differ a great deal from this one. See Chapter 6 for further details). Companies shown in bold are classified in the same group as for the previous time period. These represent 18 out of the 29 firms therefore 62% of firms remained in the same group during the entire ten year period. Some groups seem particularly stable notably the group of diversified conglomerates comprising 3M, Reckitt Benkisser, Akzo Nobel, Solvay and Procter and Gamble.

On examination this group structure suggests a consolidation of strategic positions in the second stable strategic time period where firms within individual groups appear more closely aligned.

Strategic group 1 is common across both time periods. The members of this group are 3M, Reckitt Benkisser, Akzo Nobel, Solvay and Procter and Gamble. The common factor with these firms are that they are all broadly diversified conglomerates, each with a number of operating divisions and a relatively small commitment to pharmaceuticals. The technological platform of these companies is industrial chemicals where spend on research and promotion for example are generally much lower than for a typical pharmaceutical company.

Strategic group 2 consists solely of Baxter which is a specialist supplier of hospital solutions.

Strategic group 3 changed significantly over the two time periods. Initially the group included Boehringer Ingelheim and E Merck which are both medium sized European companies whose core business is pharmaceuticals. Both of these companies have a broad product portfolio particularly E Merck which has a strong presence in generic pharmaceuticals. The other three members which remained in this group across both SSTPs are Ivax, Novo and Schering AG. Ivax is the exception here because it is an American company but these three companies are all mid sized with a relatively limited promotional spend. All derive the majority of their revenues from one therapy area. Ivax specializes in branded generic respiratory medicines, Novo in hormones, particularly growth hormone, and Schering AG is very strong in women's health products.

Strategic group 4 comprises of Lundbeck a small Danish company in period 1 but this company was joined by Schering Plough and Yamanouchi in period 2. These three

companies have in common their size and limited market scope, but they are more aggressive in their marketing than the companies in group 3. Lundbeck for example spent very heavily to promote its CNS product and Schering Plough are known for their active marketing of hay fever products. It is interesting to note how commonly certain groups of companies are paired together in strategic group analysis. Schering Plough and Yamanouchi represent this trait which may suggest a common perspective on the market.

Strategic group 5 changed its group membership in SSTP2. In the first time period this group consisted of Schering Plough and Yamanouchi, but these companies then formed a single group with Lundbeck. In the second time period Pharmacia and Sanofi Synthelabo are classified together. These companies are both "heavyweight" with strong but broad healthcare interests. Both have a strong consumer presence. Pharmacia marketed Nicorette and Sanofi Solpadol for example. Spending on research and promotion is about average for the industry.

Strategic group 6 changed markedly over the two time periods. In SSTP1 the membership consisted of Johnson & Johnson, Roche, Aventis, Pharmacia and Novartis which were all large relatively diversified pharmaceutical companies each with other healthcare and in the case of J&J non-healthcare interests. Also included within this group were Glaxo Smith Kline and Astra Zeneca which were dedicated research led pharmaceutical companies that deployed large field forces and spent heavily on research. During the second time period, this group splits and its remaining members J&J, Aventis and Roche are joined by Abbott, Bayer, Boehringer Ingelheim, Roche and E Merck. Five of these companies are of European origin. All have strong interests in

pharmaceuticals, although Bayer suffered a setback with the withdrawal of Lipobay. The strategy followed appears middle of the road, broad therapeutic focus, average to high research spend and average to high promotional spend. These companies represent the pharmaceutical industries emerging second division.

Strategic group 7 changed markedly in membership across the two time periods. In SSTP1 this group presents a mix of companies. MSD and Pfizer present a common dual pairing and are quoted as "benchmark competitors" with strong research interests (Hawthorne, 2003). Bayer, Abbott, Wyeth, Sanofi and Lilly all market primarily GP products, as do MSD and Pfizer. BMS also has a strong GP presence but has a strong franchise in Cancer products. In contrast, by SSTP2 a strong research led heavyweight pharmaceutical group is emerging. By 2002 both Novartis and Astra Zeneca had divested their agrochemical interests and all of the companies in this group – Novartis, Astra Zeneca, Glaxo Smith Kline, Wyeth, BMS, Lilly, MSD and Pfizer – are research led pharmaceutical companies with a broad range of therapeutic interests. These companies represent the first division of the pharmaceutical industry in terms of size, scope and spend.

Previous research also identified a relatively common structure with the number of groups found between SSTPs appearing broadly in agreement. The largest shift reported was by Bogner (1991) who found that the number of strategic groups between SSTP2 and SSTP3 increased from four to six. The difference was accounted for by one strategic group of three firms and one singleton group. The presence of a relatively stable strategic group structure in the UK pharmaceutical industry is therefore generally congruent with the findings of previous research.

It is worth noting here the importance of the method used to differentiate strategic groups. A clear improvement *in precision* was shown in this research, firstly by the use of an objective statistical test to establish the right number of groups and secondly by the use of variables not included in the initial analysis to provide external validity. Other relevant variables which are not in some way correlated to those used in the analysis were difficult to include, however, given the limited nature of some data sets. The chance of doing so was however improved by excluding size from the analysis because this variable correlates frequently with both marketing decisions and performance measures. Size is an outcome of strategy not a strategic variable despite much previous IO research relying upon this variable as a proxy for strategy. Thirdly, the quality of the analysis is improved through the use of a second clustering algorithm in order to counteract occasional misclassification of firms by the one direction approach used by "hierarchical methods". Fourthly, the discrepancy shown in this research between non-standardized and standardized variables, shows that relative scale differences can affect results.

The performance measures employed in this study were market share (SHARE), weighted market share (WMS) and difference in market rank compared to the beginning of the period (DIFF). These results shown in table 9.4 demonstrate a strong statistically significant difference between strategic groups in terms of performance.

Table 9.4 Performance differences between strategic groups

	SSTP 1	SSTP 2
SHARE	0.0004	0.001
WMS	0.011	0.013
DIFF	0.038	NS at 5% level

These results are in agreement with Cool who found significant performance differences in terms of market share across all time periods and for weighted market share across all but one time period (Cool, 1985). In contrast, neither Martens (1988), or Bogner (1991), found significant performance differences between strategic groups. A possible explanation may be the different performance measures employed. Martens for example measured percentage increase in weighted market share. Alternatively the smaller number of variables used to identify groups in these two studies may have reduced the precision of group identification. The presence of significant performance differences between strategic groups is therefore confirmed in this study.

9.3 Research Theme 2 The Dynamics of Strategic Groups in the UK Pharmaceutical Industry

The ten years included within this study marked a turbulent time for the pharmaceutical industry. Initially change was marked by a large number of individual firm movements but from 1996 onwards it was more common for groups of firms to move in concert.

The number of strategic groups, identified in this study, are shown in table 9.4 below. It should be noted here that these findings include all the firms that were swallowed up by mergers and that because of the nature of the resulting dataset, a different set of variables was available to identify groups. This dataset was difficult to construct

because it necessitated deconstructing each merged company back into its original form and finding archive data for key elements of strategy such as research spend. For these reasons comparisons between this theme of the research and the other two themes are by necessity limited.

Table 9.5 Number of Strategic Groups Across Each Year.

Year	Number of Strategic Groups	Total Number of Firms
1993 – 1994	9	47
1995	9	45
1996	8	40
1997	7	42
1998	9	41
1999	8	39
2000	6	35
2001	7	34
2002	6	33

The above table again demonstrates the relative stability of the strategic group structure. It also shows a major limitation of the practice of dividing industries into stable strategic time periods for strategic group research. Through ignoring mergers and new entrants, two potential major drivers of industry dynamics are specifically excluded. The number of firms moving in a given time period did not appear to be related to any of the external environmental factors measured in this research. This finding agrees with that of Bogner who found no link between movements of firms between strategic groups and external disturbances (Bogner, 1991; Bogner *et al.*, 1994).

Eighteen mergers occurred within this period, but although there were two major waves of consolidation, in 1995 and 1999 respectively, only in one year 1993, did no mergers

take place. In addition two new entrants, Eisai and Takeda entered the UK pharmaceutical industry in 1997.

On examining movement of firms a common pattern frequently emerges whereby firms more closely aligned to a group appear to form an inner core group, while companies positioned in an outer ring at the edge of the group appear less committed to the group strategy. This finding of intra-strategic group shifts agrees with the findings of earlier research (Cool & Dierickx, 1993; McNamara *et al.*, 2003,). Movement by a company to the fringe of the group either precedes or immediately follows a strategic change. This observation suggests that analysis of outliers may prove useful to anticipate strategic shifts.

It also appears true that not all firms are equally mobile and certainly some strategic groups, for example the diversified conglomerates comprising 3M, Solvay etc, seem more stable than others. This implies that industry structure may evolve around "anchor points" which consist of these stable groups. A strategic web of strategy interactions may therefore represent the industry where some groups and firms are more fluid and willing to adapt than others. The tightness of the "core" of a group may serve as a proxy for commitment to the current strategy with distance between firms providing a measure of willingness to change.

The premise that firms move from one strategic group to another in order to capitalize upon more profitable market positions was first proposed by Caves and Porter (1977). In order to empirically test this theory firms were classified into those companies which changed strategic group or those which remained within their original group.

Companies that changed position were divided into those which moved group on their own and those which formed part of a faction that split away from the original group and moved to another group in the company of other firms. These results are summarized in table 9.6. The figures show the probability recorded using a Chi Squared Test. Probabilities significant at the 10% level are marked in bold. The figures for total change include both the change and split categories.

Table 9.6 Do firms that move between strategic groups improve their position?

Movement Recorded	All Cases
Change – UP	**0.066**
Change - DOWN	0.263
Split - UP	0.977
Split - DOWN	0.823
Stay - UP	0.163
Stay - DOWN	**0.058**
Total Change – UP	**0.074**

These results provide weak support for the proposition that firms improve their position by moving between strategic groups in the UK pharmaceutical industry.

The pharmaceutical industry has undergone at least three successive waves of consolidation during its recent history. Reasons for mergers have included the need to achieve critical mass in research and development or marketing. The alternative explanation is that as competition becomes more intense, firms seek mergers as a source of cost synergies. Therefore a merger is adopted in order to meet the need for increased efficiency of operation and the investors demand for profitable growth. (This point is discussed in more detail in Chapter 4).

Examination of the eighteen mergers which occurred during the study period revealed that of these eighteen, only three – Glaxo Wellcome, Pharmacia Upjohn and Hoechst Rhone Poulence – occurred between companies belonging to the same strategic group. This result is *highly significant* achieving a statistical significance of 0.001.

It may be expected that companies pursuing broadly the same strategies would be able to more easily realize synergies, which suggests that the main driver for these mergers could be to obtain new products to bolster the pipeline and thus compensate for flagging research productivity. This motive was certainly displayed after the acquisition by Pfizer of Warner Lambert and Pharmacia Upjohn which secured the revenues from two "blockbusters" Lipitor and Celebrex together with bolstering a dry mid to near term pipeline(Lehman Brothers, 2003; Lehman-Brothers, 2002).

9.3 Research Theme 3 The relationship between strategic groups and competitive groups in the UK pharmaceutical industry

The market choices that firms make may be expected to exert some effect upon profitability as clearly some markets are larger, more accessible and less competitive than others. Therefore competitive groups *where* firms compete may have performance implications. Porter in his 1979 article argued that the interaction between *where* firms compete in terms of common customers and *how* firms compete (i.e. strategic groups), should have performance consequences. This is because firms competing for common customers and employing similar strategies would be more likely to reach an accommodation and thus avoid damaging price competition.

The term competitive group has been given various meanings by previous researchers. Porac et al defined a primary competitive group as "a collection of firms who define

each other as rivals"(Porac *et al.*, 1994, p. 135.). In contrast Bogner defines a competitive group as:

> "an intra-industry combination of firms which are following similar strategies. Firms are following similar strategies because they have different historical backgrounds which have provided them with different stocks of competencies and assets and because different managers have identified different ways in which they can compete in the industry"(Bogner, 1991 p 496).

The definition proposed by Bogner suggests a more inclusive term for a strategic group by adding a number of elements generally associated with the resource based view (Barney, 1991;Wernerfelt, 1984). In contrast, the competitive group proposed by Porac et al (1994) assumes direct rivalry. This research starts from the Porac definition but with several notable differences. Firstly, definition of rivalry depends upon your perspective. A small firm may view a larger one as a rival but not visa versa, for example Glaxo may view Astra very differently as a competitor than it views Ivax or Boehringer. Secondly, if a firm has several products then the rivalry pecking order may reflect their relative importance. Thirdly, through use of cluster analysis, competitive groups can be formed based upon the pattern of markets addressed not viewed individually in isolation.

This research found that the following six distinct competitive groups occurred in the UK pharmaceutical industry.

CG1 3M, Ivax, Glaxo Smith Kline, Boehringer Ingelheim, Schering Plough.

CG2 Abbott, Roche, Baxter, Procter & Gamble.

CG3 Johnson & Johnson, Lundbeck, Lilly, Sanofi Synthelabo, Novartis, Pharmacia.

CG4 Akzo Nobel, Yamanouchi, Schering AG.

CG5 Astra Zeneca, Eisai, Shire, Wyeth, Solvay, Novo, Reckitt Benkisser.

CG6 Aventis, Bristol Myers Squibb, Pfizer, Merck Sharpe & Dohme, Celltech, Takeda, Bayer, E Merck.

Of these six all but one competitive group was concentrated around a dominant therapy area. The exception, group 2, comprised companies like Roche and Abbott who adopted a more generalist pattern active across a number of different market segments. Therefore competitive groups in effect limit primary competition i.e. product displacement between firms, but most firms will compete to some extent, for example for time in front of the doctor.

The relationship between competitive groups and performance was tested using seven performance measures LIC (licensed products), COMARK (co-marketing), SHARE (market share), WMS (weighted market share), EBIT (earnings before interest and tax), EBITDA (earnings before interest, tax, depreciation and amortisation) and PRETAX (profit before tax). The first two of these measure co-operative activities. LIC represents products licensed from other companies where it may be expected that strength in a given area, for example an established franchise in cardiovascular medicine, would make the company a more attractive licensing partner. COMARK measures the degree of co-operative selling of a common brand. SHARE and WMS directly measure UK market performance. The last three measures EBIT, EBITDA and PRETAX are corporate financial measures and do not relate specifically to UK performance. These measures can be used here because competitive groups represent the pattern of market choices which a firm makes which for a pharmaceutical company are often common across markets. This is because having invested US$ 700 million to produce a new

chemical entity, it simply does not make economic sense to restrict the product to a few chosen markets. These results are shown in table 9.7.

Table 9.7 Performance measurement between competitive groups

Performance Measure	Significance
LIC	0.411
COMARK	0.844
SHARE	0.397
WMS	0.970
EBIT	**0.094**
EBITDA	0.314
PRETAX	**0.099**

These results are weak and do not confirm a strong relationship between competitive groups and performance. No significant relationship was found between UK performance, licensing and co-marketing activities. Nor was EBITDA found to differ significantly between groups. A weak significant difference at the 10% level was found between groups in terms of pre tax profit and EBIT.

The relationship between strategic group and competitive group membership was then tested using the same set of variables. These results are shown in table 9.8.

Table 9.8. The performance relationship between strategic and competitive groups.

Performance Measure	Significance
LIC	0.616
COMARK	**0.073**
SHARE	**0.013**
WMS	0.127
EBIT	**0.011**
EBITDA	0.118
PRETAX	**0.018**

These results indicate a strong performance relationship between strategic choice and market choice. Three performance measures SHARE, EBIT and PRETAX were significant at the 5% level or better. Two measures of performance WMS and EBITDA did not differ significantly. The two variables measuring co-operation did not differ at the 5% level, but COMARK was significant at the 10% level.

These findings provide some support for Porter's theory that market choice inter-twinned with mode of competition has performance consequences (Porter, 1979). The null hypothesis, presented in Chapter 8, that - the performance of firms within a competitive group will differ according to whether the firms are members of the same or different strategic group - is therefore supported. The implications of this result are that companies which compete in similar ways and who can therefore read each others market signals and understand their motives are likely to avoid damaging price competition and hence reap higher profits. In contrast if firms which compete in different ways address a common market then competition is likely to intensify and the costs of competing for each firm will increase leading to reduced profits.

In the above discussion three research themes have been considered. The first established that the ten years addressed by this study could be reliably divided into two stable strategic time periods each of five years duration. Within each of these five years seven clear and distinct strategic groups could be identified. These groups were relatively stable across the two SSTPs and group membership was found to have significant performance consequences.

The second research theme explored the dynamics of individual firms and their relationship to strategic groups. Weak support was found for the theory, proposed by Caves and Porter (1977), that firms moving between groups invariably move to a more advantageous market position. It was found that there was greater turbulence in the first SSTP, and that successive waves of mergers throughout the ten years reduced the number of firms and led to the market structure we see today. These mergers were found to occur preferentially between strategic groups rather than within strategic groups.

The third and final research theme addressed the relationship between strategic group membership *how* firms compete and competitive group membership *where* firms compete. The expectation was that the interaction of these two choices should have performance consequences as suggested by Porter (1979). The research presented here found strong support for this contention.

In the final chapter the conclusions of this research are presented together with the contribution to theory and suggestions as to how this research may be extended.

CHAPTER 10

CONCLUSIONS AND RECOMMENDATIONS

10.1 Summary of findings

The research reported in this thesis found that two stable strategic time periods (SSTP) existed between the years 1993 to 2002. The first SSTP ran from 1993 to 1997, and the second from 1998 to 2002. The duration of these stable strategic time periods was congruent with the range reported in previous research (Bogner, 1991; Cool, 1985; Martens, 1988). The break between these two years coincided with a marked change in both the penetration of parallel imports in the UK and the rise in generic usage. These factors it is argued, provide a good proxy for environmental change because they are closely linked to the PACT figures by which doctors prescribing behaviour are monitored and measured. Three main drivers within the healthcare environment make these factors particularly relevant in the measurement of change. Firstly the stated desire by healthcare managers to reduce costs through the increased use of generic drugs and the incentives and penalties applied to doctors in order to enact this change. Secondly, the government clawback applied to all retail pharmacists which assumes that cheaper parallel imports have been used to fill prescriptions when appropriate. Thirdly, the National Service Framework's recommendations for specific conditions, notably cardiovascular products, effectively handed a windfall to some manufacturers (see chapter 3 for a full discussion on this point).

Seven strategic groups were identified in each stable strategic time period. This group structure was relatively stable over time and 62% of firms classified in the first period

were reclassified into the same groups in the second period. The finding of a relatively stable strategic group structure agrees with previous research on the US pharmaceutical industry (Bogner, 1991; Cool *et al.*, 1994).

Strategic groups were identified using a two step clustering procedure in order to improve the quality of the classification because with the sole use of hierarchical procedures, such as Ward's method, "undesirable early combinations may persist through the analysis and lead to artificial results" (Hair *et al.*, 1998 p 498,). The choice of variables in clustering is a critical decision and probably accounts for the lack of consistency between studies, even those conducted within the same industry. It is important to use a set of variables which reliably represent strategic choice for the given industry. The aim should be to be both comprehensive and parsimonious. The use of related dependent variables for the analysis should be avoided. In this study SIZE was found to correlate strongly with both a number of operational variables and the performance measures used. Variables representative of strategy were found to be both industry and country specific. This observation explains in part both why it is difficult to draw valid comparisons across previous studies and the considerable variation in results achieved. The use of a significance test to identify the correct number of groups removes a great deal of subjectivity associated with graphing the agglomeration coefficient in order to identify "natural clusters".

Performance between the strategic groups identified was found to differ significantly at the 5% level or better. For SSTP1 performance differed between groups on all three measures SHARE ($p = < 0.0004$), WMS ($p = < 0.011$) and DIFF ($p = < 0.038$). The results for SSTP2 was that performance differed between groups in terms of SHARE

(p = < 0.001) and WMS (p = < 0.013) but the third performance variable DIFF was not significant at the 5% level. These results agree with earlier research by Cool (1985) who found significant performance differences between strategic groups.

In conclusion, the first theme of this research addressed the question as to whether strategic groups that differ significantly in terms of performance occur within the UK pharmaceutical industry. This research confirms the presence of seven strategic groups within the UK pharmaceutical industry which do differ significantly on up to three performance measures.

The second research theme examined the relationship between firms and strategic groups and first attempted to empirically test the theory that firms moving between groups improve their market position (Caves *et al.*, 1977). This research found greater movement between strategic groups pre 1997, and that by the end of the study firms appeared to have gravitated around a number of markedly different strategic positions.

Firms within groups frequently consisted of an inner group of core members following the typical strategy more closely and an outer group of fringe members. Movement to a fringe position frequently either preceded or immediately followed a change in strategy. Some groups, notably the "diversified conglomerates" appeared very stable over time. Weak support was found for the proposition that firms moving from one strategic group to another invariably moved to a higher performing group although the industry dynamics were punctuated by a series of mergers which increased industry consolidation. An interesting finding was that mergers did not appear to occur at random but occurred preferentially between strategic groups. Of the eighteen separate mergers that occurred during the study period only three – Glaxo Wellcome, Pharmacia

Upjohn and Hoechst Rhone Poulenc – were between firms belonging to the same strategic group. This difference was highly significant ($p = < 0.001$).

In conclusion, the second theme of this research addressed two separate research questions: whether firms that move between strategic groups invariably move to a higher performing group, and whether mergers occur more frequently within or between strategic groups. This research finds weak support for the proposition that firms which change groups move to higher performing groups, $p = < 0.074$, but found strong evidence that mergers occur more frequently between groups than within groups, $p = < 0.001$.

The third part of this research explored the relationship between strategic groups *how* firms compete and competitive groups *where* firms compete. Six different competitive groups were found. Of these, the pattern of market choices for group 2 comprising Roche, Abbott, Baxter and Procter and Gamble, showed active involvement in a number of different therapeutic areas. All of the other five competitive groups showed a pattern of market choices dominated by one specific therapeutic area. Competition within the pharmaceutical industry is therefore limited according to the therapeutic area in which the firm is involved. Competitive group membership on its own, however, did not appear to have strong performance consequences. A test of seven performance measures between competitive groups found a marginal relationship at the 10% level, EBIT $p = <0.094$ and PRETAX $p = <0.099$, but no significant differences at the 5% level.

The relationship between strategic group and competitive group membership was then tested using the same set of variables. The results indicate a strong performance

relationship between choice of strategy and market choice. Three performance measures SHARE ($p = < 0.013$), EBIT ($p = < 0.011$) and PRETAX ($p = < 0.018$) were statistically significant at the 5% level or better. These findings support Porter's theory that market choice when combined with mode of competition has performance consequences (Porter, 1979).

