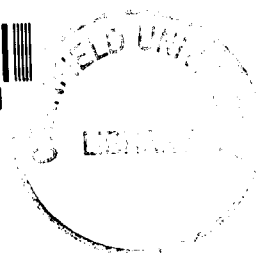




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**SWP 29/88 A SPATIAL ANALYSIS OF NEW
MANUFACTURING FIRM FORMATION
IN WALES, 1979 - 1983**

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A SPATIAL ANALYSIS OF NEW MANUFACTURING FIRM FORMATION IN WALES, 1979-1983.

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The spatial pattern of new manufacturing firm formation in Wales over the 1979-1983 period is detailed. In order to understand spatial differences in formation rates new firm formation theory was referred to and a range of hypotheses presumed to be associated with the firm formation process were explored using correlation and regression analysis. High rates of new firm formation were found to be closely associated with aspects of rurality, high levels of self-employment and a tradition of employment in small plants.

VARIATIONS IN NEW MANUFACTURING FIRM FORMATION RATES.

New manufacturing firms have in the last few years become an increasingly important focus of academic debate and government policy in Britain as in other advanced capitalist industrial countries. Indeed, in terms of job generation and through their postulated role in fostering healthy and diverse local economies in large part as a result of the work of Birch (1979), they have been viewed by some commentators as a key to national economic recovery in the long run and a panacea for all economic problems. This has served to increase both policy interest and research in the economic role of new firms and differences in rates of formation from place to place and from sector to sector in the economy (Frank et al., 1984).

Building upon the work of Mason and Harrison (1985), Johnson (1986), Mason (1987) and Watts (1987) there is a need for more detailed research into the nature and extent of spatial variations in new manufacturing firm formation rates; not least because such information is an essential prerequisite in justifying the case for a spatially selective small firms policy (Storey, 1982). For example, Gudgin and Fothergill (1984) have argued that one of the reasons for the persistence of employment decline in some of the peripheral regions in the UK is due to their low rate of new firm

creation and that it is difficult to devise policies to correct this geographical imbalance without an understanding of its causes. Frank et al. (1984) concluded that there is a shortage of up-to-date information on new firm formation rates at a sufficiently disaggregated level both sectorally and spatially. The objective of this paper is to present the results of an analysis of new manufacturing firm formation rates at a disaggregated spatial level in Wales. The focus on new manufacturing firms is due to two main reasons. First, manufacturing firms form part of the 'basic' industrial base in a local labour market area (Fothergill and Gudgin, 1982, p.34-37). Second, in the 1980s manufacturing employment change emerged as the dominant influence upon unequal growth in the UK (Fothergill and Gudgin, 1982, p.46). In this paper new firm formation theory is referred to and a range of hypotheses presumed to be associated with the firm formation process are explored

PREVIOUS RESEARCH

Three areas of general agreement on the subject of new firm formation exist. First, national level new firm policies have only limited significance, at least for the medium term, for industrial restructuring and job generation (Gould and Keeble, 1984; Lloyd and Mason, 1984). Second, there are real differences between regions in terms of the numbers of small firms, birth rates, performance and potential contribution to economic development (Storey, 1982; Lloyd and Mason, 1984; Whittington, 1984). Third, new and small firms policies risk being regionally divisive, in the sense that the currently prosperous regions are likely to benefit disproportionately from incentives designed to encourage new firm formation (Storey, 1982; Whittington, 1984).

Beyond this however major differences have arisen between researchers over the factors which 'explain' these regional differences. For example, Whittington (1984) concluded that variations in birth rates of new firms were positively associated with home ownership and negatively associated with the proportion of the population in manual occupations. Gould and Keeble (1984) asserted that, after local industrial structure, the chief determinant of rates of new firm formation was the occupational structure of the workforce. These views contrast with those presented by Gudgin and Fothergill (1984) using data for the East Midlands and Northern England who argued that simple correlations between formation rates and occupational structure are spurious when no account is taken of rural-urban differences, and that the existing size distribution of enterprise is the most relevant variable. Their

results were confirmed by O'Farrell and Crouchley (1984) using data for the Republic of Ireland. Moreover, O'Farrell and Crouchley (1984, p.23) concluded, "An analysis of spatial variations in new firm formation rates should help to identify some of those characteristics of local economies ('or labour markets') which stimulate or inhibit the rate of new firm births".