The third research theme explored the relationship between competitive groups and strategic groups. The results indicate a weak relationship between competitive groups and performance, $p = < 0.099$ but a strong relationship when choice of strategy (strategic group) is combined with market choice (competitive group), $p = < 0.02$.

10.2 Contributions to theory

The research reported in this thesis contributes to existing knowledge in four main areas. Firstly the research presented is the first strategic group study dedicated solely to the UK Pharmaceutical Industry, prior to which the only strategic group research which addressed the issue of UK pharmaceuticals was Martens (1988) study, which included the UK only as part of a study of five E.C. countries. The UK is an important pharmaceutical market and a dedicated study is both useful to bring out the individual characteristics of the UK market and to provide a comparison with previous strategic group studies centred on the pharmaceutical industry internationally.

Previous strategic group studies have generally suffered from a lack of comparability even when such studies address the same industry and investigate overalapping time periods. For example both Cool (1985) and Bogner (1991) researched strategic groups within the US pharmaceutical industry. Cool's study encompassed the years 1963 to

1982 and Bogner from 1969 to 1988. Yet both studies differed significantly in the sample of firms included and in the choice of variables chosen to distinguish strategic groupings. In contrast this research was specifically designed to be comparable with earlier research, notably the work of Cool (1985).

A significant contribution of the research reported in this thesis relates to the linkage with previous work. Importantly the research confirms that strategic group research is both industry and market specific because the variables used to accurately depict strategy in one market, i.e. the US, were found to be inappropriate in terms of describing the UK situation. This finding offers some explanation as to why previous strategic group studies have frequently reported equivocal results. Multi-industry comparisons based upon common variables would appear to lack the precision necessary to adequately depict strategy in a variety of situations.

Secondly this research contributes to the debate on the link between strategic groups and performance. This research broadly supports Cool's original findings (Cool, 1985; Cool, 1988). In contributing to this debate, the idea of competitive groups, *where firms compete,* has been linked specifically to strategic groups, *how firms compete,* and the performance implications of the interaction between these two classifications have been compared.

Nesting strategic groups and competitive groups within Porters "generic strategy" framework has allowed for more precision in the strategic positioning of firms. These positions were then used to empirically test Porter's theory of intra-industry competition using data from the UK pharmaceutical industry. The findings showed that although

competitive groups appeared to exert a relatively weak influence upon performance, when combined with strategic groups a strong relationship with performance was revealed. In addition the idea of "rivalry groups" was discussed which offers a further line of enquiry to explore Porter's theory in more detail.

Thirdly, this research contributes to the industry dynamics literature. Specifically, an aspect of Cave's and Porter's (1977) theory has been tested. This theory predicts, that firms moving between groups will invariably move to a more profitable group. The research in this thesis finds some limited support for this proposition. In addition, the idea that environmental shocks will precipitate group changes has been explored and the findings support the earlier results of Bogner (1991) that firm changes appear largely unrelated to environmental turbulence, suggesting some endogenous motive.

The inclusion of merged firms within this research is novel and contributes both to the strategic group and industry dynamics literature. Firstly, the research found that through including merged firms within the analysis a greater richness of detail was included, allowing the important finding that mergers occurred preferentially between rather than within strategic groups in UK pharmaceuticals. Secondly, the inclusion of mergers revealed that in only one year, 1993, did no mergers take place and yet despite this turbulence a clear strategic group structure occurred throughout the period studied. This finding agrees with earlier reports (Fiegenbaum, 1987; Oster, 1982) that strategic groupings may persist under turbulence. It also questions the model proposed by Mehra and Floyd (1998) that in differentiated industries a stable environment predicates the presence of strategic groups.

Finally the research has specifically explored how the methods employed to identify strategic groups can be improved and contributes to the discussion on why performance consequences between strategic groups have frequently proved equivocal. The use of a significance test to identify the number of groups present, the use of two algorithms in combination, and applying tests of external validity, were aimed specifically at contributing to the quality of strategic group research and to answering the criticism that strategic groups are simply an artifact of method. The combination of these three methods has suggested a means both to remove the subjectivity that some associate with determining the "right" number of clusters and to ensure that the resulting clusters are both valid and meaningful in future strategic group studies.

The principal implications for theory revealed by this research also fall into four areas. First, strategic groups are industry and market specific therefore it is important to choose a set of industry specific variables which accurately reflect strategic choice in the given market. This recommendation clearly has implications for drawing comparisons with previous research and provides some explanation as to why links between strategic groups and performance have often proved equivocal.

Second, the challenge that strategic groups are an artifact of method has previously been made (Barney & Hoskisson, 1990). It is therefore incumbent upon strategic group researchers to follow the advice provided in the literature (Ketchen & Shook, 1996; Punj & Stewart, 1983) and ensure that the procedures used to derive strategic groupings are robust and reliable. In particular the use of relevant variables not included in the original analysis to test the external validity of the strategic groupings identified is recommended (Aldenderfer & Blashfield,1984).

Third, care should be taken in the selection of a sample which is truly representative of the population. The inclusion of merged firms within the research introduced a greater degree of detail and sensitivity into the study.

Fourth, the use of strategic groups and competitive groups as dimensions within the template of Porter's "generic strategies" permitted greater precision in the strategic positioning of firms. This may prove useful in studying industry dynamics and drawing performance implications in other industrial settings. This modification allows a more fine-grained approach to studying competitive interactions without compromising the value of Porter's template as a strategy tool.

10.3 The Wider Application of Strategic Group Theory

Strategists in all industries are frequently faced with the problem of how to make sense of complex patterns. These patterns may relate to the shape of competition within the industry or simply relate to industry dynamics such as signals between firms or simply firms shifting position over time. Here, strategic group theory offers the manager the opportunity to group firms according to the type of strategy which they are deploying and hence to better understand the competitive dynamics of their industry and to track relevant changes over time.

The implications for strategy provided by the research in this thesis are that the strategic group/competitive group matrix should prove extremely useful for strategists to simplify the complex markets in which they operate and to draw inferences on potential competitive moves and viable market positions. The idea of outlier analysis may prove

particularly beneficial because, as shown by the research, relative position within a strategic group may be indicative of a level of commitment to the "group strategy" while positional changes within a group may signal a shift in intentions before a more fundamental strategic move.

A particular benefit of strategic group theory in this application is that the methods employed to distinguish strategic groups are flexible and offer a set of tools from simple mapping to the use of more complex multivariate techniques. These techniques in turn can accommodate both qualitative and quantitative data therefore managers can utilize readily available industry data. This benefit allows the use of industry standard databases such as those provided by IMS or Nielsen to be effectively incorporated into industry planning unlike the Miles and Snow framework for example which requires some knowledge of internal drivers such as managerial attitudes to be taken into account.

The idea of Porter's generic strategies appears now to be commonly applied within industry planning. This allows some initial analysis but in practice often lacks the flexibility and precision to allow much industry data to be included. In an industry where differentiation is an important determinant of sustainable competitive advantage for example it becomes difficult and often rather subjective to distinguish between firms which are competing broadly along the same lines.

The research presented in this thesis adds to the manager's armoury by providing a fine grained framework which fits within Porter's framework allowing the strategic position of firms to be pinpointed with more precision. The use of the strategic

group/competitive group framework allows the use of a wide range of industry data to be employed thus both increasing data utility by firms and allowing more precise and detailed analysis of competitive dynamics to be carried out.

A further advantage of the application of strategic group and competitive group theory is that it encourages managers to identify the bases on which industry competition is fought and the dimensions which are important to their firm's sources of competitive advantage. The competitive group dimension also provides the facility to explore industry segmentation in greater detail and to explore opportunities for alliances or other forms of co-operative venture.

The findings presented earlier in this thesis may also assist managers to better understand competitive dynamics and to predict firm moves. The use of reference firms within a group and the idea of an inner and outer strategic grouping may be applied within industry analysis to both understand the degree of commitment which firms have to the "core group strategy" and the degree to which they mimic industry leaders which may serve as reference points within the group. In contrast, firms positioned at the edge of a strategic group may be more likely to modify their strategy or move to another strategic position and hence may be worthy of considerable attention if the competitive dynamics of the industry are to be understood and anticipated.

In conclusion, strategic group theory provides a useful and practical means to classify firm strategies and make sense of industry dynamics and competitive exchanges over time. The research presented in this thesis, although centred on the UK pharmaceutical industry may therefore be usefully and profitably applied in other industry settings. A

task facing every management is how to align firm strategies with the opportunities presenting themselves in the marketplace, whilst skilfully anticipating and wrong footing competitors. The application of strategic group theory may be usefully applied in this process.

10.4 Study Limitations

The research in this thesis is naturally limited by the sample of firms included within it. Ideally it would have been preferable to include more firms but the further down the league table you move in general, the sparser is the data. This problem is made more acute when you consider the secretive nature of some pharmaceutical firms and reliable information on research spending, for example, for some of the privately owned firms was difficult to obtain. Significant companies included in this privately owned group include Mundi Pharma, Servier, Ferring and Leo Laboratories.

A second significant problem with a longitudinal study is to obtain a 'valid' and 'reliable' data set for all firms and all variables across all years. A number of specific problems arise. Firstly, the industry has undergone a series of mergers and acquisitions where companies disappear and finding archival data for firms which went out of business ten years ago presents a problem. Secondly, reporting standards differ between firms and here the Japanese companies can present a particular problem. Thirdly, and perhaps most problematic, how firms classify the world in terms of geographical segments differs between firms. Clearly for a quantitative study which is reliant upon data analysis, such as this one, these problems impose limitations on the scope of the study.

In Chapter 2 the importance of making valid comparisons between studies was discussed and here data availability between countries, together with the country specific nature of some strategy variables can present a problem. One of the aims of this study was to link to previous empirical strategic group research on pharmaceuticals. Such comparisons are however limited by the different variables employed and the lack of agreement between marketing channels in the US as compared to the UK.

Finally it is important to realize the preconceptions and unconscious bias which any researcher could bring to a study of this kind. Throughout this study care has been taken to use more objective statistical tests to identify group structures for example through the use of the upper tail significance test. Future research could usefully duplicate the method to further test the robustness of the results.

10.5 Suggestions for further research

Strategic group research offers opportunity to compare and make sense of firms and the strategies employed by firms. The key to any useful classification however is its practicality. Previous strategic group research suffers from the lack of comparability between studies. The research presented in this thesis illustrates that strategy is both market and country specific. The strategic choices which are important in the pharmaceutical industry are not precisely the same as those in another unrelated industry. Similarly marketing channels, customs and laws differ between companies and strategy seeks to match environmental threats and opportunities. This means that future strategic group studies should seek to identify and utilize a comprehensive set of the relevant industry strategic choice variables.

A further criticism of strategic group research is the lack of common methods employed to identify groups. There are a number of choices which need to be carefully considered. First among these is the choice of variables where care should be taken to accurately and comprehensively represent strategic choice within the given industry. Variables should be checked for cross correlation and care should be taken to avoid the use of dependent variables such as firm size within the data set because such variables are likely to correlate strongly with measures used to test performance such as market share. Clustering algorithms in turn place their own structural assumptions upon the data and the use of two different but complementary methods has been recommended (Ketchen *et al.*, 1996; Punj *et al.*, 1983) but often ignored. Similarly the use of objective means to determine the right number of clusters is recommended. If future research gravitates towards industry specific, multivariate studies employing common methods, then the opportunity for valid comparison and building on previous research should be enhanced.

Finally strategic groups offer the opportunity to compare strategies within a common industry across different countries allowing the opportunity to enhance our knowledge of strategy choices and the degree to which global strategy affects results. Clearly such comparisons are themselves limited by data availability, but the common use of such global data providers as IMS should assist this process. To date Marten's study (1988) stands as the only cross country comparison of strategic groups in the pharmaceutical industry and it would be interesting to see detailed industry studies between countries.

In conclusion, to be useful any classification scheme has to be practical in nature and based upon clearly understood principles. The concept of strategic groups offers an

opportunity to compare and contrast the pattern of strategic choices between firms and to better understand competitive dynamics. The strategic group/competitive group framework and the further sub-division into rivalry groups should provide the opportunity to measure the performance implications of strategic moves at a more detailed level. In the UK pharmaceutical industry, for example, the true locus of competition is at the sub-therapy level not at the broad therapeutic level. The issue of the locus of competition is, however, industry specific and future research should ideally be based upon developing common methods in order to aid comparison between studies.

APPENDIX A

Table 1 Tests of Normality

		Kolmogorov-Smirnov			Shapiro-Wilk		
	YEAR	Statistic	df	Sig.	Statistic	df	Sig.
BRANGEN	1993	0.137	29	0.178	0.940	29	0.098
	1994	0.117	29	0.200	0.947	29	0.151
	1995	0.125	29	0.200	0.925	29	0.040
	1996	0.180	29	0.017	0.870	29	0.002
	1997	0.188	29	0.010	0.890	29	0.006
	1998	0.179	29	0.018	0.882	29	0.004
	1999	0.164	29	0.044	0.896	29	0.008
	2000	0.187	29	0.011	0.852	29	0.001
	2001	0.197	29	0.006	0.815	29	0.000
	2002	0.193	29	0.007	0.839	29	0.000
DRUGST	1993	0.138	29	0.170	0.828	29	0.000
	1994	0.222	29	0.001	0.697	29	0.000
	1995	0.163	29	0.048	0.807	29	0.000
	1996	0.188	29	0.011	0.727	29	0.000
	1997	0.185	29	0.013	0.734	29	0.000
	1998	0.188	29	0.010	0.724	29	0.000
	1999	0.182	29	0.015	0.735	29	0.000
	2000	0.197	29	0.006	0.747	29	0.000
	2001	0.197	29	0.006	0.747	29	0.000
	2002	0.164	29	0.044	0.787	29	0.000
FOCUS	1993	0.178	29	0.020	0.894	29	0.007
	1994	0.170	29	0.032	0.915	29	0.022
	1995	0.154	29	0.075	0.924	29	0.039
	1996	0.120	29	0.200	0.930	29	0.055
	1997	0.126	29	0.200	0.896	29	0.008
	1998	0.179	29	0.018	0.896	29	0.008
	1999	0.136	29	0.182	0.922	29	0.034
	2000	0.123	29	0.200	0.920	29	0.030
	2001	0.123	29	0.200	0.920	29	0.030
	2002	0.103	29	0.200	0.917	29	0.025
FOREIGN	1993	0.116	29	0.200	0.943	29	0.118
	1994	0.116	29	0.200	0.943	29	0.118
	1995	0.116	29	0.200	0.943	29	0.118
	1996	0.116	29	0.200	0.943	29	0.118
	1997	0.116	29	0.200	0.943	29	0.118
	1998	0.116	29	0.200	0.943	29	0.118
	1999	0.181	29	0.016	0.897	29	0.008
	2000	0.384	29	0.000	0.523	29	0.000
	2001	0.353	29	0.000	0.537	29	0.000
	2002	0.207	29	0.003	0.802	29	0.000
MAINT	1993	0.145	29	0.124	0.943	29	0.121
	1994	0.103	29	0.200	0.948	29	0.166
	1995	0.104	29	0.200	0.955	29	0.244
	1996	0.102	29	0.200	0.946	29	0.146
	1997	0.105	29	0.200	0.942	29	0.111

	1998	0.124	29	0.200	0.937	29	0.085
	1999	0.118	29	0.200	0.942	29	0.115
	2000	0.115	29	0.200	0.945	29	0.133
	2001	0.118	29	0.200	0.940	29	0.102
	2002	0.097	29	0.200	0.940	29	0.102
PHARMA	1993	0.195	29	0.006	0.814	29	0.000
	1994	0.195	29	0.006	0.814	29	0.000
	1995	0.195	29	0.006	0.814	29	0.000
	1996	0.195	29	0.006	0.814	29	0.000
	1997	0.195	29	0.006	0.814	29	0.000
	1998	0.195	29	0.006	0.814	29	0.000
	1999	0.128	29	0.200	0.893	29	0.007
	2000	0.164	29	0.044	0.866	29	0.002
	2001	0.198	29	0.005	0.853	29	0.001
	2002	0.211	29	0.002	0.831	29	0.000
PRODSTR	1993	0.150	29	0.096	0.918	29	0.027
	1994	0.186	29	0.012	0.861	29	0.001
	1995	0.225	29	0.001	0.839	29	0.000
	1996	0.190	29	0.009	0.857	29	0.001
	1997	0.196	29	0.006	0.788	29	0.000
	1998	0.202	29	0.004	0.863	29	0.001
	1999	0.235	29	0.000	0.832	29	0.000
	2000	0.227	29	0.001	0.826	29	0.000
	2001	0.148	29	0.105	0.906	29	0.014
	2002	0.176	29	0.023	0.862	29	0.001
PROFPROM	1993	0.143	29	0.137	0.959	29	0.307
	1994	0.162	29	0.049	0.933	29	0.066
	1995	0.166	29	0.040	0.893	29	0.007
	1996	0.188	29	0.010	0.829	29	0.000
	1997	0.137	29	0.172	0.954	29	0.238
	1998	0.126	29	0.200	0.945	29	0.133
	1999	0.140	29	0.153	0.947	29	0.149
	2000	0.171	29	0.029	0.881	29	0.003
	2001	0.171	29	0.029	0.881	29	0.003
	2002	0.166	29	0.039	0.935	29	0.073
RDI	1993	0.140	29	0.150	0.949	29	0.175
	1994	0.164	29	0.046	0.947	29	0.152
	1995	0.109	29	0.200	0.964	29	0.416
	1996	0.136	29	0.182	0.953	29	0.221
	1997	0.126	29	0.200	0.958	29	0.294
	1998	0.169	29	0.034	0.929	29	0.052
	1999	0.116	29	0.200	0.971	29	0.594
	2000	0.104	29	0.200	0.977	29	0.767
	2001	0.123	29	0.200	0.972	29	0.603
	2002	0.166	29	0.040	0.930	29	0.055
SIZE	1993	0.086	29	0.200	0.984	29	0.929
	1994	0.088	29	0.200	0.982	29	0.888
	1995	0.097	29	0.200	0.979	29	0.822
	1996	0.101	29	0.200	0.977	29	0.757
	1997	0.097	29	0.200	0.972	29	0.614
	1998	0.121	29	0.200	0.959	29	0.317
	1999	0.122	29	0.200	0.957	29	0.285
	2000	0.114	29	0.200	0.961	29	0.348
	2001	0.114	29	0.200	0.961	29	0.348

2002	0.090	29	0.200	0.959	29	0.316

Result of Bootstrapping of Variables

Each of the distributions for the bootstrapped variables are shown below in figures 1 to10.