FACTORS

The research outlined above has indicated that a major objective in new manufacturing firms research is the identification of independent factors which may be associated with the new manufacturing firm process, and in what ways their influences on, or relationship to, local 'incubator environments' (or labour markets) can be assessed. Some analysts of the new firm formation process, especially non-geographers, have found the concept of the environment elusive but not particularly bothersome. Cooper (1970, 1971, 1973), for example, felt he could leave respondents in Santa Clara County, California free to define 'local' as they thought fit. The 'Cambridge Phenomenon' (Segal, Quince and Partners, 1985) is defined in a territorial sense as encompassing where spinoffs from firms in Cambridge have taken root. The resultant nebular diffusion around a highly productive breeding ground may be perhaps be dismissed simply as 'neighbourhood' effect but this does not explain much about how replicable these new firm clusters might be, nor why some other areas do not have as high new firm formation rates. Cross (1981, p.247) argued that, "...the role of the labour market would appear to be of importance in the process of new firm formation". A working presumption adopted in this paper is that most new firms locate close to the founders' place of residence, at least in the earliest days of a new firm (Johnson and Cathcart, 1979; Gudgin, 1978, p.105; Scott, 1976, p.136). The spatial framework adopted is that of the Revised (1978) Travel-to-Work Areas (TTWAs) the daily urban system which attempts to define areas within which the majority of most people's activities are acted out, in which they search for work, education and leisure - and by extension premises.

Table 1 below lists the factors found in the research literature to be associated with new manufacturing firm formation and the surrogate variables used. Some inhibit individuals from new firm formation whilst others are more permissive.

Rurality

Researchers have reported higher rates of new firm formation in rural areas than in older industrial towns (Gudgin, 1978; Fothergill and Gudgin, 1979, 1982; Gudgin et al., 1979; Cross, 1981; Mason, 1982; O'Farrell and Crouchley, 1984; Gould and Keeble, 1984). Undoubtedly, the residential attractiveness of particular rural areas play a significant role. Indeed, this could of course be the chief explanation of rural bias in new firm formation because rural areas have tended disproportionately to attract managers and higher income workers for reasons of residential amenity and the perceived benefits of living in historic villages and attractive countryside. Also, a relatively large agricultural sector might enhance the new firm formation rate in manufacturing since farmers have direct experience of self-employment and at the present time agricultural employment is continuing to decline throughout Wales thereby adding to the supply of potential entrepreneurs (O'Farrell and Crouchley, 1984).

Entry Into Industry

Cross (1981) has suggested one of the fundamental variables conditioning such spatial variations in the nature of the local labour market was a supply-side factor determining the potential availability of new firm founders. In general terms, new firm formation tends to be low in those regions which specialise in traditional heavy industries, especially where a small number of large plants dominate the local labour market (Chinitz, 1961). In fact, the role of an area's existing mix of industries in influencing subsequent industrial change is well recognised (Gudgin, 1978; Cross, 1981; Gould and Keeble, 1984). At a labour market level the combination of industrial structure, industrial diversification and concentration and the varying propensity to generate new firms may have an important bearing on subsequent labour market firm formation rates. Checkland (1981) has argued in his study of West Central Scotland that the failure of this area to generate indigenous new firms was because of the traditional concentration on shipbuilding and heavy engineering created a milieu in which other kinds of activities were unable to take root. Using the analogy of the legendary 'upas tree' which was believed to have the power to destroy other growths for a radius of fifteen miles under its shade, Checkland has claimed that "the upas trees of heavy engineering killed anything that sought to grow beneath its branches (ibid, p.12). In such settings as these, therefore, local populations have neither the opportunity and incentive nor do they develop the skills needed to set up new businesses. Despite the continued contraction of the 'upas trees' of traditional heavy industrial complexes they still have an

influence on local entrepreneurial climates if only by virtue of the fact that most new businesses are likely to be imitative. Therefore, at the TTWA level the combination of industrial structure and the varying propensity of different industrial sectors to generate new firms may have an important bearing on subsequent TTWA new firm formation rates.

Industrial Specialisation

In his study of new manufacturing firm formation at a local office area level in Scotland Cross (1981, p.261-62) hypothesised that if an area had a diverse manufacturing employment base (a low entropy specialisation Tress statistic), the greater the number of new firms would be found in that area. He claimed that a Tress statistic could be used as a measure of industrial concentration. However, Cross (1981, p.276) found contrary to expectation that industrial specialisation was positively associated with new firm formation at a local office area level.

Degree of Local Autonomy

It is possible to argue that the incentives given by regional policy to encourage externally-owned branches to move to areas of traditional heavy industry may have further stunted indigenous enterprise. Increasing external ownership may decrease the number of risk-taking managerial positions which reduces the potential supply of founders (Johnson and Cathcart, 1979, p.278; O'Farrell and Crouchley, 1984, p.229). Conversely, complete in-transfers of small or medium sized companies may introduce a considerable number of potential firm founders from growth industries (Keeble, 1976; Gould and Keeble, 1984, p.197) and with appropriate experience for entrepreneurship in particular localities may over time engender high firm formation rates. Therefore, the nature of ownership of an establishment can be used as a possible surrogate measure of managerial function carried out at an establishment. In fact, as suggested above, it could be claimed that independent local establishments could contain a higher number of risk-taking positions than, say, a branch or subsidiary establishment.

Size of 'Incubator' Firm

There does appear to be a relationship between an area's plant size structure and its rate of new firm formation. Employees who work in small firms it is argued appear more likely to set up a new business than those working in large firms (Cooper, 1971; Johnson and Cathcart, 1979; Gudgin et al., 1979;

Fothergill and Gudgin, 1982; Storey, 1982; Lloyd and Mason, 1983; Gudgin and Fothergill, 1984; Gould and Keeble, 1984, p.124-28; O'Farrell and Crouchley, 1984; but see Beesley, 1955, for a dissenting view). It is suggested that employees working in large factories are not provided with the relevant work experience necessary for entrepreneurial training and encouragement. In contrast, the presence of a very active small firm sector can provide plenty examples for potential founders to follow. For example, contacts with other small firms may be made as part of an employee's job and informal contacts with potential and actual founders may be more likely. Therefore, employment in a small firm is assumed to be a better preparation for founding a business because of the likely wider range of task experience derived, the opportunity for regular contact with the director (who may also be the founder) and the lower levels of salaries, fringe benefits and job security than in large firms. Although entry rates may be a function of the proportion of small plants and employees working in small plants in an area, a higher percentage of small plants and small plant employees may be the result of higher entry rates in the past. The population density of an area may directly influence the size of plants. Low population density areas attract relatively fewer large plants partly because a small town or village catchment cannot provide the quality and quantity of labour required. Hence, less urbanised labour markets will possess a higher proportion of small plants. The size factor is a catch-all for several plausible influences and, therefore, care must be exercised in interpreting its implications (O'Farrell and Crouchley, 1984, p.231).

Occupational Experience

While the size of an enterprise may itself have an impact on the propensity of its workforce to acquire skills and attitudes essential for small business initiation and management, this represents only one of a whole cluster of correlated variables which influence the nature of work experience and its opportunities for the varied demands levied by small firm management. The skills and employment circumstances of potential founders are also likely to differ across TTWAs. Such differences may have implications for formation rates. The labour force of an industry in one TTWA may consist largely of unskilled workers while the same industry in another TTWA may have a relatively high percentage of professional and managerial workers. The latter may be more aware of potential profitable new business ideas and may be better equipped to see these ideas through to commercial fruition (Johnson, 1986). There is evidence to suggest that skilled manual workers are better equipped than

unskilled and semi-skilled workers for small firm entrepreneurship because they acquire more of the problem-solving skills required, while management and professional employees, particularly where they have had some responsibility for financial matters or some involvement with marketing and sales, seem to be better equipped than manual workers to start a business, though not necessarily to turn out a good product (Cross, 1981; Fothergill and Gudgin, 1982; Storey, 1982; Lloyd and Mason, 1983; Gould and Keeble, 1984). In the broader context, therefore, another of the general variables conditioning the supply potential of suitable new firm founders is the occupational spectrum of a region. Where the majority of the enterprises are small, the occupational spectrum (the balance of management to skilled and production line workers) will tend to reflect this (Storey, 1982), reinforcing the observed propensity for traditional small firm areas to have good rates of new firm formation. Where, however, the local industrial base is dominated by large corporate enterprises (the majority of which may be multinational enterprises), the mix of skills may well be antithetic to the requirements for entrepreneurship.

Self-Employment

O'Farrell and Crouchley (1984), Pickles and O'Farrell (1987) and O'Farrell (1986) have postulated outside the manufacturing sector itself, the greatest pool of new firm founders probably exists among the economically active self-employed persons.