Figure APP1 Bootstrap of BRANGEN variable

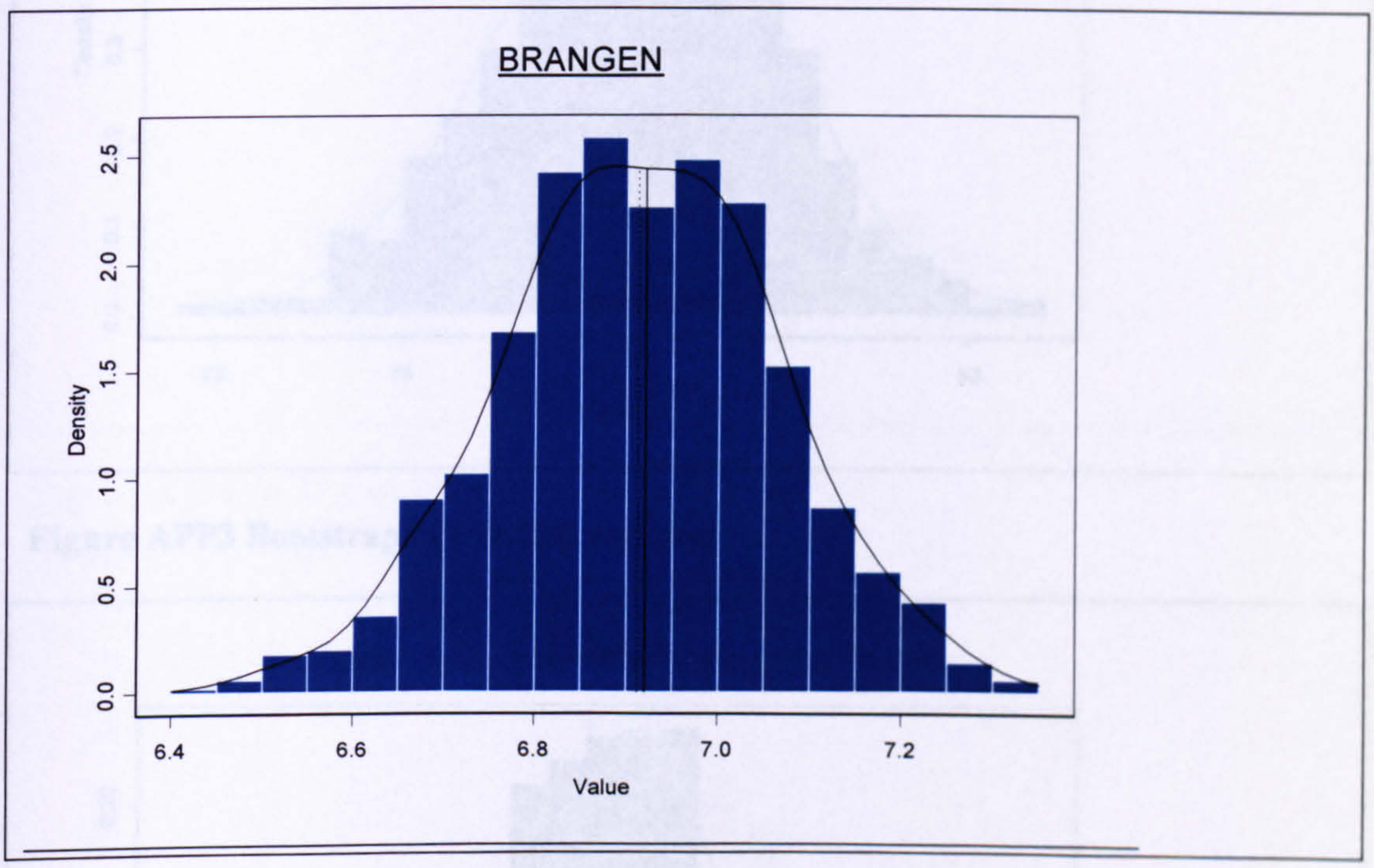


Figure APP2 Bootstrap of DRUGST variable

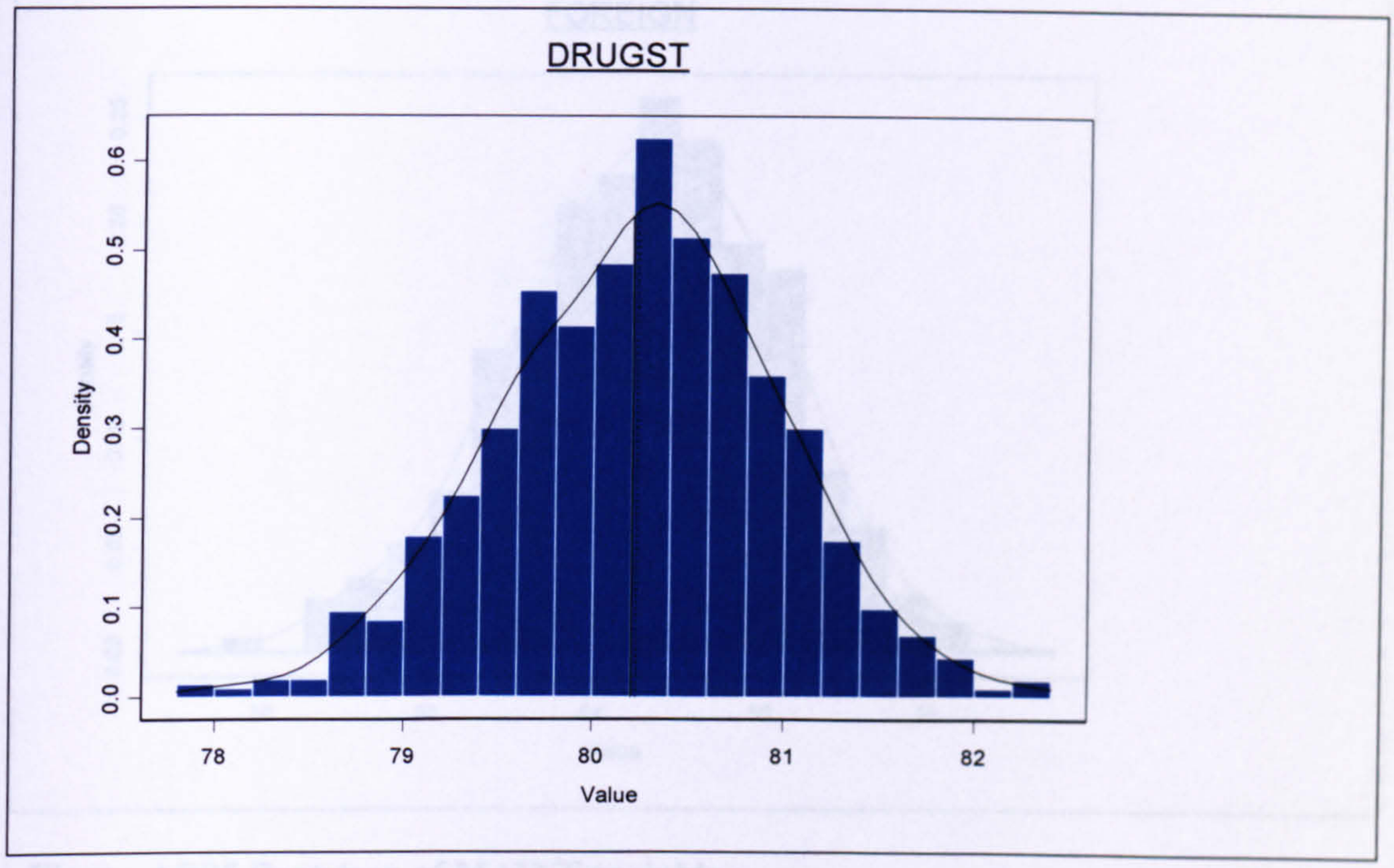


Figure APP3 Bootstrap of FOCUS variable

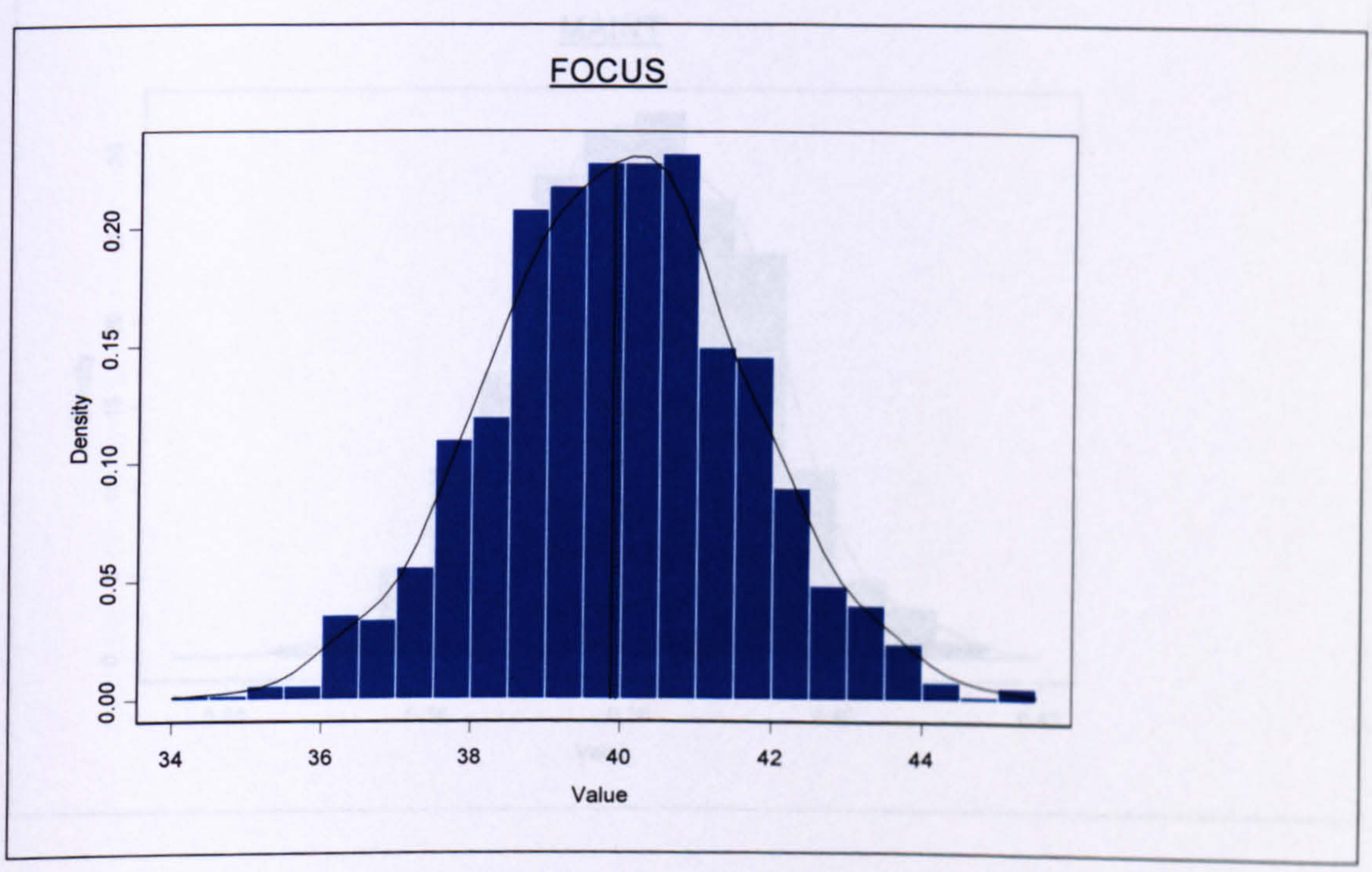


Figure APP4 Bootstrap of FOREIGN variable

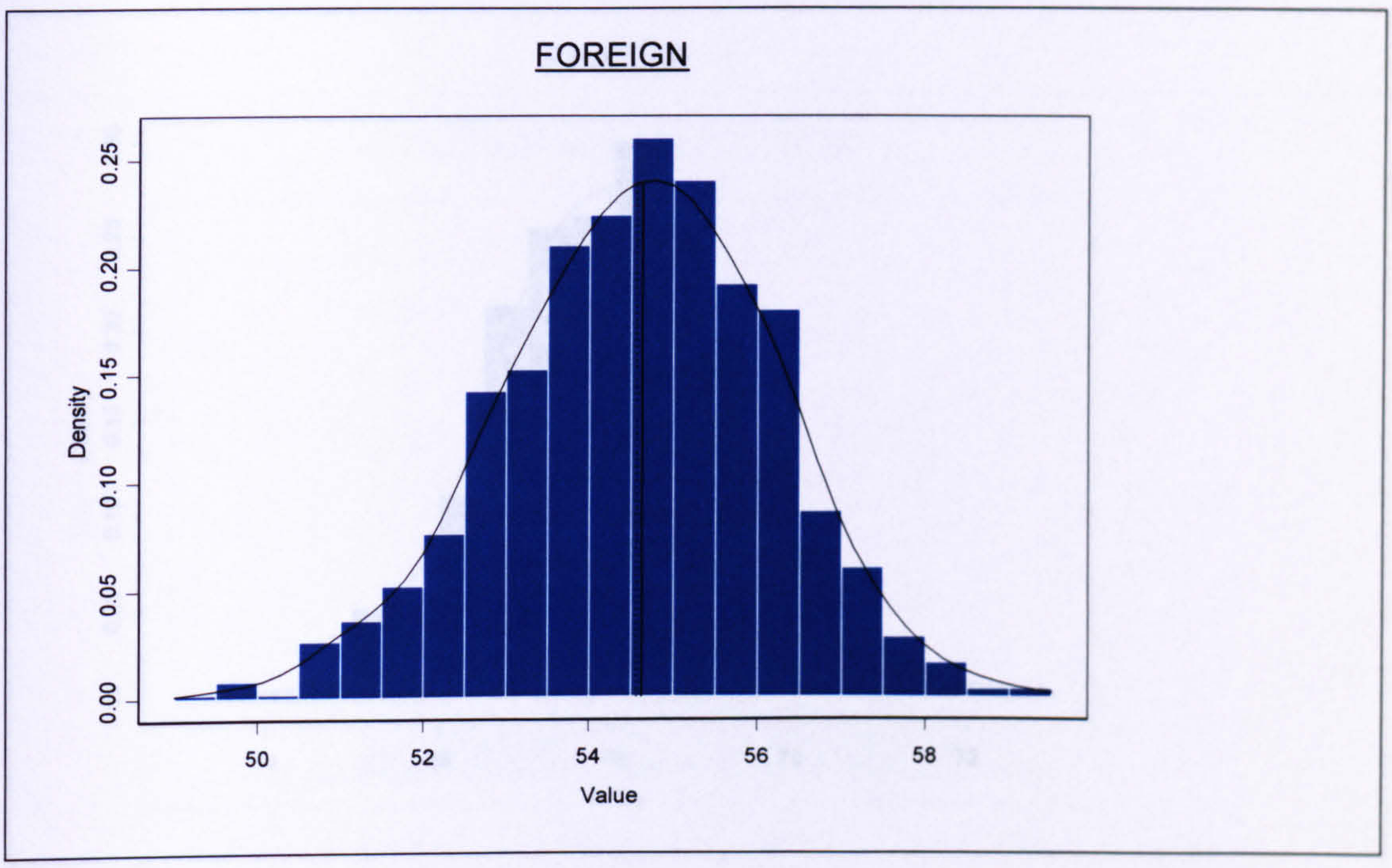


Figure APP5 Bootstrap of MAINT variable

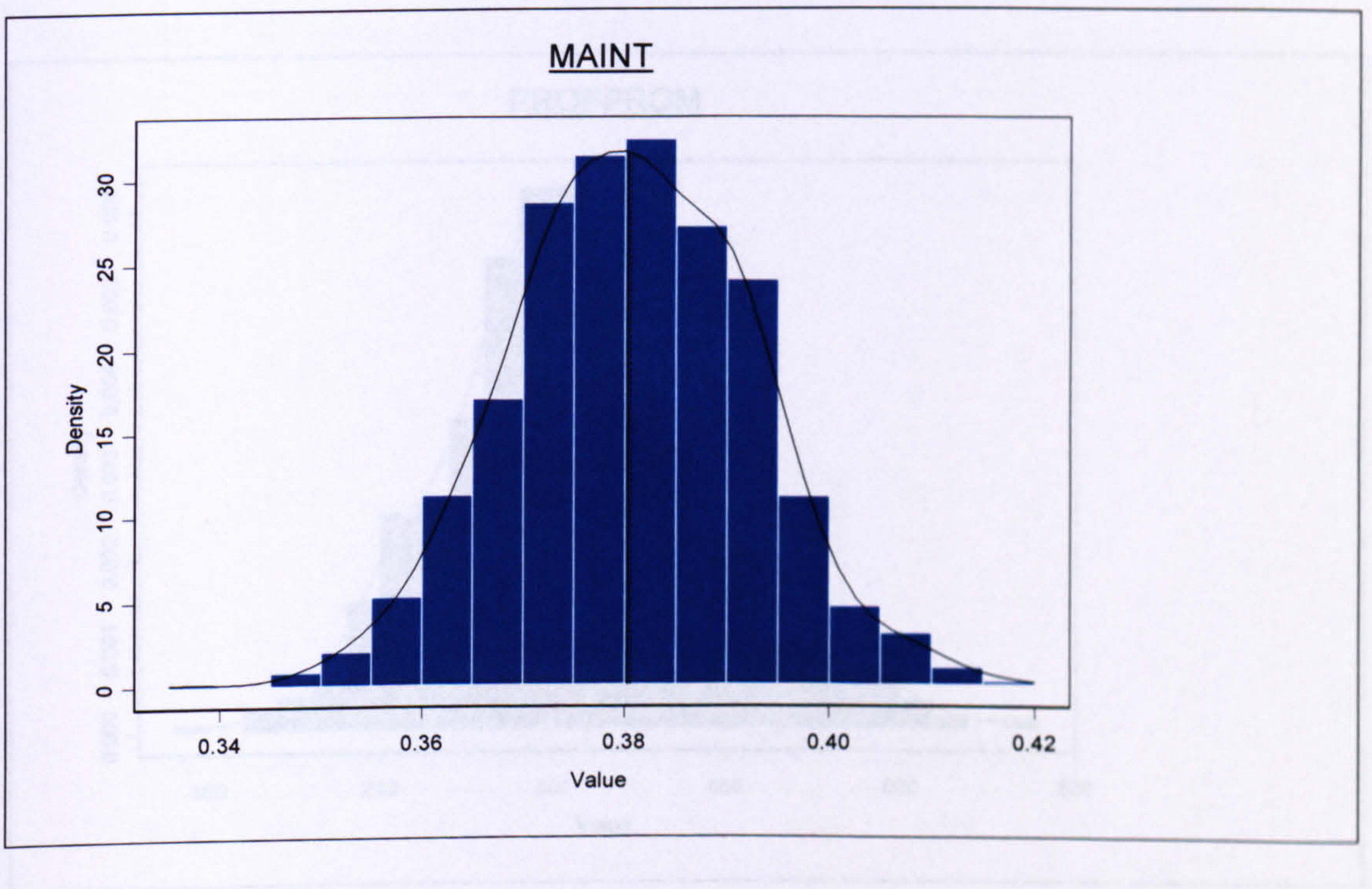


Figure APP6 Bootstrap of PHARMA variable

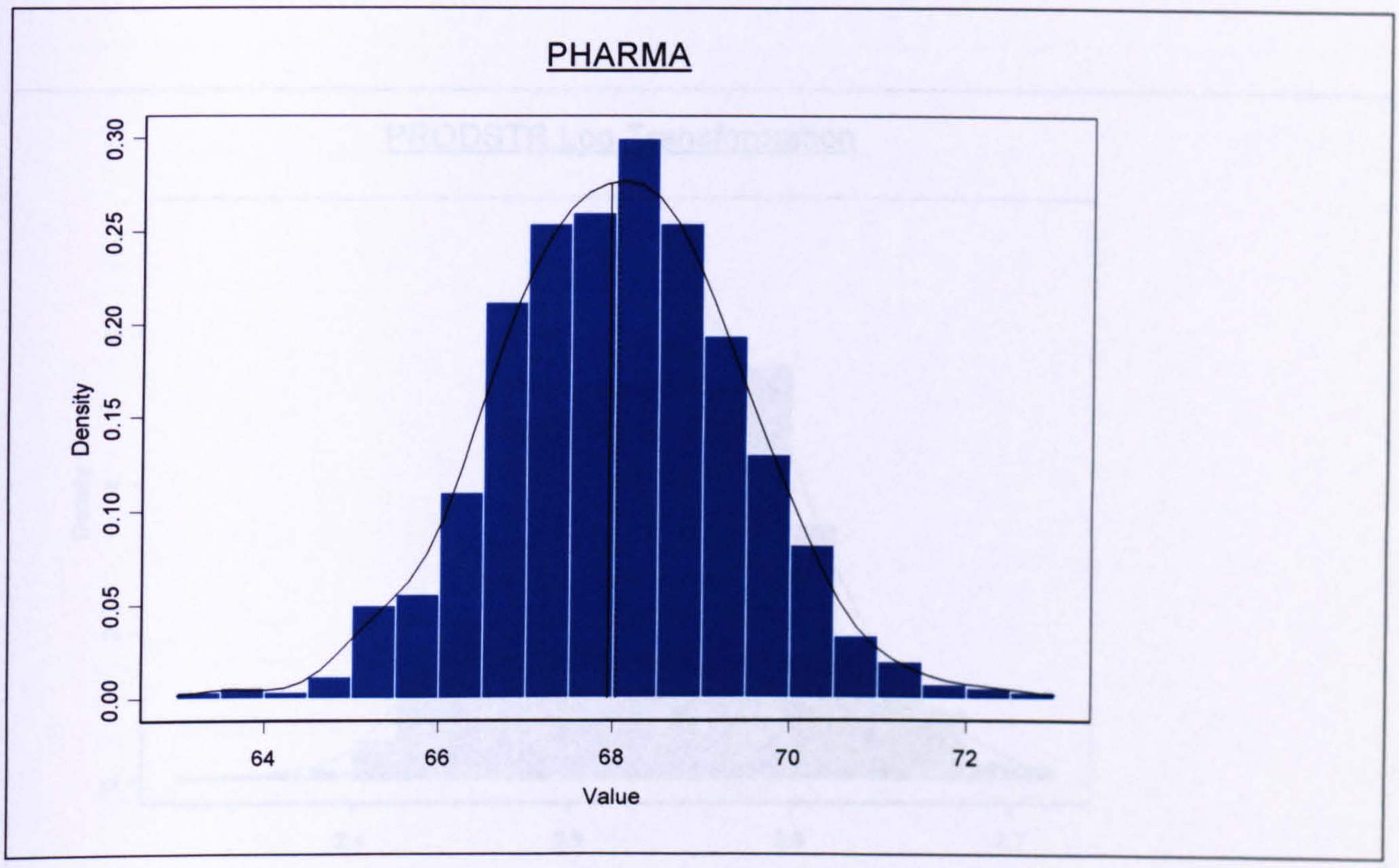


Figure APP7 Bootstrap of PROFPROM variable

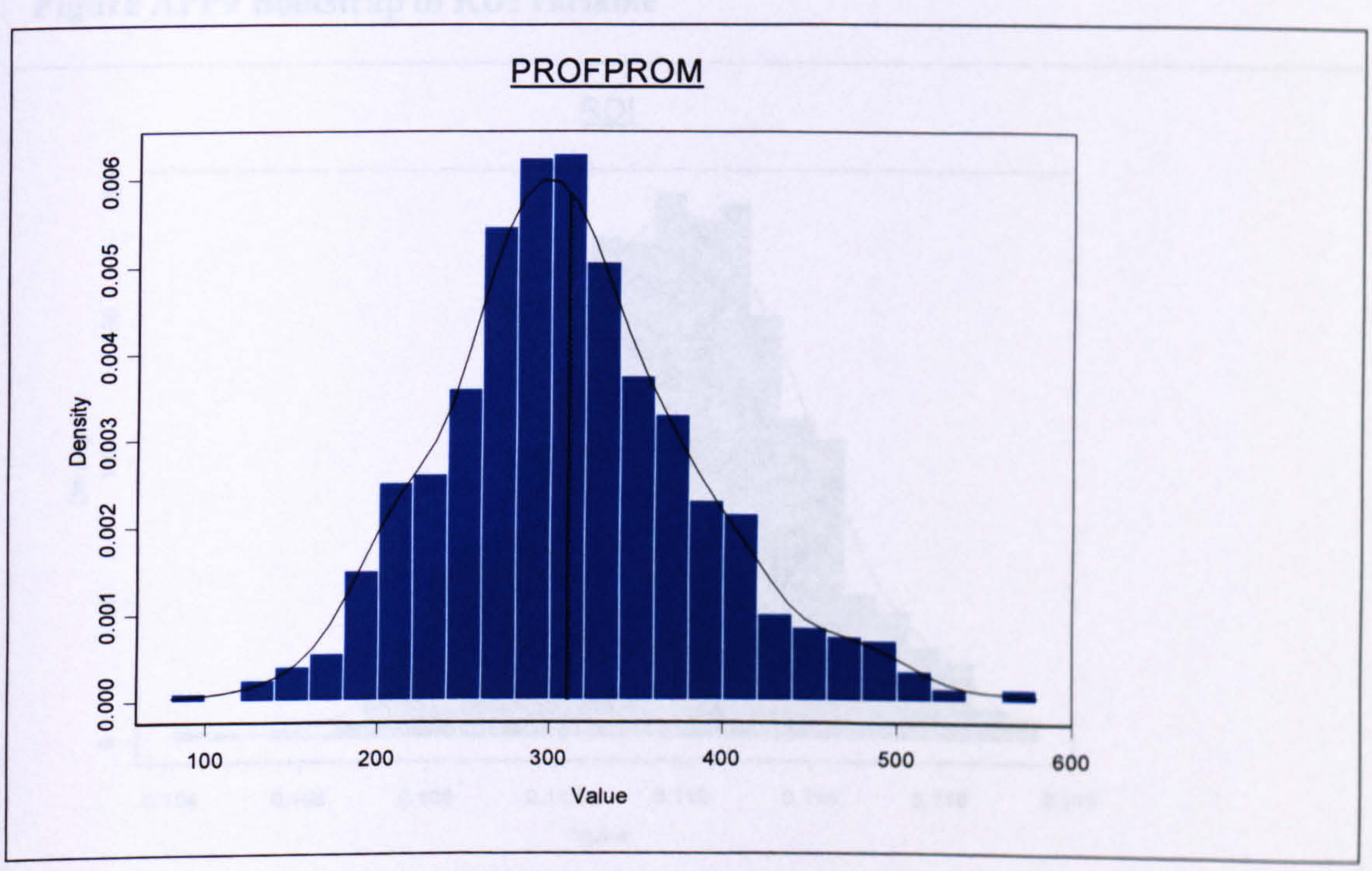


Figure APP8 Bootstrap of PRODSTR (Log) variable

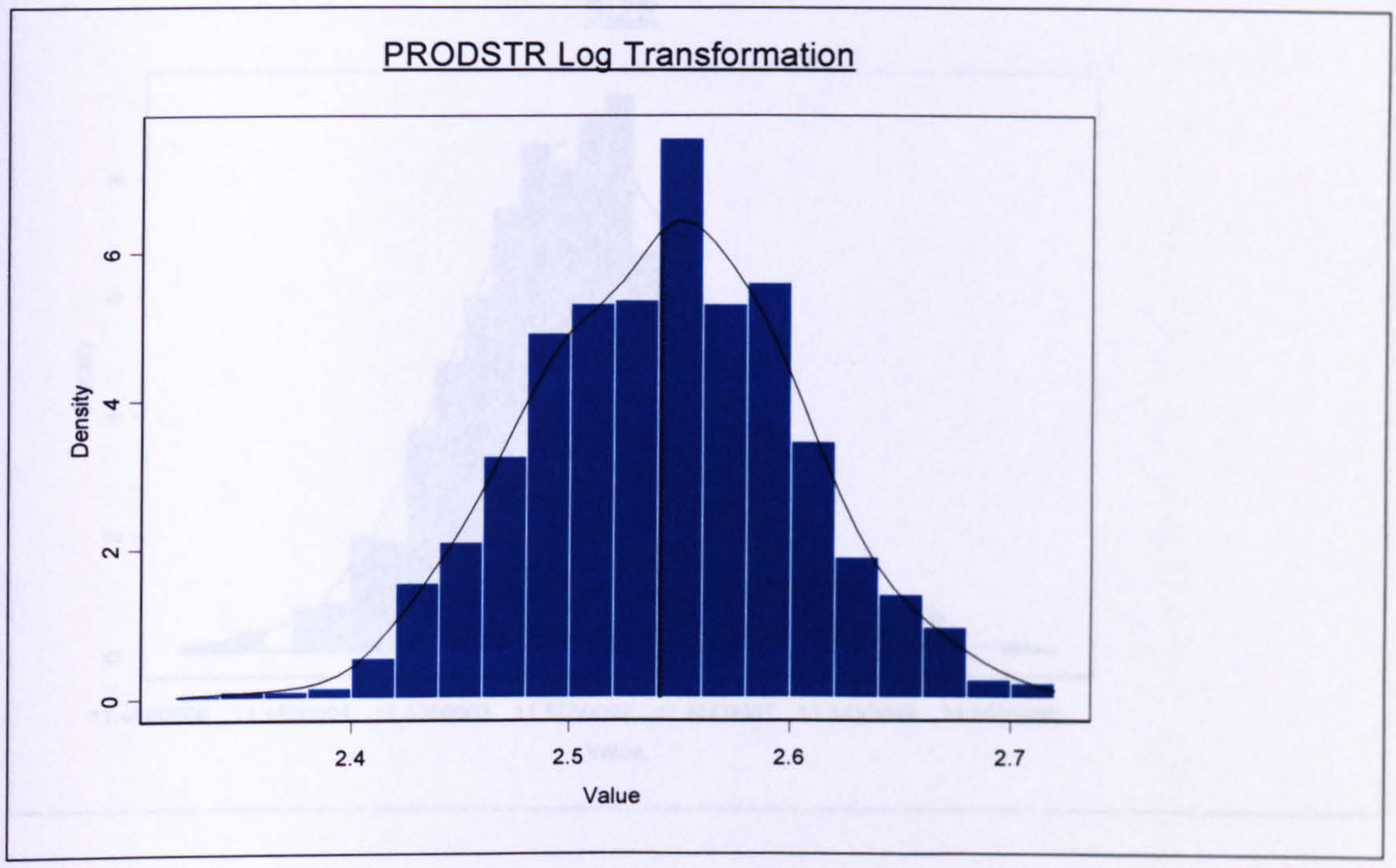


Figure APP9 Bootstrap of RDI variable

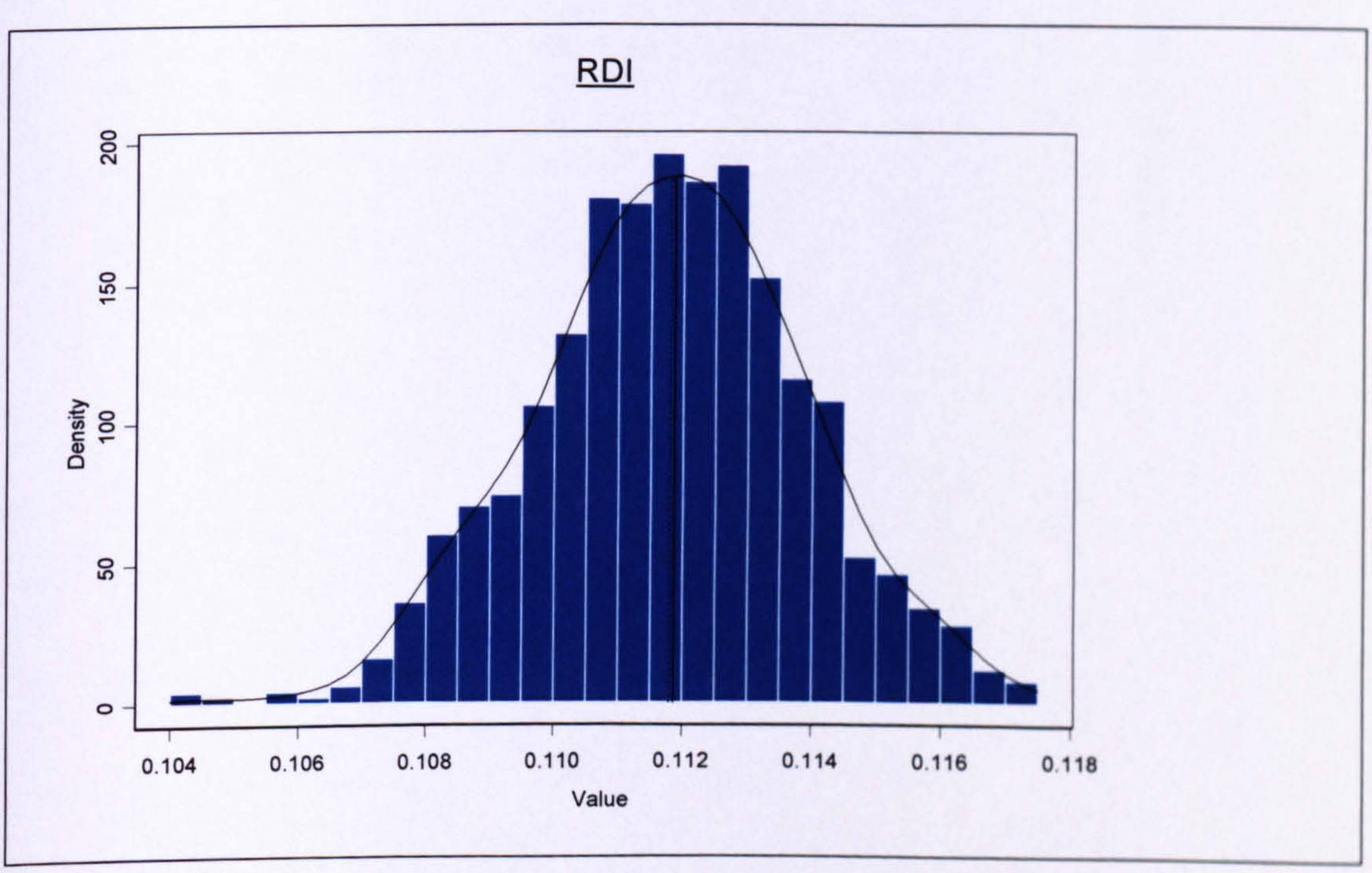


Figure APP10 Bootstrap of SIZE variable

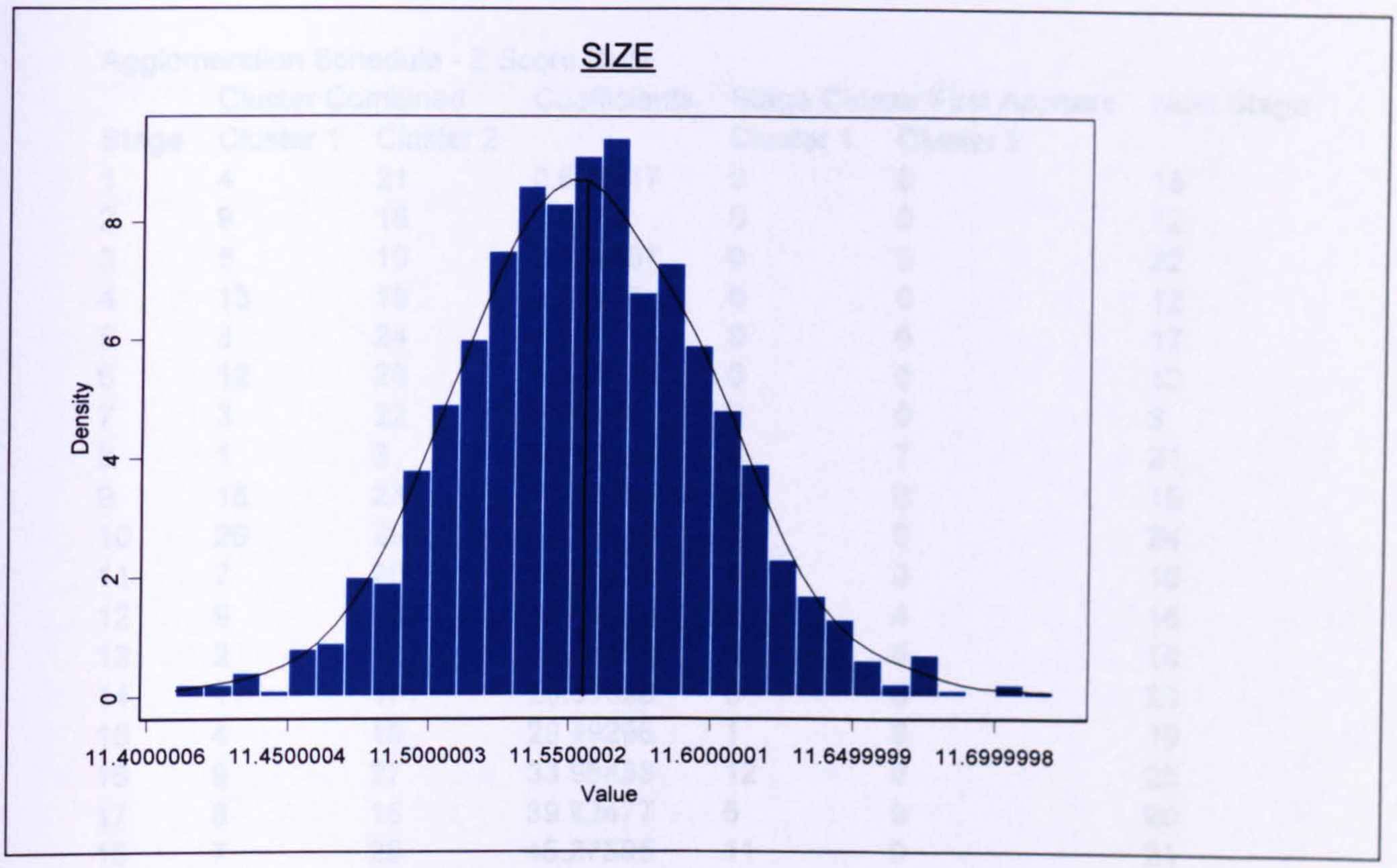


Table 2 Data standardized to Z scores agglomeration schedule Ward's Method – SSTP1

Agglomeration Schedule - Z Score Data

	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
Stage	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	4	21	0.639917	0	0	15
2	9	16	1.3513	0	0	12
3	5	10	2.174387	0	0	22
4	13	19	3.01918	0	0	12
5	8	24	4.137776	0	0	17
6	12	28	5.575746	0	0	13
7	3	22	7.24312	0	0	8
8	1	3	9.163154	0	7	21
9	18	23	11.17539	0	0	15
10	26	29	13.77636	0	0	24
11	7	25	16.50024	0	0	18
12	9	13	19.44928	2	4	16
13	2	12	22.48455	0	6	19
14	11	17	25.81828	0	0	20
15	4	18	29.49296	1	9	19
16	9	27	33.98438	12	0	25
17	8	15	39.92477	5	0	20
18	7	20	46.27595	11	0	21
19	2	4	55.24881	13	15	22
20	8	11	64.39042	17	14	23
21	1	7	74.94379	8	18	27
22	2	5	91.27495	19	3	25
23	8	14	108.7647	20	0	24
24	8	26	127.5321	23	10	26
25	2	9	150.5763	22	16	28
26	6	8	177.4683	0	24	27
27	1	6	216.5975	21	26	28
28	1	2	280	27	25	0

Table 3 Non standardized data agglomeration schedule – Ward's Method – SSTP1

Agglomeration Schedule for non standardized data set - SSTP1

	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
Stage	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	1	20	18.32599	0	0	10
2	5	10	46.13995	0	0	14
3	13	16	76.85682	0	0	6
4	8	24	117.0984	0	0	12
5	9	26	196.6839	0	0	11
6	13	19	314.5887	3	0	11
7	4	21	452.6501	0	0	19
8	28	29	594.2335	0	0	17
9	11	17	740.0052	0	0	21
10	1	22	889.4544	1	0	16
11	9	13	1104.788	5	6	21
12	8	15	1333.37	4	0	18
13	7	25	1615.854	0	0	22
14	5	27	1959.478	2	0	23
15	12	18	2338.542	0	0	19
16	1	3	2789.93	10	0	22
17	2	28	3521.118	0	8	24
18	8	14	4311.759	12	0	23
19	4	12	5189.184	7	15	26
20	6	23	6168.893	0	0	25
21	9	11	7164.011	11	9	24
22	1	7	8251.434	16	13	26
23	5	8	9859.919	14	18	27
24	2	9	12359	17	21	25
25	2	6	16500.98	24	20	27
26	1	4	23842.99	22	19	28
27	2	5	33657.88	25	23	28
28	1	2	66956.63	26	27	0

Table 4 Tree Validation Bootstrapping Results – Standardized Data - SSTP1

Clusters	Fusion Values	Cumul. ESS	Random Means	Cumul. ESS	Absolute Diff.	Random St.Devs.	Standard Errors	t Statistics
28	0.128	0.128	0.128	0.128	0	0	0	0
27	0.142	0.27	0.146	0.274	0.004	0	0	0
26	0.165	0.435	0.173	0.446	0.008	0	0	0
25	0.169	0.604	0.218	0.665	0.049	0.049	1.003	10.936
24	0.224	0.827	0.285	0.95	0.061	0.04	1.525	16.634
23	0.288	1.115	0.326	1.276	0.039	0.032	1.219	13.301
22	0.334	1.449	0.371	1.647	0.037	0.048	0.765	8.34
21	0.384	1.833	0.42	2.067	0.036	0.058	0.619	6.756
20	0.403	2.236	0.486	2.554	0.084	0.074	1.128	12.306
19	0.52	2.756	0.562	3.115	0.042	0.093	0.448	4.887
18	0.545	3.301	0.656	3.772	0.112	0.103	1.08	11.786
17	0.59	3.891	0.757	4.528	0.167	0.112	1.483	16.178
16	0.606	4.497	0.864	5.393	0.258	0.113	2.289	24.972
15	0.667	5.164	1.018	6.41	0.351	0.127	2.755	30.055
14	0.735	5.899	1.177	7.587	0.442	0.153	2.879	31.401
13	0.898	6.798	1.361	8.949	0.463	0.196	2.363	25.78
12	1.188	7.985	1.607	10.556	0.42	0.232	1.81	19.741
11	1.27	9.255	1.883	12.439	0.613	0.248	2.473	26.975
10	1.794	11.05	2.143	14.582	0.349	0.253	1.379	15.045
9	1.828	12.878	2.476	17.058	0.648	0.272	2.38	25.964
8	2.112	14.989	2.801	19.859	0.689	0.276	2.496	27.233
7	3.266	18.255	3.177	23.036	-0.088	0.289	-0.305	-3.332
6	3.497	21.752	3.529	26.566	0.032	0.272	0.119	1.299