Turbulence

The supply of potential firm founders may also be increased due to large-scale contraction and redundancy of manufacturing employees, a number of which may not have an alternative source of employment, other than self-employment by founding a business for themselves. Employment loss in closures may be a suitable surrogate for this turbulence factor (Cross, 1981; Storey and Jones, 1987).

Education

Another conditioning variable associated with new firm formation is the level of educational attainment in a labour market. But it must be stated that there is no simple and clear relationship between higher levels of education leading to an increased propensity to establish new firms. However, it has been suggested that firms started by those with a management background, particularly if they have a

degree or a professional qualification, show the fastest rates of growth (Fothergill and Gudgin, 1982). Some observers have argued that academic qualifications are a necessary but not a sufficient condition for entrepreneurial success (Storey, 1982, p.107). In a sample of manufacturing founders who had established new firms in the Irish Republic between 1977 and 1981 O'Farrell (1986) observed that individuals with higher levels of educational attainment had a greater probability of founding a new manufacturing firm. Also, Keeble and Gould (1985) have suggested that the higher level of new firm formation and survival in East Anglia is in part due to the higher education levels of founders in East Anglia.

Access to Capital

Often prior work experience has provided an awareness of sources of outside finance and of the conventions necessary in presenting successful cases for loan funds. At a personal level, many will have accumulated adequate collateral against which loans can be served (Cross, 1981; Storey, 1982). By contrast, many new businesses which are started by those with basic education and manual rather than professional backgrounds display low rates of growth, not least because of the limited aspirations of their founders, their lack of personal capital and their frequent reluctance to use outside sources of finance. Such differences in the creditworthiness and access to personal and institutional finance will feed forward to condition levels of launch (Storey, 1982; Whittington, 1984). Higher returns from both second mortgages and from the use of the domestic home as collateral for a bank loan has the effect of raising the threshold of personal capital availability in those regions with relatively higher housing values. On the other hand the cost of entry may correspondingly be higher too. At the present time redundancy payments may provide the role of risk funds for a putative new founder to invest them in his own enterprise rather than insecure savings funds.

Market Demand

Particular industrial, occupational and plant-size characteristics give a TTWA its own distinctive features which can influence new firm formation but it must be borne in mind that there are other aspects of the environment which influence new enterprise development. Most new firms serve local and regional market areas (Johnson and Cathcart, 1979; Storey, 1982; Lloyd and Mason, 1984; O'Farrell and Crouchley, 1984). Relatively few first-time enterprises are set up on a basis of a product

of their own and most are engaged in sub-contract work for larger companies and institutions (Gudgin, 1978). On both counts, therefore, the rate of new firm formation and the subsequent growth of such enterprises will tend to be significantly influenced by the level of final and intermediate demand in the local and regional economy which itself will rest upon the performance of corporate 'prime-movers' and public sector agencies. The expansion of a labour market's total and manufacturing employment bases and increased local population demand may lead to the opening up of new markets and expand existing ones thereby providing opportunities for new firms. Rising total and manufacturing employment and local population will also increase the pool from which new firm founders are most likely to emerge (Cross, 1981, p.263). However, the growing scale of branch plant activities in their economies may modify this situation because outsourcing produces little locally-orientated demand to stimulate the growth of local small enterprise (Lever, 1974; Mc Dermott, 1976; Hoare, 1978; Marshall, 1979) (Factor 4 in Table 1).

Premises

The availability and low cost of premises have been identified (Fothergill and Gudgin, 1982) as being factors which are conducive to enterprise development. The premises issue has in recent years been influenced by development agencies who have been actively involved in constructing and supplying a variety of premises in terms of size as well as cost. In fact, some of the inter-labour market variation, for example, may be due to the varying performance of development agencies as well as the commitment of local authorities in liaising between themselves and the new firm founders.

Unemployment

The formation decision may be influenced by potential founders comparing actual incomes with expected incomes resulting from the establishment of a new business (Creedy and Johnson, 1983, p.178). It is often suggested that unemployment in a labour market may stimulate firm formation, and there is some evidence from questionnaire work that the threat of unemployment may sometimes affect the formation decision (Fothergill and Gudgin, 1982; Storey, 1982; Atkin et al., 1983; Binks and Coyne, 1983). In marked contrast, Foreman-Peck (1984) using a time-series regression technique found no evidence of a relationship between manufacturing business formation rates in England and Wales during the interwar period. Also, Binks' more recent work (Binks and Jennings, 1986) which

made allowance for time-series autocorrelation in monthly rates of new-company registration and unemployment; unemployment levels in Britain in 1971 and 1981 yielded a significant negative, not positive relationship. This study has indicated that during the 1970s, rising unemployment has been associated with discouraging, not encouraging new firm formation. Therefore, on the basis of the above evidence it can be hypothesised that the extent of unemployment may be used as a surrogate measure of expected earnings as well as a 'push' factor leading to enterprise formation.

SURROGATE VARIABLES

The surrogate variables for the thirteen factors stated above are detailed below. Also, the hypothesised direction between the independent 'surrogate' variable and new manufacturing firm formation rates is stated.

Factor 1: Rurality

It is hypothesised that a TTWA with a high land area density, 1971 (X1) (or a low population density, 1971) has a positive relationship with new firm formation rates. Also, a strong tradition of employment in agriculture, 1971 (X2) in a TTWA is similarly positively related to high rates of new firm formation (Appendix 1).

Factor 2: Entry into Industry

It is postulated that a high percentage of total manufacturing employees in low entry barrier industries (SICs 17, 18 & 19), 1971 (X3) is positively associated with new firm formation, whilst a high percentage of total manufacturing employment in heavy industries (SICs 4, 5, 6 & 10), 1971 (X4) is negatively related to the rate of new firm formation. Also, the percentage of total employment in mining and quarrying industries (SIC 2), 1971 (X5) is suggested to be negatively associated to the rate of new firm formation.

Factor 3: Industrial Specialisation

It is suggested that high entropy specialisation statistics (Formula 1) for total employment, 1971 (X6) and manufacturing employment, 1971 (X7) both promote new firm formation.

Formula 1

$$S = \sum_{j=1}^m P_{ij} \ln \frac{P_{ij}}{P_j}$$

where

S	=	specialisation entropy statistic;
P_{ij}	=	the proportions associated with a particular employment category j within TTWA i ;
P_j	=	category proportions for the TTWA as a whole;
ln	=	natural logarithm;
m	=	number of categories;
Σ	=	summation.

Factor 4: Degree of Local Autonomy

It is postulated that a high percentage of total manufacturing employment in foreign-controlled manufacturing establishments, 1983 (X8) is negatively related to new firm formation rates.

Factor 5: Size of 'Incubator' Firm

It is hypothesised that a high percentage of total manufacturing employment in small establishments with 25 or fewer employees, 1985 (X9) is positively related to the rate of new firm formation, whilst a high percentage of total manufacturing employment in large plants greater than 500 employees, 1985 (X10) is postulated to be negatively associated with the new firm formation rate.

Factor 6: Occupational Experience

It is suggested that a high percentage of total economically active persons being managers and professionals (SEGs 1, 2 & 13), 1971 (X11) is positively associated with new firm formation rates, whilst a high percentage of total economically active persons being manual employees (SEGs 9, 10 & 11), 1971 (X12) is hypothesised to be negatively related to new firm formation rates.

Factor 7: Self-Employment

It is postulated that a high percentage of total economically active persons being self-employed, 1971 (X13) is positively associated with new firm formation rates.

Factor 8: Turbulence

It is suggested that a high number of manufacturing closures, 1979-1983 per 1,000 manufacturing employees (1978) (X14) and a high employment loss rate in closures, 1979-1983 as a percentage of manufacturing employment stock (1978) (X15) are both positively related with the rate of new firm formation.

Factor 9: Education

It is hypothesised that a high percentage of persons with higher degrees, 1978 (X16) is positively related to the rate of new firm formation.

Factor 10: Access to Capital

It is postulated that a high percentage house-owning population, 1981 (X17) is positively associated with the rate of new firm formation.

Factor 11: Market Demand

It is suggested that there is a positive relationship between the rates of total employment change, 1971-1981 (X18), manufacturing employment change, 1971-1981 (X19) and population change, 1971-1981 (X20) with new firm formation rates.

Factor 12: Premises

It is hypothesised that the availability (X21) and low cost of premises is positively associated with the rate of new firm formation.

Factor 13: Unemployment

Following Whittington (1984) it is postulated that a high percentage change in the rate of unemployment, 1979-1983 (X22) is positively related to the rate of new firm formation.

RESEARCH QUESTIONS

The remainder of this paper will test the applicability of the hypotheses (Table 1) and the twenty surrogate variables that could be assembled to the TTWA spatial framework in Wales (Appendix 1).