5	3.755	25.507	4.136	30.702	0.382	0.372	1.025	11.182
4	4.609	30.116	4.753	35.455	0.144	0.428	0.336	3.668
3	5.378	35.494	5.578	41.033	0.2	0.437	0.458	4.991
2	7.827	43.32	6.751	47.784	-1.076	0.475	-2.264	-24.694
1	12.68	56	8.217	56	-4.463	0.691	-6.457	-70.434

Table 5 Tree Validation Bootstrapping Results – Non Standardized Data - SSTP1

Clusters	Fusion Values	Cumul. ESS	Random Means	Cumul. ESS	Absolute Diff.	Random St.Devs.	Standard Errors	t Statistics
28	1.833	1.833	3.784	3.784	1.951	2.117	0.922	10.053
27	2.781	4.614	6.201	9.985	3.42	2.551	1.341	14.624
26	3.072	7.686	8.145	18.13	5.073	2.893	1.754	19.13
25	4.024	11.71	10.588	28.717	6.564	3.222	2.037	22.219
24	7.959	19.668	12.731	41.448	4.772	3.678	1.297	14.153
23	11.79	31.459	14.938	56.386	3.148	4.148	0.759	8.277
22	13.806	45.265	17.404	73.79	3.598	4.519	0.796	8.685
21	14.158	59.423	19.959	93.749	5.801	4.826	1.202	13.11
20	14.577	74	22.951	116.7	8.374	5.235	1.599	17.448
19	14.945	88.945	25.841	142.541	10.896	5.467	1.993	21.742
18	21.533	110.479	29.044	171.585	7.511	6.338	1.185	12.927
17	22.858	133.337	32.597	204.182	9.738	6.625	1.47	16.035
16	28.248	161.585	37.096	241.279	8.848	7.298	1.212	13.226
15	34.362	195.948	42.693	283.972	8.331	8.656	0.962	10.499
14	37.907	233.854	49.868	333.84	11.961	10.688	1.119	12.208
13	45.139	278.993	56.859	390.699	11.72	12.584	0.931	10.16
12	73.119	352.112	65.596	456.295	-7.523	14.347	-0.524	-5.72
11	79.064	431.176	77.882	534.177	-1.182	17.03	-0.069	-0.757
10	87.742	518.918	91.977	626.154	4.235	21.985	0.193	2.101
9	97.971	616.889	115.316	741.47	17.345	27.605	0.628	6.854
8	99.512	716.402	141.76	883.23	42.247	28.994	1.457	15.895
7	108.742	825.144	173.145	1056.375	64.403	40.231	1.601	17.463
6	160.849	985.992	218.466	1274.841	57.618	50.488	1.141	12.449
5	249.908	1235.901	287.962	1562.803	38.054	61.732	0.616	6.725
4	414.198	1650.099	384.206	1947.009	-29.993	74.801	-0.401	-4.374
3	734.201	2384.3	522.351	2469.36	-211.85	129.565	-1.635	-17.837
2	981.49	3365.789	823.528	3292.888	-157.961	187.179	-0.844	-9.206
1	3329.875	6695.665	3224.558	6517.446	-105.318	677.332	-0.155	-1.696

Table 6 Agglomeration Schedule for SSTP2. Ward's Method Variable Set 1[Z Scores]

Agglomeration Schedule							
	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage	
Stage	Cluster 1	Cluster 2		Cluster 1	Cluster 2		
1	9	13	0.354033	0	0	18	28
2	4	18	0.728843	0	0	11	27
3	5	10	1.15501	0	0	12	26
4	7	12	1.903146	0	0	8	25
5	16	19	3.0663	0	0	18	24
6	26	29	4.31097	0	0	22	23
7	8	23	5.606776	0	0	11	22
8	2	7	7.003912	0	4	16	21
9	17	24	8.487198	0	0	15	20
10	1	3	9.98831	0	0	13	19
11	4	8	11.71594	2	7	16	18
12	5	28	13.52133	3	0	21	17
13	1	22	16.27709	10	0	20	16
14	21	27	19.1509	0	0	26	15
15	11	17	22.30582	0	9	25	14
16	2	4	25.94047	8	11	19	13
17	20	25	29.64466	0	0	20	12
18	9	16	33.4216	1	5	21	11
19	2	15	38.14762	16	0	23	10
20	1	20	43.90533	13	17	24	9
21	5	9	51.12767	12	18	23	8
22	14	26	60.6686	0	6	24	7
23	2	5	72.81949	19	21	26	6
24	1	14	88.11934	20	22	27	5
25	6	11	106.3193	0	15	27	4
26	2	21	125.3923	23	14	28	3
27	1	6	155.5978	24	25	28	2
28	1	2	196	27	26	0	1

Table 7 Agglomeration Schedule for SSTP2. Ward's Method Variable Set 1.Non Standardised Data]

Agglomeration Schedule						
	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
Stage	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	11	17	17.42901	0	0	18
2	20	25	36.17928	0	0	13
3	9	26	58.08275	0	0	11
4	1	22	80.77591	0	0	13
5	13	28	103.9203	0	0	11
6	19	29	201.2875	0	0	17
7	5	14	301.6809	0	0	12
8	15	23	422.8496	0	0	19
9	4	18	557.939	0	0	19
10	2	12	701.5133	0	0	15
11	9	13	886.782	3	5	17
12	5	8	1080.899	7	0	22
13	1	20	1289.97	4	2	16
14	10	24	1569.236	0	0	18
15	2	16	2020.486	10	0	24
16	1	7	2511.207	13	0	20
17	9	19	3049.628	11	6	21
18	10	11	3592.312	14	1	21
19	4	15	4229.925	9	8	22
20	1	3	5680.361	16	0	24
21	9	10	7140.244	17	18	26
22	4	5	8845.09	19	12	25
23	21	27	10594.39	0	0	28
24	1	2	13154.64	20	15	27
25	4	6	19351.87	22	0	26
26	4	9	27685.45	25	21	27
27	1	4	47343.99	24	26	28
28	1	21	68700.05	27	23	0

Table 8 Agglomeration Schedule for SSTP2. Ward's Method Variable Set 2.Z Scores]

Agglomeration Schedule						
	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
Stage	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	5	10	0.330388	0	0	7
2	4	18	0.763389	0	0	5
3	9	12	1.235105	0	0	4
4	7	9	2.18045	0	3	12
5	4	23	3.224799	2	0	18
6	13	19	4.444912	0	0	21
7	5	8	5.771645	1	0	10
8	17	24	7.118582	0	0	19
9	1	3	8.623614	0	0	14
10	5	28	10.14535	7	0	18
11	11	22	11.87672	0	0	23
12	2	7	13.86105	0	4	13
13	2	15	16.40973	12	0	20
14	1	25	19.50904	9	0	17
15	21	27	22.81156	0	0	26
16	16	20	26.40284	0	0	20
17	1	29	31.1348	14	0	24
18	4	5	35.95097	5	10	22
19	17	26	41.6436	8	0	22
20	2	16	49.08753	13	16	21
21	2	13	57.09576	20	6	25
22	4	17	67.57965	18	19	25
23	6	11	78.8459	0	11	27
24	1	14	92.32614	17	0	27
25	2	4	109.5962	21	22	26
26	2	21	129.6803	25	15	28
27	1	6	156.841	24	23	28
28	1	2	196	27	26	0

Table 9 Agglomeration Schedule for SSTP2. Ward's Method Variable Set 2 [Non Standardized Data]

Agglomeration Schedule						
	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
Stage	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	8	23	0.657508	0	0	13
2	2	9	1.553867	0	0	14
3	26	28	2.976481	0	0	10
4	3	15	5.005052	0	0	18
5	4	18	7.461259	0	0	19
6	1	17	10.67147	0	0	15
7	13	19	14.31111	0	0	10
8	12	25	19.81561	0	0	20
9	6	11	26.02678	0	0	15
10	13	26	34.30064	7	3	14
11	7	16	42.62393	0	0	17
12	20	29	53.05598	0	0	20
13	5	8	65.33655	0	1	18
14	2	13	83.1874	2	10	22
15	1	6	105.1418	6	9	16
16	1	22	130.3196	15	0	23
17	7	24	157.3075	11	0	23
18	3	5	188.6585	4	13	21
19	4	10	229.4661	5	0	24
20	12	20	273.2148	8	12	22
21	3	14	337.867	18	0	27
22	2	12	431.4446	14	20	26
23	1	7	560.95	16	17	24
24	1	4	1126.676	23	19	26
25	21	27	2551.288	0	0	28
26	1	2	4782.821	24	22	27
27	1	3	13306.14	26	21	28
28	1	21	33925.26	27	25	0

Table 10 Principle Component Scores SSTP2. Full Variable Set [Non Standardized Data]

3M	5.1355	51.9375	7.8266	58.8885	-25.339
ABB	24.9269	40.9556	25.0011	40.9862	-17.5779
AKZO	7.1953	41.9453	9.8689	90.5029	-5.9062
AVE	27.8245	39.178	33.0906	71.5999	-5.6218
AZ	35.3885	52.8764	47.553	98.3596	-4.9981
BAX	23.0477	0.2555	29.4549	49.4599	16.1128
BAY	13.3646	42.8912	11.4918	59.8458	-15.3284
BI	31.6898	44.902	44.744	93.297	-0.5907
BMS	39.6609	45.3596	48.3832	43.5693	-15.4892
GSK	40.7886	51.2251	51.4131	80.4932	-9.0149
IVX	34.9931	54.078	58.8704	62.4587	-18.5845
JJ	23.1576	48.7403	24.5247	50.2815	-20.9611
LIL	42.894	52.6998	53.9971	47.1988	-19.296
LUN	34.6887	50.6133	56.836	101.3293	1.2738
MER	27.9629	33.5749	42.4228	89.036	6.4447
MSD	24.6464	56.0955	25.3711	62.0683	-22.8681
NOV	37.2598	56.0424	56.0317	60.4737	-19.897
NVA	32.7576	46.3825	39.8801	71.5321	-9.8815
PFZ	40.454	60.9215	47.2573	47.5851	-26.7149
PG	6.3655	53.8582	5.5415	46.6007	-30.0057
PHR	43.3732	55.6721	36.1466	-53.5831	-58.6992
RB	1.6185	52.1308	6.6012	62.8023	-25.6055
ROC	25.532	35.1018	32.1963	91.4164	4.0169
SAG	39.1786	40.9918	54.3754	65.467	-5.2304
SOL	7.9759	55.0177	7.1438	51.0446	-28.99
SPL	38.506	47.1692	47.6472	46.5741	-17.1332
SS	46.1131	60.9948	50.838	-3.8189	-43.9072
WYE	41.5688	53.6754	50.3265	48.5913	-21.217
YAM	28.6018	59.048	43.123	46.6243	-26.137

Table 11 Principle Component Scores SSTP2. Full Variable Set [Standardized Data]

Principal Component Scores					
3M	-3.1334	0.6102	-0.2286	-0.1325	-0.3681
ABB	0.0485	-0.7116	-0.9973	-0.893	0.5721
AKZO	-2.0214	0.0035	-0.7984	0.8659	0.1526
AVE	1.4112	-1.0118	-0.4886	0.3803	0.4149
AZ	2.031	0.3687	-0.0618	1.6622	-0.5846
BAX	-1.3421	-5.8006	0.0495	-0.7383	0.9893
BAY	-0.6107	-0.308	-1.3399	0.1527	-0.0057
BI	0.7875	0.1006	0.6142	0.8886	0.7621
BMS	1.0251	-0.1354	-0.3216	-0.0675	0.0316
GSK	2.5546	-0.0443	0.0223	1.2658	-1.0883
IVX	-1.9276	-0.6964	1.9693	0.5001	-1.4902
JJ	0.3071	-0.4742	-0.9411	0.0746	-0.5173
LIL	1.813	0.7636	0.6712	0.0172	0.0451
LUN	-0.2376	2.7753	1.0929	0.6439	2.9848
MER	-0.809	-1.3225	-0.0422	0.6219	1.2955
MSD	0.6258	1.4834	-2.0557	0.5874	-0.573
NOV	-0.2581	0.134	2.3357	0.4164	-1.1911
NVA	1.887	-0.9111	-0.8711	0.361	0.302
PFZ	2.151	1.9505	-0.5696	0.2692	-0.3839
PG	-2.7261	1.4404	-1.5934	-0.2622	0.0676
PHR	2.0759	-0.2972	-0.0948	-3.5421	-0.9166
RB	-3.9497	-0.2477	-0.0968	0.5779	-1.8997
ROC	1.2049	-1.8864	-0.3621	0.8536	0.5262
SAG	0.5651	-0.7946	1.9559	0.0465	0.3239
SOL	-2.7067	1.3535	-1.109	-0.8647	0.4719
SPL	0.2356	0.4229	1.0203	-1.0308	0.6448
SS	1.5835	1.4399	0.1995	-1.9646	-0.1237
WYE	1.7096	0.0399	0.3367	0.0118	-0.8634
YAM	-2.294	1.7553	1.7043	-0.7013	0.4213

Table 12 Agglomeration Schedule Based upon Principle Component Scores SSTP2 Full Variable Set [Standardized Data]

Agglomeration Schedule						
	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
Stage	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	4	18	0.197976	0	0	6
2	20	25	0.582494	0	0	14
3	5	10	1.013816	0	0	17
4	7	12	1.662244	0	0	8
5	13	28	2.398106	0	0	7
6	4	23	3.341568	1	0	19
7	9	13	4.483593	0	5	17
8	2	7	5.731313	0	4	16
9	1	3	7.329929	0	0	14
10	8	24	9.106006	0	0	12
11	11	17	10.95976	0	0	21
12	8	26	13.03474	10	0	22
13	16	19	15.4797	0	0	20
14	1	20	18.39677	9	2	18
15	21	27	21.62866	0	0	24
16	2	15	25.12059	8	0	19
17	5	9	28.9363	3	7	20
18	1	22	35.32436	14	0	26
19	2	4	41.85347	16	6	22
20	5	16	48.4245	17	13	24
21	11	29	55.25116	11	0	23
22	2	8	64.73694	19	12	25
23	11	14	81.50648	21	0	26
24	5	21	98.53624	20	15	25
25	2	5	118.4212	22	24	27
26	1	11	140.3094	18	23	28
27	2	6	178.5874	25	0	28
28	1	2	248.525	26	27	0

Table 13 Agglomeration Schedule Based upon Principle Component Scores SSTP2.Full Variable Set [Non Standardized Data]

Agglomeration Schedule						
	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
Stage	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	9	26	8.440851	0	0	11
2	13	28	19.34613	0	0	11
3	11	17	30.70507	0	0	19
4	20	25	44.34762	0	0	14
5	1	22	58.99617	0	0	14
6	15	23	121.1874	0	0	20
7	5	8	186.2959	0	0	12
8	4	18	256.5396	0	0	18
9	2	12	337.4434	0	0	15
10	19	29	418.6104	0	0	17
11	9	13	517.1817	1	2	17
12	5	14	627.4003	7	0	20
13	10	24	805.4988	0	0	18
14	1	20	987.1802	5	4	16
15	2	16	1260.702	9	0	21
16	1	7	1554.779	14	0	21
17	9	19	1866.094	11	10	19
18	4	10	2242.764	8	13	22
19	9	11	2711.035	17	3	26
20	5	15	3351.625	12	6	22
21	1	2	4567.377	16	15	24
22	4	5	5890.21	18	20	25
23	21	27	7363.687	0	0	28
24	1	3	8925.302	21	0	27
25	4	6	12369.26	22	0	26
26	4	9	19635.17	25	19	27
27	1	4	30419.87	24	26	28
28	1	21	50135.44	27	23	0

Figure 11 Tree Validation Bootstrapping Diagram– Standardized Data – SSTP2 Variable Set 2

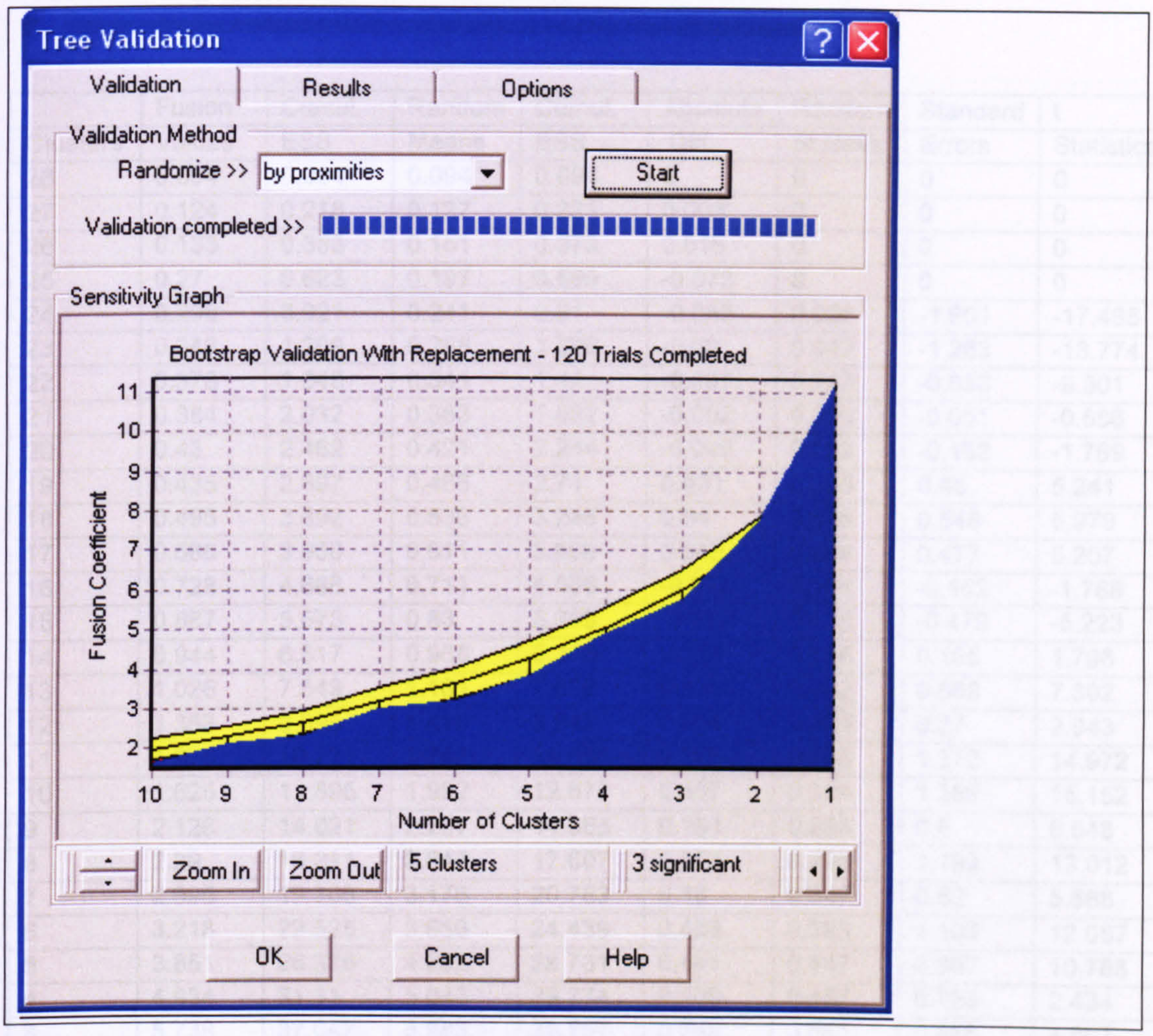


Table 14 Tree Validation Bootstrapping Results – Standardized Data – SSTP2 Variable Set 2

Clusters	Fusion Values	Cumul. ESS	Random Means	Cumul. ESS	Absolute Diff.	Random St.Devs.	Standard Errors	t Statistics
28	0.094	0.094	0.094	0.094	0	0	0	0
27	0.124	0.218	0.127	0.221	0.003	0	0	0
26	0.135	0.353	0.151	0.373	0.016	0	0	0
25	0.27	0.623	0.197	0.569	-0.073	0	0	0
24	0.298	0.921	0.241	0.81	-0.058	0.036	-1.601	-17.465
23	0.348	1.269	0.288	1.098	-0.06	0.047	-1.263	-13.774
22	0.378	1.648	0.341	1.44	-0.037	0.043	-0.853	-9.301
21	0.384	2.032	0.383	1.822	-0.002	0.036	-0.051	-0.556
20	0.43	2.462	0.421	2.244	-0.009	0.052	-0.162	-1.769
19	0.435	2.897	0.466	2.71	0.031	0.065	0.48	5.241
18	0.495	3.392	0.536	3.245	0.04	0.074	0.548	5.979
17	0.566	3.958	0.611	3.856	0.045	0.094	0.477	5.207
16	0.728	4.686	0.711	4.568	-0.017	0.104	-0.162	-1.768
15	0.887	5.573	0.83	5.398	-0.057	0.118	-0.479	-5.223
14	0.944	6.517	0.968	6.365	0.024	0.146	0.165	1.796
13	1.026	7.543	1.161	7.526	0.135	0.202	0.669	7.302
12	1.353	8.895	1.416	8.942	0.064	0.236	0.27	2.943
11	1.375	10.271	1.743	10.686	0.368	0.268	1.372	14.972
10	1.625	11.895	1.992	12.677	0.367	0.264	1.389	15.152
9	2.126	14.021	2.287	14.965	0.161	0.268	0.6	6.548
8	2.29	16.311	2.643	17.607	0.353	0.296	1.193	13.012
7	2.995	19.306	3.176	20.783	0.18	0.347	0.52	5.668
6	3.218	22.525	3.656	24.439	0.438	0.395	1.108	12.087
5	3.851	26.376	4.292	28.731	0.441	0.447	0.987	10.768
4	4.934	31.31	5.043	33.774	0.109	0.487	0.223	2.434
3	5.738	37.047	5.983	39.757	0.246	0.551	0.446	4.867
2	7.764	44.811	7.305	47.062	-0.459	0.564	-0.815	-8.891
1	11.189	56	8.938	56	-2.251	0.922	-2.44	-26.62

Figure 12 Tree Validation Bootstrapping Diagram– Non Standardized Data SSTP2 Variable Set 2

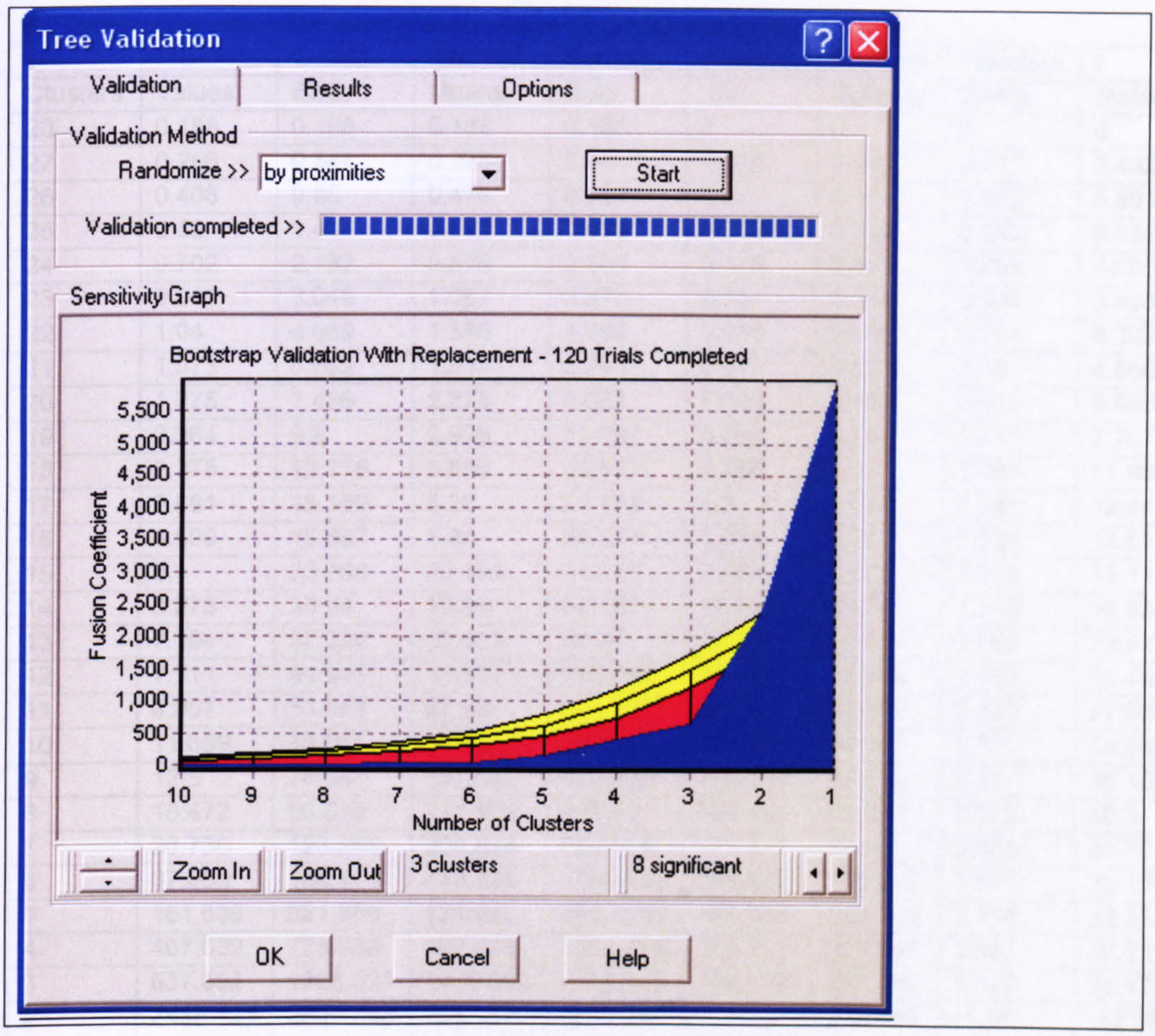


Table 14 Tree Validation Bootstrapping Results – Non Standardized Data – SSTP2 Variable Set 2

Clusters	Fusion Values	Cumul. ESS	Random Means	Cumul. ESS	Absolute Diff.	Random St.Devs.	Standard Errors	t Statistics
28	0.188	0.188	0.188	0.188	0	0	0	0
27	0.256	0.444	0.273	0.46	0.016	0.052	0.317	3.462
26	0.406	0.85	0.476	0.937	0.07	0.112	0.623	6.801
25	0.58	1.43	0.692	1.629	0.113	0.128	0.883	9.638
24	0.702	2.132	0.876	2.505	0.175	0.135	1.289	14.06
23	0.917	3.049	1.067	3.573	0.15	0.298	0.504	5.493
22	1.04	4.089	1.395	4.968	0.355	0.466	0.761	8.302
21	1.573	5.662	1.814	6.781	0.241	0.561	0.43	4.686
20	1.775	7.436	2.279	9.061	0.505	0.552	0.915	9.986
19	2.364	9.8	2.926	11.987	0.562	0.791	0.711	7.757
18	2.378	12.178	3.866	15.853	1.488	1.37	1.087	11.856
17	2.981	15.159	5.28	21.134	2.3	2.016	1.141	12.442
16	3.509	18.667	7.84	28.974	4.331	3.254	1.331	14.52
15	5.1	23.768	12.163	41.137	7.063	5.877	1.202	13.11
14	6.273	30.04	19.05	60.187	12.778	8.428	1.516	16.539
13	7.194	37.234	30.023	90.21	22.83	10.914	2.092	22.82
12	7.711	44.945	43.637	133.847	35.926	16.688	2.153	23.484
11	8.957	53.902	67.49	201.337	58.533	22.835	2.563	27.962
10	11.659	65.561	99.955	301.292	88.296	34.347	2.571	28.043
9	12.5	78.061	152.643	453.935	140.143	42.338	3.31	36.109
8	18.472	96.533	211.955	665.89	193.483	54.822	3.529	38.5
7	26.736	123.269	300.614	966.504	273.877	71.52	3.829	41.773
6	37.002	160.271	423.888	1390.392	386.886	110.019	3.517	38.361
5	161.636	321.906	621.941	2012.333	460.306	168.308	2.735	29.834
4	407.032	728.939	962.435	2974.768	555.403	227.947	2.437	26.58
3	637.582	1366.521	1476.058	4450.826	838.476	267.942	3.129	34.137
2	2435.237	3801.758	2080.97	6531.795	-354.267	305.363	-1.16	-12.656
1	5891.177	9692.935	3161.14	9692.935	-2730.04	461.136	-5.92	-64.582

Figure 13 Tree Validation Bootstrapping Diagram– Standardized Data – SSTP2 Principle Components