Unfortunately, appropriate surrogate variables for the percentage of persons with higher degrees (X16) and the availability of premises (X21) could not be assembled to the TTWA spatial scale and were omitted from the following analyses. However, an attempt was made to analyse spatial new firm formation rates within a bivariate as well as a multivariate framework in order to identify some of the factors underlying variations in entry. Therefore, the results identify not only the attractiveness ('demand' or 'pull' factors) of a given labour market as a location for new firm formation but also its effectiveness ('supply' or 'push' factors) as a source location for entrepreneurship.

DATA COLLECTED

The identification of new manufacturing firms has always been a difficult problem for research workers (Mason, 1983). In this study it was defined as one which has no obvious parent in any existing business enterprise. This distinguishes between subsidiaries established by existing companies - both domestic and overseas - and new independent indigenous firms. Independence was defined in legal terms recognising, however, that many independent firms may be functionally dependent (O'Farrell and Crouchley, 1984, p.222). The following analysis is based in part upon the data provided by the Industry Department of the Welsh Office, Cardiff. The Welsh Office and the Factory Inspectorate are the only official bodies which identify 'new manufacturing enterprises without origin' (ENMWO) throughout the Principality. However, only those ENMWOs which, at some stage since birth, have reached eleven employees and which opened and survived between 1st January 1979 and 31st January 1983, fall within the data set. In subsequent years, if the employment total of the ENMWO fell below eleven the case was retained on file and the new employment recorded. The date of start-up of the new independent firms was defined as the year of entry on the Welsh Office database. The Welsh Office also has data available on location within both Revised 1978 and 1984 TTWA locations; a product according to the 1968 and 1980 Standard Industrial Categories (SICs); total employees; and the date when the firm was first registered as a business.

Unfortunately, the Welsh Office data set does suffer from a number of shortcomings akin to those noted by Johnson and Cathcart (1979) and Lloyd and Mason (1984, p.213) with regard to Department of Industry data. First, the databank does not contain a complete list of all manufacturing firms in Wales. Second, it excludes firms which have not reached the size of eleven employees; given

that most new firms employ very few workers, at least in their early years, the effect of this cut-off is that the majority of new enterprises in any area are omitted from the data. Third, included with the ENMWO statistics, and accounting for about 15% of the total, are new manufacturing establishments set up by previously non-manufacturing firms (Pounce, 1981). Fourth, the data have also been criticised as deficient in identifying new firms that satisfy the criteria for inclusion by the Welsh Office (or the Department of Industry) (Johnson and Cathcart, 1979). Finally, with regard to this research the Revised (1978) TTWA data in the database was aggregated spatially into sixteen groupings of the forty TTWAs (Figure 1) in order to comply with the 1947 Statistics of Trade Act.

(Insert Figure 1)

Consequently, the spatial framework used was not totally satisfactory for the task it was intended for, but it was the best available. No acceptable method of partitioning the Welsh Office's thresholded data to the forty TTWA level was possible. Further, the independent surrogate variables used in this paper were drawn from a variety of data sources and they correspond to a variety of time periods. Again, this data has not been previously published at the Revised (1978) TTWA scale and was regarded as the most appropriate and 'best' available data in respect of the objective of this paper to derive a statement, or a series of statements covering the main factors associated with new firm formation.

RESEARCH METHODOLOGY

In order to take account of the existing industrial base, firm formation rates have been expressed as a rate - the number of surviving new firms formed in a TTWA / per 1,000 manufacturing employees in the base year of 1978 (the dependent variable - Y). This measure is used throughout the study since it reflects the process by which the population of industrial employees is the relevant indicator of the number of potential entrepreneurs (Gudgin, 1978; O'Farrell and Crouchley, 1984, p.227-28). A base measured in terms of numbers of firms (or plants) fails to take account of the size of the latter.

Also, in the absence of any strong theoretical arguments in favour of a specific functional form between new firm formation and the independent factor(s) associated with it, a linear relationship has usually been tested (Gudgin, 1978; Johnson and Cathcart, 1979; Gudgin and Fothergill, 1984; O'Farrell

and Crouchley, 1984). The simplest form of analysis that can be used to model and more importantly to examine such a relationship or relationships is correlation analysis along with its associated techniques of bivariate and multiple regression analysis (Norusis, 1983). This research employed bivariate and multivariate correlation analysis which are methods that attempt to measure the degree of association between a single dependent variable and either a single independent variable, or a series of independent variables. In contrast, bivariate and multivariate regression analysis is concerned with causal relationships between two or more independent variables. The backward elimination multiple regression method (Norusis, 1983) was chosen to explore the multivariate influences at work. Therefore, the following exploratory analyses are seen as a means of guidance, seeking to delineate possibly important factors in the new firm formation process.