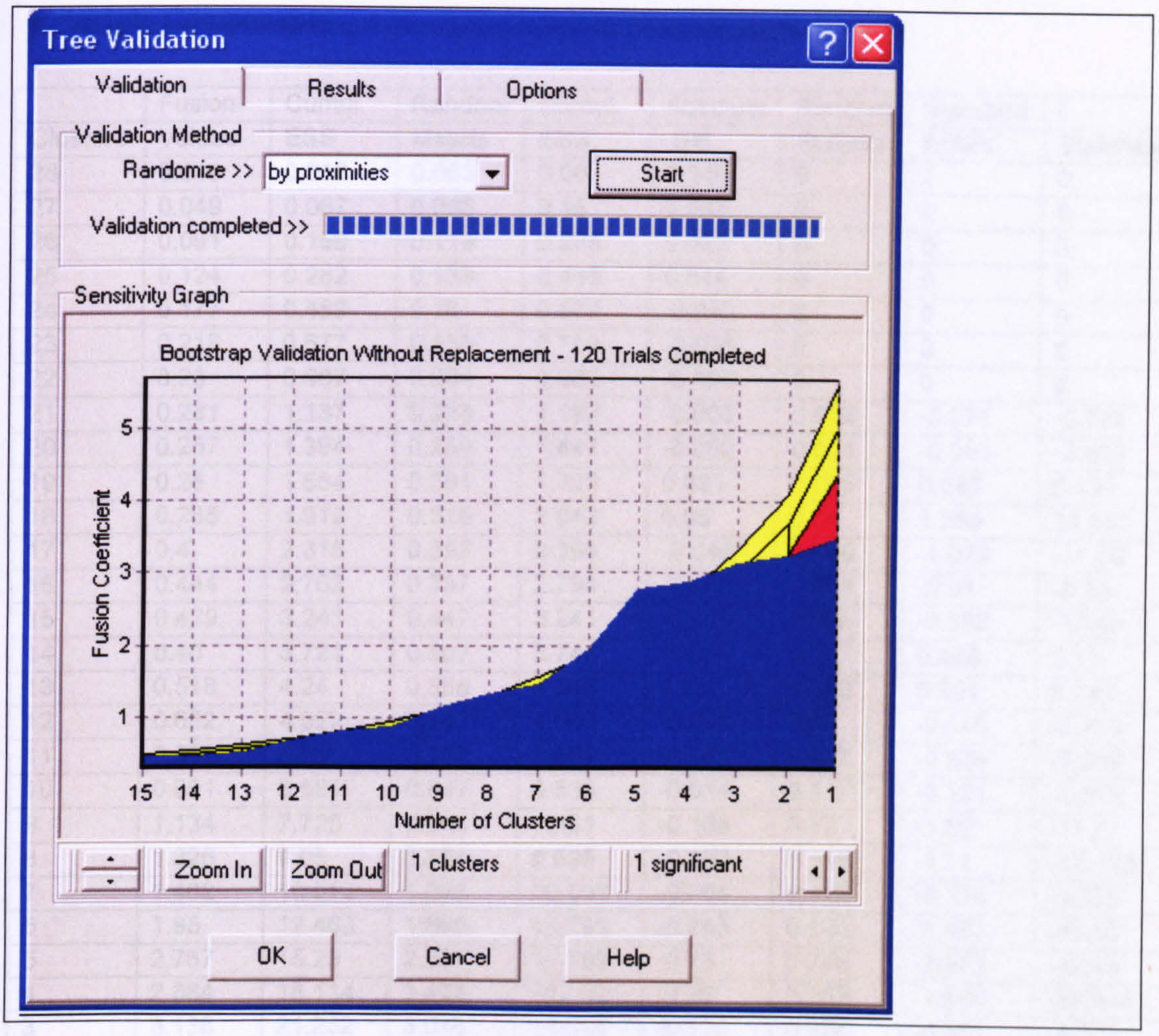


Table 15 Tree Validation Bootstrapping Results – Standardized Data – SSTP2 Principle Components

	Fusion	Cumul.	Random	Cumul.	Absolute	Random	Standard	t
Clusters	Values	ESS	Means	ESS	Diff.	St.Devs.	Errors	Statistics
28	0.018	0.018	0.063	0.063	0.046	0	0	0
27	0.049	0.067	0.096	0.16	0.047	0	0	0
26	0.091	0.158	0.119	0.278	0.028	0	0	0
25	0.124	0.282	0.138	0.416	0.014	0	0	0
24	0.177	0.459	0.16	0.577	-0.016	0	0	0
23	0.218	0.677	0.183	0.759	-0.036	0	0	0
22	0.23	0.907	0.204	0.963	-0.026	0	0	0
21	0.231	1.137	0.228	1.192	-0.002	0.032	-0.071	-0.775
20	0.257	1.394	0.255	1.447	-0.002	0.034	-0.051	-0.553
19	0.26	1.654	0.281	1.728	0.021	0.036	0.586	6.394
18	0.265	1.919	0.315	2.043	0.05	0.04	1.255	13.692
17	0.4	2.318	0.353	2.396	-0.046	0.045	-1.029	-11.23
16	0.444	2.762	0.397	2.794	-0.046	0.051	-0.91	-9.931
15	0.479	3.241	0.447	3.241	-0.032	0.055	-0.582	-6.344
14	0.48	3.721	0.507	3.748	0.027	0.057	0.468	5.11
13	0.518	4.24	0.568	4.316	0.05	0.062	0.801	8.742
12	0.682	4.922	0.647	4.963	-0.036	0.08	-0.445	-4.849
11	0.808	5.73	0.727	5.689	-0.081	0.097	-0.834	-9.098
10	0.861	6.591	0.847	6.536	-0.014	0.117	-0.121	-1.316
9	1.134	7.725	0.995	7.531	-0.139	0.13	-1.07	-11.67
8	1.326	9.05	1.164	8.695	-0.162	0.146	-1.11	-12.113
7	1.462	10.513	1.398	10.093	-0.064	0.172	-0.374	-4.075
6	1.95	12.463	1.668	11.761	-0.283	0.195	-1.451	-15.83
5	2.767	15.23	2.037	13.798	-0.73	0.246	-2.973	-32.43
4	2.884	18.114	2.494	16.292	-0.39	0.252	-1.544	-16.844
3	3.138	21.252	3.016	19.308	-0.123	0.306	-0.401	-4.372
2	3.245	24.498	3.703	23.01	0.457	0.41	1.114	12.157
1	3.502	28	4.99	28	1.488	0.617	2.41	26.293

Figure 14 Tree Validation Bootstrapping Diagram – Non Standardized Data – SSTP2 Principle Components

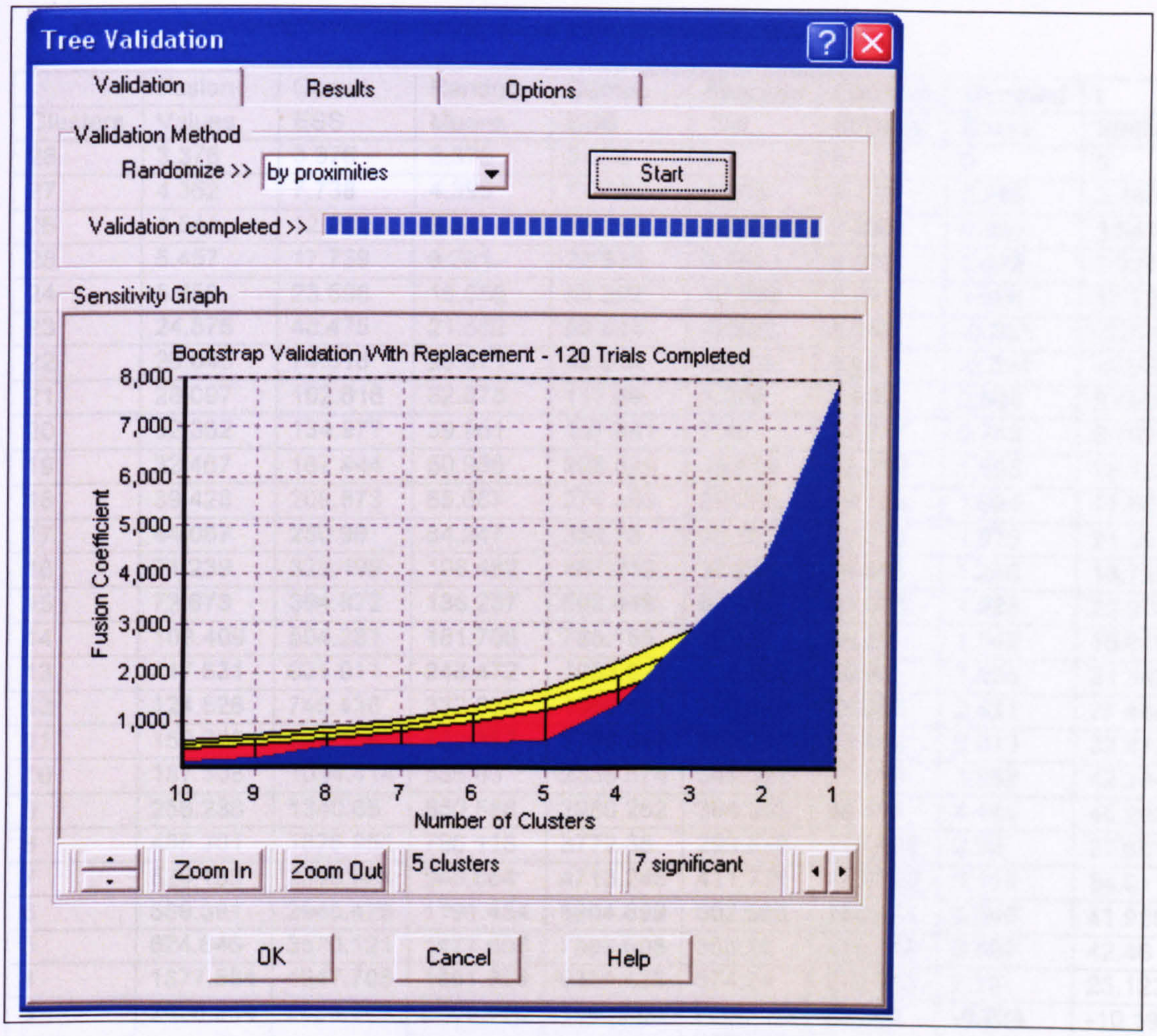


Table 16 Tree Validation Bootstrapping Results – Non Standardized Data – SSTP2 Principle Components

Clusters	Fusion Values	Cumul. ESS	Random Means	Cumul. ESS	Absolute Diff.	Random St.Devs.	Standard Errors	t Statistics
28	3.376	3.376	3.376	3.376	0	0	0	0
27	4.362	7.738	4.395	7.772	0.033	0.116	0.288	3.143
26	4.544	12.282	5.34	13.112	0.796	2.386	0.334	3.641
25	5.457	17.739	9.221	22.333	3.764	5.603	0.672	7.329
24	5.859	23.598	15.959	38.292	10.099	6.213	1.626	17.733
23	24.876	48.475	21.552	59.844	-3.325	4.142	-0.803	-8.756
22	26.043	74.518	25.971	85.814	-0.073	5.09	-0.014	-0.156
21	28.097	102.616	32.075	117.89	3.978	7.893	0.504	5.498
20	32.362	134.977	39.951	157.841	7.59	10.217	0.743	8.103
19	32.467	167.444	50.985	208.826	18.518	13.292	1.393	15.197
18	39.428	206.873	65.657	274.483	26.229	16.184	1.621	17.68
17	44.087	250.96	84.247	358.73	40.16	20.319	1.976	21.56
16	71.239	322.199	108.482	467.212	37.242	29.605	1.258	13.723
15	72.673	394.872	136.237	603.449	63.565	33.053	1.923	20.979
14	109.409	504.281	181.706	785.155	72.297	46.89	1.542	16.819
13	117.631	621.911	248.472	1033.627	130.842	65.92	1.985	21.652
12	124.526	746.438	332.834	1366.461	208.308	86.054	2.421	26.406
11	150.668	897.106	432.382	1798.844	281.714	93.484	3.013	32.873
10	187.308	1084.414	536.83	2335.674	349.522	90.493	3.862	42.134
9	256.236	1340.65	650.588	2986.262	394.352	95.155	4.144	45.209
8	486.301	1826.951	786.118	3772.38	299.818	118.495	2.53	27.601
7	529.133	2356.084	940.864	4713.245	411.731	132.058	3.118	34.011
6	589.391	2945.475	1191.454	5904.699	602.063	156.421	3.849	41.988
5	624.646	3570.121	1477.906	7382.605	853.26	219.219	3.892	42.46
4	1377.584	4947.705	1951.824	9334.429	574.24	270.913	2.12	23.123
3	2906.364	7854.069	2568.606	11903.04	-337.758	361.58	-0.934	-10.19
2	4313.879	12167.95	3419.129	15322.17	-894.75	409.498	-2.185	-23.835
1	7886.229	20054.18	4732.008	20054.17	-3154.22	636.411	-4.956	-54.066

Figure 15 Tree Validation Bootstrapping Diagram – Standardized Data – SSTP2 Full Set of Variables

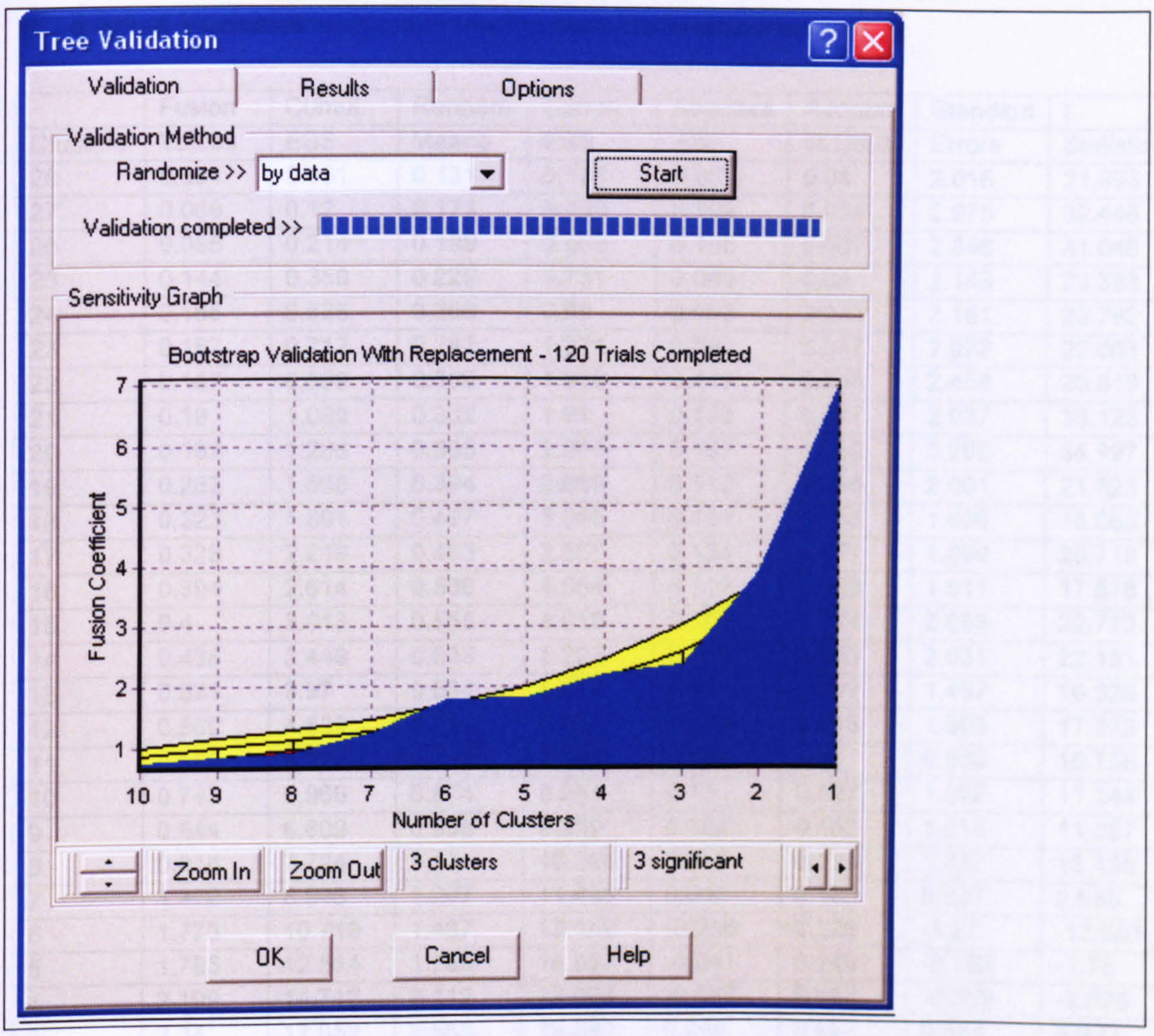


Table 17 Tree Validation Bootstrapping Results – Standardized Data – SSTP2 Full Set of Variables

	Fusion	Cumul.	Random	Cumul.	Absolute	Random	Standard	t
Clusters	Values	ESS	Means	ESS	Diff.	St.Devs.	Errors	Statistics
28	0.051	0.051	0.131	0.131	0.08	0.04	2.016	21.993
27	0.069	0.12	0.171	0.303	0.102	0.034	2.975	32.448
26	0.095	0.214	0.199	0.502	0.105	0.037	2.846	31.046
25	0.144	0.359	0.229	0.731	0.085	0.04	2.143	23.383
24	0.166	0.525	0.259	0.99	0.093	0.043	2.181	23.792
23	0.187	0.712	0.282	1.271	0.095	0.047	2.022	22.063
22	0.187	0.899	0.306	1.578	0.119	0.048	2.458	26.819
21	0.19	1.089	0.332	1.91	0.143	0.047	3.037	33.126
20	0.197	1.286	0.365	2.275	0.167	0.052	3.208	34.997
19	0.282	1.568	0.394	2.669	0.112	0.056	2.001	21.823
18	0.323	1.891	0.427	3.095	0.104	0.063	1.656	18.063
17	0.328	2.219	0.463	3.558	0.134	0.071	1.899	20.719
16	0.394	2.614	0.506	4.064	0.112	0.069	1.611	17.578
15	0.4	3.013	0.555	4.619	0.156	0.074	2.088	22.773
14	0.436	3.449	0.603	5.223	0.168	0.083	2.031	22.151
13	0.521	3.97	0.651	5.874	0.13	0.087	1.497	16.326
12	0.569	4.539	0.721	6.595	0.152	0.095	1.593	17.373
11	0.683	5.222	0.792	7.387	0.109	0.11	0.986	10.758
10	0.743	5.966	0.874	8.261	0.13	0.127	1.022	11.144
9	0.844	6.809	0.998	9.259	0.154	0.152	1.015	11.067
8	0.914	7.724	1.13	10.389	0.216	0.175	1.237	13.495
7	1.222	8.946	1.267	11.656	0.045	0.188	0.237	2.588
6	1.773	10.719	1.487	13.142	-0.286	0.226	-1.27	-13.851
5	1.795	12.514	1.755	14.897	-0.041	0.249	-0.163	-1.78
4	2.199	14.712	2.112	17.009	-0.087	0.336	-0.259	-2.825
3	2.34	17.052	2.585	19.593	0.245	0.452	0.543	5.922
2	3.935	20.987	3.217	22.81	-0.718	0.531	-1.353	-14.755
1	7.013	28	4.323	27.133	-2.69	0.908	-2.964	-32.333

Figure 16 Tree Validation Bootstrapping Diagram – Non Standardized Data – SSTP2 Full Set of Variables

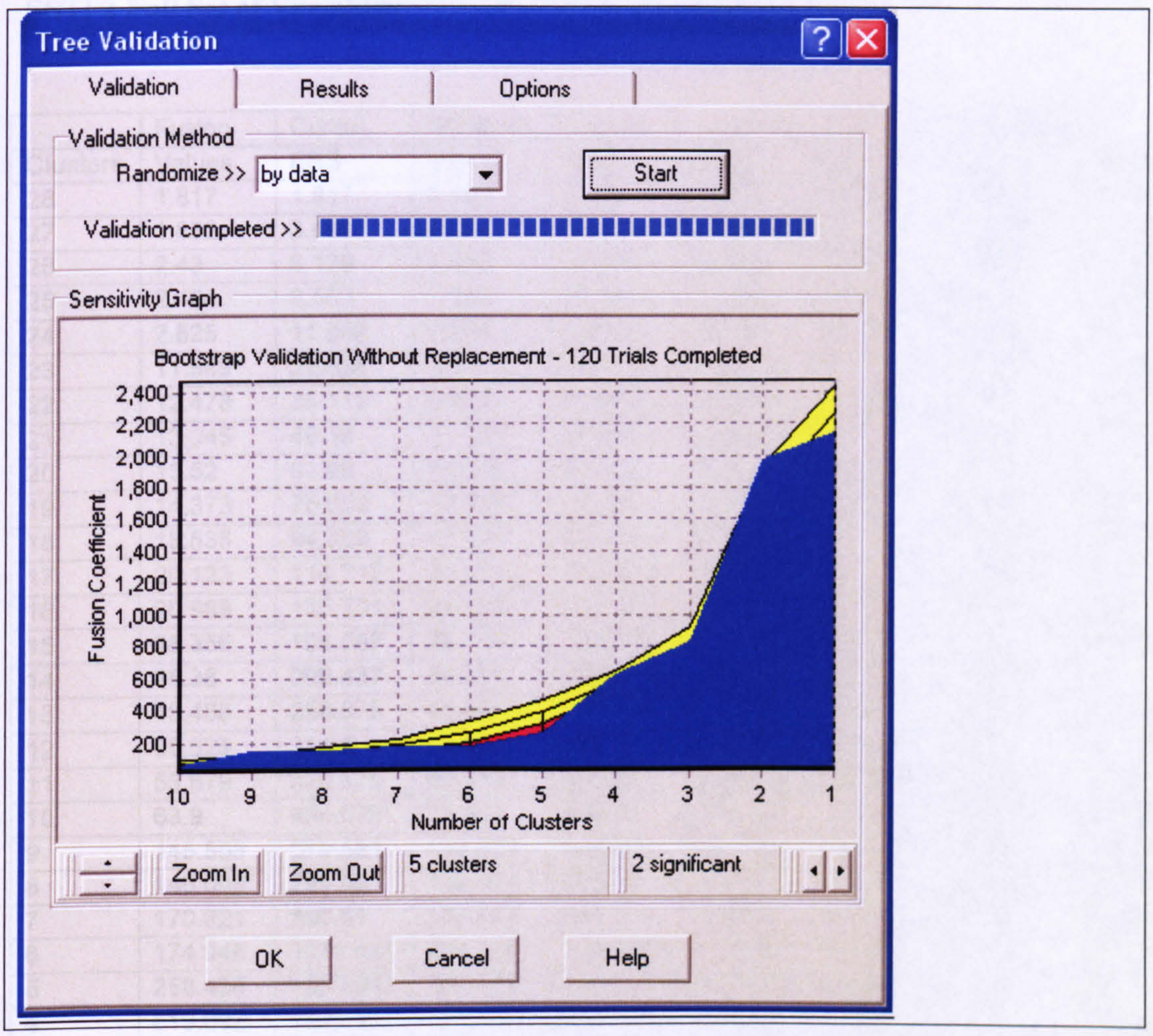


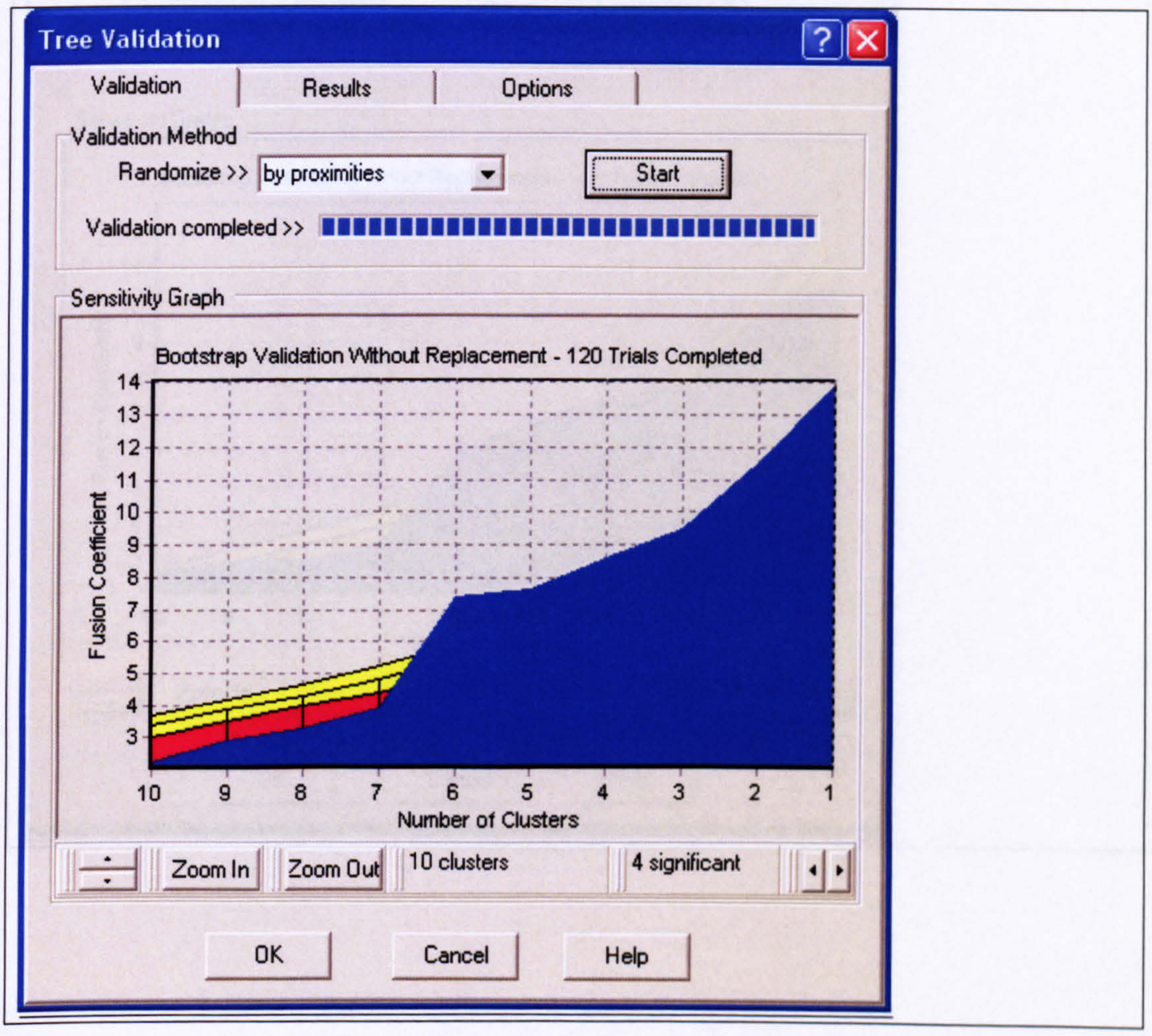
Table 18 Tree Validation Bootstrapping Results – Non Standardized Data – SSTP2 Full Set of Variables

Clusters	Fusion Values	Cumul. ESS	Random Means	Cumul. ESS	Absolute Diff.	Random St.Devs.	Standard Errors	t Statistics
28	1.817	1.817	2.193	2.193	0.376	1.191	0.315	3.439
27	1.882	3.699	3.551	5.744	1.67	1.396	1.196	13.043
26	2.43	6.129	4.652	10.396	2.222	1.651	1.346	14.679
25	2.434	8.563	5.769	16.164	3.335	1.685	1.979	21.586
24	2.525	11.088	6.974	23.138	4.449	1.905	2.335	25.476
23	11.549	22.636	8.177	31.315	-3.372	2.101	-1.605	-17.51
22	12.478	35.115	9.536	40.851	-2.943	2.305	-1.277	-13.926
21	13.045	48.16	11.145	51.995	-1.901	2.603	-0.73	-7.966
20	13.52	61.68	13.055	65.051	-0.464	3.025	-0.154	-1.675
19	14.373	76.053	15.326	80.377	0.953	3.453	0.276	3.011
18	18.535	94.589	17.697	98.074	-0.838	3.792	-0.221	-2.412
17	20.123	114.712	20.501	118.575	0.378	4.247	0.089	0.97
16	20.989	135.701	24.169	142.743	3.179	5.241	0.607	6.618
15	28.356	164.057	28.784	171.527	0.428	6.126	0.07	0.762
14	45.38	209.437	34.225	205.752	-11.155	6.87	-1.624	-17.711
13	49.438	258.875	41.486	247.238	-7.952	8.091	-0.983	-10.722
12	55.625	314.5	49.552	296.79	-6.073	9.197	-0.66	-7.203
11	55.679	370.179	60.113	356.903	4.434	12.646	0.351	3.825
10	63.9	434.079	77.807	434.71	13.907	16.028	0.868	9.465
9	145.503	579.581	103.955	538.666	-41.548	22.988	-1.807	-19.716
8	146.008	725.59	139.924	678.59	-6.084	27.411	-0.222	-2.421
7	170.921	896.51	185.722	864.312	14.802	37.673	0.393	4.286
6	174.948	1071.458	260.156	1124.468	85.208	64.117	1.329	14.497
5	258.458	1329.917	389.651	1514.119	131.192	68.861	1.905	20.783
4	619.993	1949.91	577.419	2091.538	-42.574	70.95	-0.6	-6.546
3	833.54	2783.45	784.672	2876.21	-48.869	135.015	-0.362	-3.948
2	1968.141	4751.591	1750.243	4626.453	-217.898	189.275	-1.151	-12.558
1	2137.34	6888.931	2262.479	6888.932	125.139	170.153	0.735	8.023

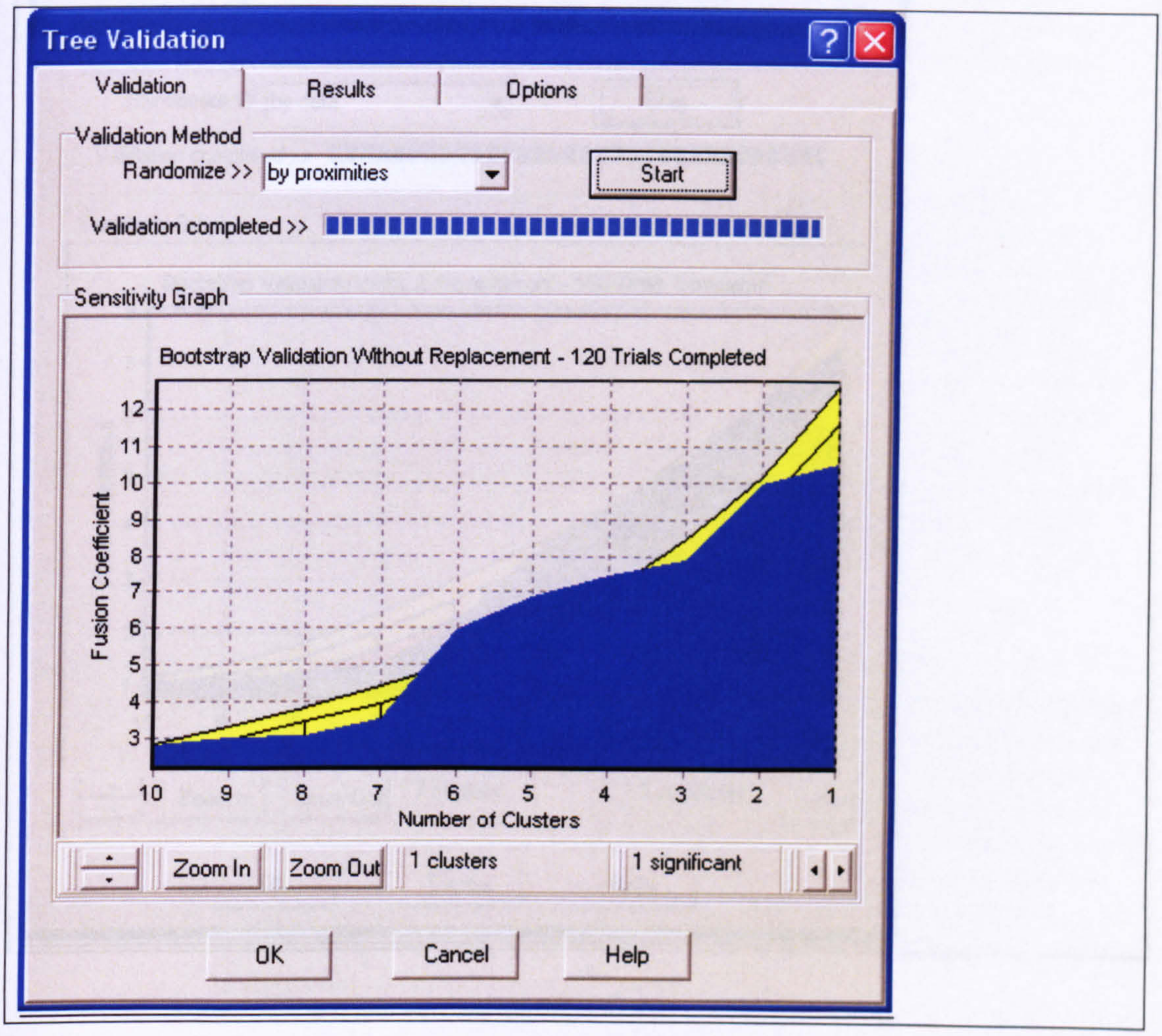
APPENDIX B

Bootstrap Validation Applied to Proximity Data.

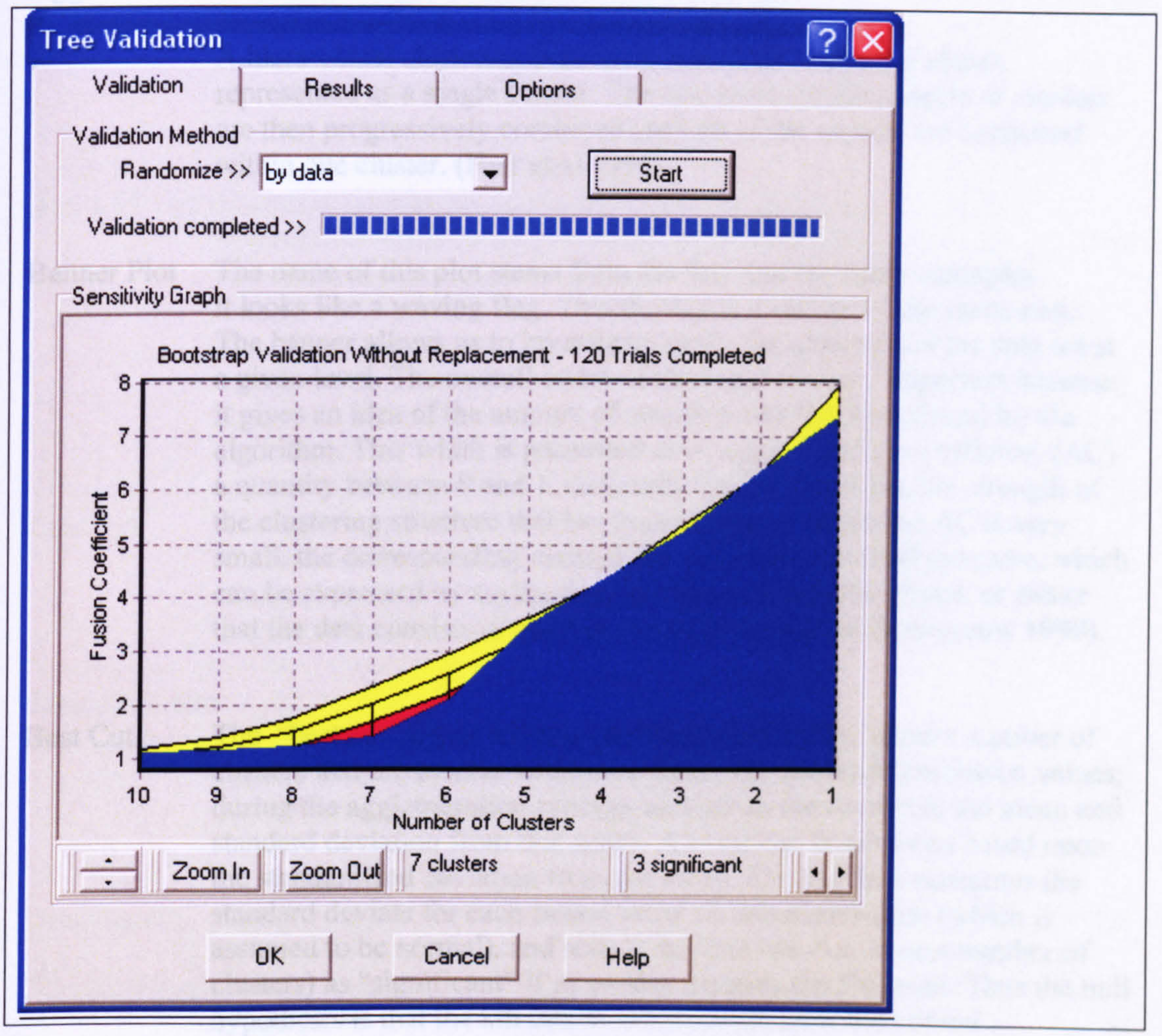
1993-1994 Proximity Data



1996 Proximity Data



1997 Proximity Data



APPENDIX C STATISTICAL GLOSSARY

Agglomerative Method

A hierarchical clustering procedure that starts with each object represented as a single cluster. The two most similar objects or clusters are then progressively combined until all of the objects are contained within one cluster. (Hair et al 1998)

Banner Plot The name of this plot stems from the fact that for many examples it looks like a waving flag. This display is a variant of the icicle plot. The banner allows us to investigate easily the structure of the data set at a given level. The overall width of the banner is very important because it gives an idea of the amount of structure that has been found by the algorithm. This width is presented as an agglomerative coefficient (AC) a quantity between 0 and 1. Generally the AC describes the strength of the clustering structure that has been obtained. When the AC is very small, the corresponding method has not found a natural structure, which can be expressed by saying that no clusters have been found, or rather that the data consists of one big cluster (Kaufman & Rousseeuw 1990).

Best Cut The "best cut" upper tail rule provides a test for the correct number of clusters that are present within the data. This test takes the fusion values, during the agglomeration process, as a series the computes the mean and standard deviation from this series. A t-statistic is produced based upon the standardized deviation from the mean. The test then computes the standard deviate for each fusion value on this distribution (which is assumed to be normal), and selects the first one (i.e. lowest number of clusters) as "significant" if its t-value exceeds the 5% level. Thus the null hypothesis is that the kth fusion value comes from the normal distribution of fusion values (Wishart, 2004).

Bootstrap Validation

It is often argued that cluster analysis always finds clusters even where there is no true structure present within the data. The bootstrap tree validation method starts with the assumption that we expect to find structure within the data and to search for partitions that mark the greatest departure from random. In statistical terms, we therefore test the null hypothesis that the structure displayed by a partition of a given tree is random, and seek to reject the hypothesis.

For a proximity matrix this is accomplished by destroying any structure that it contains by randomizing the proximities. Alternatively, we can randomize the input data, construct a proximity matrix from it and hence obtain a tree. Having obtained a randomised variant of either our original

data or our proximity matrix, this process is repeated for a series of random trials. Each trial generates a different tree for the given data, in random order, and the series of trials provide both a mean tree and a confidence interval. We then compare the given tree with the randomised trees, looking for a significant departure from random. In this way we test the null hypothesis that the given data are random, and hence contain no structure (Wishart 2004).

Box's M Test Statistical test for the equality of the covariance matrices of the independent variables across the groups of the independent variable. The test uses the generalized variances, that is, the determinants of the within-covariance matrices. If the statistical significance is greater than the critical level (e.g. 0.01), then the equality of the covariance matrices is supported. If the test shows statistical significance, then the groups are deemed to be different and the assumption of equality is violated. (Hair et al 1998)

Centroid Average or mean value of the objects contained in the cluster on each variable, whether used in the cluster variate or in the validation process. A cluster centroid therefore is the average value of the objects contained in the cluster on all the variables in the cluster variate. (Hair et al 1998)

Cluster Variate

Set of variables or characteristics representing the objects to be clustered and used to calculate the similarity between objects. (Hair et al 1998)

Dendrogram A graphical representation or "tree graph" used to display the results of a hierarchical clustering procedure. Starting with each object shown as a separate cluster, the dendrogram shows graphically how clusters are progressively combined until all are contained in a single cluster. (Hair et al 1998)

Divisive method

A clustering procedure that starts with all of the data combined within one cluster. This is then progressively divided into two clusters that contain the most dissimilar objects. (Hair et al 1998)

Euclidean distance

The distance between two objects defined as the hypotenuse of a right angled triangle drawn between two points.

Kruskal-Wallis One Way Analysis of Variance

The Kruskal-Wallis one way analysis of variance by ranks is the non-parametric alternative to one way analysis of variance. This technique tests the null hypothesis that the k samples come from the same population. (Siegel 1956).

Non-hierarchical procedure

Clustering procedure that produces only one cluster solution. This procedure starts with a set of cluster seeds, for example the cluster centroids or the tree partitions of a previous clustering procedure, these seeds are then used to group objects within a pre specified distance of the seeds. Non-hierarchical procedures, unlike hierarchical methods, do not produce all possible solutions, only the one requested solution. (Hair et al 1998)

Normal Distribution

Bell shaped symmetrical distribution grouped around the mean where 1 standard deviation either side of the mean includes 68% of the data and 1.96 standard deviations either side of the mean encompass 95%. It is an assumption of all parametric statistical methods that the data tested is drawn from a normal distribution. Also referred to as a Gaussian distribution.

Multicollinearity

The extent to which a variable may be explained by the other variables in the analysis. As multicollinearity increases this clouds interpretation because it is difficult to discern the effect of any single variable due to the inter-relationships between the variables. (Hair et al 1998)

Scree Test A graphical method where the magnitude of the eigenvalues (vertical axis) are plotted against their ordinal numbers (whether it was the first eigenvalue, the second, etc). Generally what happens is that the magnitude of successive eigenvalues drops off sharply (steep descent) and then tends to level off. The recommendation is to retain all eigenvalues (and hence components) in the sharp descent before the first one on the line where they start to level off. (Stevens 2002 p 389)

Ward's Method

A hierarchical clustering procedure where the similarity used to combine objects is represented by the sum of squares of the distance between the two objects summed over all variables. The result tends to be spherical clusters of a similar size. This is due to the minimization of within-group variation. Also called the increase in sum of squares method. (Hair et al 1998)

References

Aitken M, Holt F. 2000. A prescription for direct drug marketing. *McKinsey Quarterly* **2**: 82-91

Aldenderfer MS, Blashfield RK. 1984. *Cluster Analysis*. Sage Publications: London

Alvesson M, Deetz S. 2000. *Doing Critical Management Research*. Sage Publications: London

Anderberg MR. 1973. *Cluster Analysis for Applications*. Academic Press: New York

Andrews K. 1987. *The Concept of Corporate Strategy* (3rd ed.). Dow Jones-Irwin: Homewood Illinois

Athanassopoulos AD. 2003. Strategic Groups, Frontier Benchmarking and Performance Differences: Evidence from the UK Retail GRocery Industry. *Journal of Management Studies* **40**(4): 921-953

Atherton ST. 1998. Involving Clinical Professionals in Managing and Planning Services. *British Medical Journal* **316**: 379

Aventis. 2002. Annual Report:

Bain JS. 1959. *Industrial Organization*. Wiley: New York

Bain JS. 1968. *Industrial Organisation* (2nd Edition ed.). John Wiley: New York

Baird I, Kumar D. 1983. The Use of Financial Risk Measures in the Study of Strategic Groups. *Working Paper University of Illinois, Champaign*(January)

Ball D. 1992. Use and Development of PACT. In FO Wells (Ed.), *Medicines: Responsible Prescribing*: 25-35. Queen's University of Belfast: Belfast

Barney J, Hoskisson R. 1990. Strategic groups: Untested assertions and research proposals. *Managerial and Decision Economics* **11**: 187 -198

Barney JB. 1991. Firm resources and sustained competition. *Journal of Management* **17**(1): 99 - 120

Barney JB. 1997. *Gaining and Sustaining Competitive Advantage*. Addison Wesley

Bastianelli E, Jurg Eckhardt., Tierlynck O. 2001. Pharma: Can the middle hold? *McKinsey Quarterly*(Number 1): 117-125

Boeker W. 1991. Organisational Strategy: An Ecological Perspective. *Academy of management Journal* **34**(3): 613-635

Bogner WC. 1991. Patterns of intra-industry competition: A dynamic analysis of theoretical foundations of strategic groups: 513. University of Illinois at Urbana Champaign

Bogner WC, Howard Thomas., McGee J. 1996. A longitudinal study of the competitive positions and entry paths of European firms in the US Pharmaceutical industry. *Strategic Management Journal* **17**: 85-107

Bogner WC, Pandian JR, Thomas H. 1994. The firm specific aspects of strategic group dynamics. In H Daems, H Thomas (Eds.), *Strategic groups, strategic moves and performance*: 299-329. Pergamon: Oxford

Boston Consulting Group. 1993. The contribution of pharmaceutical companies: What's at stake for America?:

Boston Consulting Group. 1996. Sustaining innovation in U.S. pharmaceuticals. Intellectual property protection and the role of patents.:

Boston Consulting Group. 1999. The pharmaceutical industry into its second century: From serendipity to strategy.:

Boyce J, Lamont T. 1998. The New Health Authorities: Moving Forward, Moving Back? *British Medical Journal* **316**: 215

Brian S. Everitt, Sabine Landau, Morven Leese. 2001. *Cluster Analysis*. Arnold: London
Brown ER, Wyn R. 1996. Public Policies to Extend Health Care Coverage. In RM Anderson, TH Rice, GF Kominski (Eds.), *Changing the U.S. Health Care System: Key Issues in Health Services, Policy, and Management*: 41- 61. Jossey-Bass Publishers: San Francisco
Bryman A. 2001. *Social Research Methods*. Oxford University Press: Oxford
Bunch C. 1998. Challenging times for specialist services. *British Medical Journal* **316**: 378-381
Butler CA, PolischUK TM, Sullivan PJ, Patel RB. 2001. Rx Insight 2001. Lehman Brothers: New York
Butler T, Rowland M. 1998. How Will Primary Care Groups Work? *British Medical Journal* **316**: 214
Carroll GR, Swaminathan A. 1992. The organizational ecology of strategic groups in the American Brewing Industry from 1975 to 1990. *Industrial and Corporate Change* **1**: 65-97
Cartellieri C, Parsons AJ, Rao V, Zeisser MP. 1997. The real impact of internet advertising. *McKinsey Quarterly* **3**: 45-62
Caves R, Pugel T. 1980. *Intraindustry differences in conduct and performance viable strategies in US manufacturing firms.*: New York
Caves RE, Ghemawat P. 1992. Identifying Mobility Barriers. *Strategic Management Journal* **13**(January): 1-12
Caves RE, Porter ME. 1977. From entry barriers to mobility barriers: Conjectual decisions and contrived deterrence to new competition. *Quarterly Journal of Economics* **91**: 241 - 261
Chrisman JJ, Hofer CW, Boulton WR. 1988. Towards a system for classifying business strategies. *Academy of Management Review* **13**(No 3): 413-428
Cookson C. 2000. Double size, double complexity, *Financial Times*: 2: London
Cool K. 1985. Strategic Group Formation and Strategic Group Shifts . A Longitudinal Analysis of the US Pharmaceutical Industry. 1963-1982: 566. Purdue University
Cool K, Dierickx I. 1993. Rivalry, Strategic Groups and Firm Profitability. *Strategic Management Journal* **14**: 47 - 59
Cool K, Dierickx I, Martens R. 1994. Asset Stocks, Strategic Groups and Rivalry. In H Daems, and Howard Thomas (Ed.), *Strategic Groups, Strategic Moves and Performance*: 219-234. Pergamon
Cool K, Lars-Hendrik Roller, Leleux B. 1999. The relative impact on actual and potential rivalry on firm profitability in the Pharmaceutical industry. *Strategic Management Journal* **20**: 1-14
Cool K, Schendel D. 1988. Performance differences among strategic group members. *Strategic Management Journal* 9(3): 207 - 223
Cool KO, Schendel D. 1987a. Strategic Group Formation Additional Notes.
Cool KO, Schendel D. 1987b. Strategic Group Formation and Performance: The Case of the US Pharmaceutical Industry, 1963-1982. *Management Science* **33**(No 9): 1102-1124
Crown J. 1999. Review of Prescribing, Supply & Administration of Medicines. HMSO
Curto FF. 1998. Strategic Groups, Industry Structure and Firms' Strategies: Theory and Evidence from the UK Grocery Retailing Industry, *Warwick Business School*: 397. Warwick University: Warwick
Danzon PM. 1997. *Pharmaceutical Price Regulation: National Policies Versus Global Interests*. AEI Press: Washington D.C

Danzon PM, Epstein A, Nicholson S. 2004. Mergers and acquisitions in the pharmaceutical and biotech industries. *NBER Working paper series: Working paper 10536* **June**: 1-45
Davis P. 1997. *Managing Medicines. Public Policy and Therapeutic Drugs*. Open University: Buckingham
Dess G, Davis P. 1984. Porter's (1980) Generic Strategies as Determinants of Strategic Group Membership and Organizational Performance. *Academy of Management Journal*(No 3): 467 - 488
Dranove D, Peteraf MA, Shanley M. 1998. Do strategic groups exist? An economic framework for analysis. *Strategic Management Journal*(November): 1029-1044
Duyster G, Hagedoorn J. 1995. Strategic Groups and Inter-Firm Networks in International HIgh Tech Industries. *Journal of Management Studies* **32**(3): 359-381
Everitt BS, Landau S, Leese M. 2001. *Cluster Analysis*. Arnold: London
Fiegenbaum A. 1987. Dynamic Aspects of Strategic Groups and Competitive Strategy: Concepts and Empirical Examination in the Insurance Industry. University of Illinois, Champaign
Fiegenbaum A, Primeaux W. 1985. An Empirical Examination of the Dynamics of Strategic Groups. *Working Paper College of Commerce and Business Administration University of Illinois*(Number 1108)
Fiegenbaum A, Sudharshan D, Thomas H. 1987. The Concept of Stable Time Periods in Strategic Group Research. *Managerial and Decision Economics* **8**: 139-148
Fiegenbaum A, Sudharshan D, Thomas H. 1990. Strategic Time Periods and Strategic Groups Research: Concepts and an Empirical Example. *Journal of Management Studies* **27**(2): 133-148
Fiegenbaum A, Thomas H. 1990. Strategic Groups and Performance: The US Insurance Industry 1970-1984. *Strategic Management Journal* **11**(March-April): 197-215
Fiegenbaum A, Thomas H. 1995. Strategic Groups as Reference Groups: Theory, Modeling and Empirical Examination of Industry and Competitive Strategy. *Strategic Management Journal* **16**: 461-476
Fisher C. 2004. *Researching and writing a dissertation for business students*. Prentice Hall: Harlow
Galambos L. 2000. Global oligopoly, Regional Authority and National Power: Crosscurrents in Pharmaceuticals Today and Tomorrow. In HE Ketter (Ed.), *Consolidation and Competition in the Pharmaceutical Industry*: 18-28. Office of Health Economics: London
Gapper J. 2004. How big pharma stumbled in its quest for blockbusters, *Financial Times*: 21: London
Gordon AD. 1999. *Classification*. chapman & Hall/CRC Press: Boca Raton
Grabowski H, Vernon J. 2000. Pressures from the demand side: Changing market dynamics and industrial structures. In HE Ketter (Ed.), *Consolidation and Competition in the Pharmaceutical Industry*: 62-79. Office of Health Economics: London
Guedri Z. 1998. Performance variations among strategic group members in the Pharmaceutical Industry: An examination of individual sustainable growth capabilities, 1995-1997, *Faculty of Commerce and Administration*: 157. Concordia University: Montreal
Hair JF, Anderson RE, Tatham RL, Black WC. 1998. *Multivariate Data Analysis*. Prentice Hall: Upple Saddle River, New Jersey
Ham C. 1994. *Management and Competition in the New NHS*. Radcliffe Medical Press Ltd: Oxford

Ham C. 1997. The United Kingdom. In C Ham (Ed.), *Health Care Reform. Learning from International Experience*: 46-63. Open University Press: Buckingham
Ham C. 1998. Financing the NHS. *British Medical Journal* **316**: 212-213
Hannan MT, Freeman J. 1977. The Population Ecology of Organisations. *American Journal of Sociology* **82**(929-964)
Harrigan KR. 1979. Strategies for Declining Businesses. Harvard University
Hatten K. 1974. Strategic Models in the US Brewing Industry. Purdue University
Hatten K, Hatten ML. 1987. Strategic Groups, Asymmetrical Mobility Barriers and Contestability. *Strategic Management Journal* **8**(4): 329 - 342
Hatten KJ, Schendel D. 1978. Heterogeneity within an industry: Firm conduct in the US Brewing Industry, 1952-1971. *The Journal of Industrial Economics* **26**: 97-113
Hatten KJ, Schendel D, Cooper AC. 1978. A Strategic Model of the US Brewing Industry: 1952-1971. *Academy of Management Journal* **21**: 592-610
Hawes J, Crittenden W. 1984. A Taxonomy of Competitive Retailing Strategies. *Strategic Management Journal*(July - September): 275 - 287
Hawthorne F. 2003. *The Merck Druggernaut: the Inside Story of a Pharmaceutical Giant*. John Wiley & Sons: Chichester
Henderson R. 2000. Drug industry mergers won't necessarily benefit R&D. *Research Technology Management* July-August: 10-11
Henderson R, Cockburn I. 1994. Measuring competence? Exploring firm effects in pharmaceutical research. *Strategic Management Journal* **15**(Winter Special Issue): 63 - 84
Hepburn A. 1992. The Role of the Regional Health Authority in Primary Care Prescribing. In FO Wells (Ed.), *Medicines: Responsible Prescribing*: 91-99. Queen's University of Belfast: Belast
Hergert M. 1983. The incidence and implication of strategic grouping in the US manufacturing industries. Harvard University
HMSO. 1989. Working for Patients. The Governments White Paper
HMSO. 1997. The New NHS. The Governments White Paper
Hofer C, Schendel D. 1978. *Strategy Formulation: Analytical Concepts*. West Publishing: St Paul
Huff AS, Huff JO, Barr PS. 2000. *When firms change direction*. Oxford University Press: Oxford
Hunt MS. 1972. Competition In The Major Home Appliance Industry, 1960-1970. Harvard University: Cambridge, MA
IMS. 1996. Pharmaprognosis UK 1997-2002. IMS World Publications Ltd: London
IMS. 2001. *World Review*: London
IMS. 2003. Pharmaprognosis UK 2003-2007. IMS World Publications Ltd: London
IMS H. 1999. British Pharmaceutical Index. IMS Health Limited: Pinner, Middlesex
IMS H. 2002. British Pharmaceutical Index. IMS Health Limited: Pinner, Middlesex
Kaufman L, Rousseeuw PJ. 1990. *Finding groups in data* (First ed.). John Wiley and Son: New York
Kay J. 2000. Changes in market structure: the economic issues. In HE Ketter (Ed.), *Consolidation and Competition in the Pharmaceutical Industry*: 9-17. Office of Health Economics: London
Ketchen DJ, Shook CL. 1996. The Application of Cluster Analysis in Strategic Management Research: An Analysis and Critique. *Strategic Management Journal* **17**: 441-458

Kim L, Lim Y. 1988. Environment: Generic Strategies and Performance in a Rapidly Developing Country: A Taxonomic Approach. *Academy of Management Journal* **31**(4): 802-827
Kling JA, Smith KA. 1995. Identifying Strategic Groups in the U.S. Airline Industry: An Application of the Porter Model. *Transportation Journal*(Winter): 26-34
Leask G. 2002. Open Sesame. *Pharmaceutical Marketing* **14**(7): 32-34
Leask G, Parker D. 2003a. An Application of Strategic Group Theory to the UK Pharmaceutical Industry., *Aston Working Paper*: 1-17: Birmingham
Leask G, Parker D. 2003b. Strategic Group Theory: Still a Rich Research Vein or Simply a Worn Out Old Seam?, *Aston Working Paper*: 1-32: Birmingham
Lee J. 2003. Innovation and Strategic Divergence: An Empirical Study of the U.S. Pharmaceutical Industry from 1920 to 1960. *Management Science* **49**(2): 143-159
Lee J, Lee K, Rho S. 2002. An Evolutionary Perspective on Strategic Group Emergence: A Genetic Algorithm Model. *Strategic Management Journal* **23**: 727-746
Lehman Brothers. 2003. Rx Insight 2003. Lehman Brothers Global Equity Research: New York
Lehman-Brothers. 2002. Pharma Pipelines. Lehman Brothers: London
Licht MH. 2000. Multiple regression and correlation. In Lawrence G. Grimm, Paul R. Yarnold (Eds.), *Reading and understanding multivariate statistics*: 19-64. American Psychological Association: Washington
Light DW. 1998. Is NHS Purchasing Serious? An American Perspective. *British Medical Journal* **316**: 217-220
Linnaeus C. 1756. *Systema Naturae* (Ninth edition ed.). Theodor Haak: Leiden
Lunn J. 1989. R&D, concentration and advertising: A simultaneous equations model. *Managerial and Decision Economics* **10**(2): 15-19
Macdonald S. 2003. Increased Drug Spending is Creating Funding Crisis, Report says. *British Medical Journal* **326**(29 March 2003): 677
Martens R. 1988. Strategic Group Formation and Performance. The Case of the Pharmaceutical Industry in Five E.C. Countries 1978-1985, *Faculty of Applied Economics*: 402. UFSIA Antwerp University: Antwerp
Mascarenhas B. 1989. Strategic Group Dynamics. *Academy of Management Journal* **32**(2): 333-352
Mascarenhas B, Aaker DA. 1989. Mobility Barriers and Strategic Groups. *Strategic Management Journal* **10**: 475-485
Mason E. 1939. Price and Production Policies of Large Scale Enterprises. *American Economic Review*(March): 61-74
Mason E. 1949. The current state of the monopoly problem in the US. *Harvard Law Review* **62**: 1265-1285
Mayor S. 2002. NICE Estimates That Its Recommendations Have Cost The NHS £575m. *British Medical Journal* **325**(26th October): 924
McGee J. 1985. Strategic Groups: A Bridge Between Industry Structure and Strategic Management. In H Thomas, D Gardner (Eds.), *Strategic Marketing and Management*: 293-314. John Wiley & Son: Chichester
McGee J. 2003. Strategic Groups: Theory and Practice. In DO Faulkner, A Campbell (Eds.), *The Oxford Handbook of Strategy: A Strategy Overview and Competitive Strategy*, Vol. 1: 261-301. Oxford University Press: Oxford
McGee J, Thomas H. 1986. Strategic Groups: Theory, Research and Taxonomy. *Strategic Management Journal*(March-April 1986): 141-160
McKelvey B. 1982. *Organizational systematics. Taxonomy, evolution, classification.* University of California Press: Los Angeles

McKillop T. 2004. An Enlightened Market. *Pharma Times*(May): 49-50
McNamara G, Deephouse DL, Luce RA. 2003. Competitive Positioning Within and Across a Strategic Group Structure: The Performance of Core, Secondary and Solitary Firms. *Strategic Management Journal* **24**(2): 161-181
McNeil R. 1996. Pharmaceutical Strategies: Class Acts, *Financial Times Pharmaceutical and Healthcare Publishing - Management Reports*: 170. Financial Times: London
Mehra A, Floyd SW. 1998. Product market Heterogeneity, Resource Imitability and Strategic Group Formation. *Journal of Management* **24**(4): 511-531
Miles RE, Snow CC. 1978. *Organizational Strategy, Structure and Process*: McGraw Hill
Morrison DG. 1967. Measurement problems in cluster analysis. *Management Science* **13**(12): 775-780
Nair A, Filler L. 2003. Cointegration of Firm Strategies Within Groups: A Long Run Analysis of Firm Behaviour in the Japanese Steel Industry. *Strategic Management Journal* **24**(2): 145-159
Newman H. 1973. Strategic Groups and the Structure conduct Performance Relationship: A study with respect to the Chemical Process Industries. Harvard University
Osborne JD. 1996. Strategic Group Antecedents: Thematic Groups in the Pharmaceutical Industry, *Department Of Management*: 155. Southern Illinois University: Carbondale
Osbourne DJ. 1996. Strategic Group Antecedents: Thematic Groups in the Pharmaceutical Industry 1963-1982, *Department of Management*. Graduate School Southern Illinois University: Carbondale
Oster S. 1982. Intraindustry structure and the ease of strategic change. *Review of Economics and Statistics* **LXIV**(August): 376-383
Oster SM. 1994. *Modern Competitive Analysis*. Oxford University Press: New York
Parston G, McMahon L. 1998. A third way? England - yes; Scotland - maybe. *British Medical Journal* **316**: 213
Patton G. 1976. A Simultaneous Equation Model of Corporate Strategy: The Case of the U.S. Brewing Industry. Purdue University
Pegels CC, Sekar C. 1989. Determining Strategic Groups Using Multidimensional Scaling. *Interfaces* **19**(3): 47-57
Pilling D. 1999. In a state over drugs for the elderly:, *Financial Times*, London Edition ed.: 19: London
Podger G. 1992. The Indicative Prescribing Scheme. In FO Wells (Ed.), *Medicines: Responsible Prescribing*: 7-12. Queen's University of Belfast: Belast
Porac JF, Thomas H, Baden-Fuller CWF. 1989. Competitive Groups as Cognitive Communities: The Case of the Scottish Knitwear Manufacturers. *Journal of Management Studies* **26**: 397-416
Porac JF, Thomas. H, Baden-Fuller CWF. 1994. Competitive Groups as Cognitive Communities: The Case of Scottish Knitwear Manufacturers. In H Daems, H Thomas. (Eds.), *Strategic Groups, Strategic Moves and Performance*: 117-137. Elsevier Science Ltd: Oxford
Porter AD. 1993. *Pharmaceutical Equities: Evaluation and Trading*. Woodhead Publishing Limited: Cambridge
Porter ME. 1973. Consumer Behavior, Retailer Power, and Manufacturer Strategy in Consumer Goods Industries. Harvard University

Porter ME. 1976. *Interbrand Choice, Strategy, and Bilateral Market Power*. Harvard University Press: Cambridge, Massachusets
Porter ME. 1979. The structure within industries and companies' performance. *Review of Economics and Statistics*(May): 602-613
Porter ME. 1980. *Competitive Strategy. Techniques for Analyzing Industries and Competitors*. Free Press: New York
Primeaux WJ. 1985. A Method for Determining Strategic Groups and Life Cycle Stages of an Industry. In H Thomas, D Gardner (Eds.), *Strategic Marketing and Management*: 315 - 328. John Wiley & Sons: Chichester
Punj G, Stewart DW. 1983. Cluster analysis in marketing research: Review and suggestions for application. *Journal of Marketing Research* **XX**(May): 134-148
Pursche WR. 1996. Pharmaceuticals - the consolidation isn't over. *McKinsey Quarterly*(Number 2): 110-119
Ramsler M. 1982. Strategic groups and foreign market entry. Entry in global banking competition. Harvard University
Reger R. 1988. Competitive Positioning in the Chicago Banking Market: Mapping the Mind of the Strategist. University of Illinois, Champaign
Rosleff F, Lister G. 1995. European healthcare trends: towards managed care in Europe, *Solutions for Business*: 92. Coopers & Lybrand
Ryans A, Wittinck D. 1985. Security Returns as a Basis for Estimating the Competitive Structure of an Industry. In H Thomas, D Gardner (Eds.), *Strategic Marketing and Management*: 329 - 346. John Wiley & Sons: Chichester
Schendel D, Patton R. 1978. A Simultaneous Equation Model of Corporate Strategy. *Management Science* **24**(No 15): 1611-1621
Scherer F. 1980. *Industrial Market Structure and Economic Performance*. Rand McNally: Chicago
Siegel S. 1956. *Nonparametric statistics for the behavioural sciences*. McGraw Hill: London
Sjorstrom JCF. 1994. Corporate effects on industry competition. A strategic groups analysis., *Faculty of social studies*: 585. University of Oxford: Oxford
Smith K, Grimm C. 1987. Environmental Variation, Strategic Change and Firm Performance: A Study of Railroad Deregulation. *Strategic Management Journal* **8**(No 4): 363 - 376
Smith KG, Guthrie JP, Chen M-J. 1989. Strategy, Size and Performance. *Organization Studies* **10**(1): 63-81
Sokal RR, Sneath PHA. 1963. *Principles of Numerical Taxonomy*. W H Freeman and Company: San Francisco
Stevens JP. 2002. *Applied multivariate statistics for the social sciences* (Fourth ed.). Lawrence Erlbaum Associates: London
Tabachnick BB, Fidell LS. 2001. *Using Multivariate Statistics* (Fourth ed.). Allyn & Bacon: Needham Heights
Tang M-J, Thomas H. 1992. The Concept of Strategic Groups: Theoretical Construct or Analytical Convenience. *Managerial and Decision Economics* **13**: 323-329
The Boston Consulting Group. 2000. New Perspectives on Value Creation: 59
Thomas H, Venkatraman N. 1988. Research on Strategic Groups: Progress and Prognosis. *Journal of Management Studies* **25**(6): 537-555
Thomas. H, Carroll C. 1994. Theoretical and Empirical Links Between Strategic Groups, Cognitive Communities and Networks of Interacting Firms. In H Daems, H Thomas (Eds.), *Strategic Groups, Strategic Moves and Performance*: 7-29. Elsevier Science Ltd: Oxford

Tomlinson H. 2004. Business: GSK wins battle over executive pay packages, *The Guardian*: 17: London
Voyer JJ. 1993. Pharmaceutical industry strategic groups based on cognitive maps, *Academy of Management Proceedings*: 5
Voyer. JJ. 1993. Pharmaceutical Industry Strategic Groups Based on Cognitive Maps, *Academy of Management Conference*: 1-19: Atlanta
Wailoo A, Roberts J, Brazier J, McCabe C. 2004. Efficiency, Equity and NICE Clinical Guidelines. *British Medical Journal* **328**(6th March 2004): 536-537
Walton J. 2000. Investors' views on merger and acquisition, alliance and licensing activity in the Pharmaceutical Industry. In HE Ketter (Ed.), *Consolidation and Competition in the Pharmaceutical Industry*: 80-101. Office of Health Economics: London
Wernerfelt B. 1984. A resource based view of the firm. *Strategic Management Journal* 5(2): 171 - 180
Wishart D. 2004. *ClustanGraphics Primer* (Third Edition ed.). Clustan Limited: Edinburgh
Yelland D. 2004. Drug company finds the right remedy for fat-cat headlines; The message; Media and marketing, *The Times*: 35: London
Yuen P. 2002. OHE Compendium of Health Statistics. Office of Health Economics
Zuniga-Vicente JA, de la Fuente-Sabate JM, Rodriguez-Puerta J. 2004a. A Study of Industry Evolution in the Face of Major Environmental Distrurbances: Group and Firm Strategic Behaviour of Spanish Banks, 1983-1997. *British Journal of Management* **15**: 219-245
Zuniga-Vicente JA, de la Fuente-Sabate JM, Suarez Gonzalez I. 2004b. Dynamics of the strategic group membership-performance linkage in rapidly changing environments. *Journal of Business Research* **57**: 1378-1390