RESULTS

The Spatial Pattern of New Firm Formation

The survey procedure identified a total of 224 ENMWOs as having been started independently in Wales between 1st January 1979 and 31st December 1983. By 1983 these ENMWOs provided only 2.1% of the region's total manufacturing employment, or 4460 jobs. This confirms the view that new firms have only a minimal impact on job generation in the short run (Gould and Keeble, 1984; Lloyd and Mason, 1984). Table 2 indicates that the largest single concentration of new firms occurred in the Cardiff TTWA with 29 surviving new firms having been formed there (12.9% of the total Welsh ENMWOs).

(Insert Table 2)

It is apparent from Figure 2a that the highest firm formation rate occurred in the Brecon TTWA aggregation which experienced a rate four times the average formation rate for Wales.

(Insert Figures 2a & 2b)

High rates were also recorded in the Aberystwyth TTWA aggregation, Shotton TTWA, Bargoed TTWA, Ebbw Vale TTWA and the Barmouth TTWA aggregation. Conversely, low rates were recorded in the TTWA aggregations of Llanelli and Aberdare and Pontypridd TTWA. Also, Figure 2b indicates that all rural TTWAs (with the exception of the Denbigh TTWA aggregation) had done better than expected, based on the 1978 distribution of manufacturing employment, whilst the majority of urban labour markets had done worse than expected. However, Bargoed, Shotton, Ebbw Vale, Cardiff and Wrexham TTWAs are exceptions to the latter generalisation. On a technical point, Gudgin and Fothergill (1984, p.205) found that formation rates based on manufacturing employees alone cause "an arbitrary and misleading exaggeration of formation rates in rural areas" and that they should be recalculated using manufacturing employment plus 20% of other non-manufacturing total employment in order to remove the rural-urban bias in the formation rate denominator. Even a wider employment denominator is calculated revised new firm formation rates are again most buoyant in a block of TTWAs in Mid Wales, and that urban TTWAs again recorded low firm formation rates even when the rural-urban bias in the denominator had been removed (Figure 3).

(Insert Figure 3)

Correlation and Regression Analyses

Table 3 shows that ten out of the twenty surrogate variables are significantly associated with new firm formation rates.

(Insert Table 3)

Moreover, a small cluster of factors are shown to be significantly statistically related to the dependent variable at the 0.001 and 0.01 levels of significance and they are as follows: rurality (Factor 1), self-employment (Factor 7), size of 'incubator' firm (Factor 5), turbulence (Factor 8), and market demand (Factor 11). The importance of occupational experience (Factor 6) and degree of local autonomy (Factor 4) factors were also significantly associated with new firm formation rates though only at the

0.05 level of significance. A detailed description of the specifics surrounding the postulated hypothesised factors and surrogate variables is detailed below.

From Table 3 it is apparent that land area density (X1) and percentage in agriculture (X2) are positively related, as hypothesised to entry rates thereby confirming the view that rural areas with a strong tradition of agricultural employment are significantly associated with new firm formation. As was anticipated, areas with a high percentage of employment in heavy industries (SICs 4, 5, 6 & 10) (X3) and mining and quarrying (SIC 2) (X5) had a negative relationship with firm formation. These relationships were not found to be statistically significant but the 'upas trees' of heavy industrial complexes have exerted a negative influence on local entrepreneurial climates. Similarly, the relationship between firm formation rates and percentage employment in postulated easy-entry industries (SICs 17, 18 & 19) (X4) was found not to be significant in a statistical sense but the positive relationship was in the direction hypothesised. Both the entropy specialisation statistics for total employment (X6) and manufacturing employment (X7) were found to be positively associated with new firm formation rates though not in a statistical sense. These results collaborate Cross's (1981) finding for Scotland and the relationship may in part be due to the fact that rural TTWAs tend to be more specialised in employment terms than traditional urban TTWAs

It was found that a high level of manufacturing employment in a TTWA controlled by foreign establishments (X8) was negatively associated with new firm formation rates. The relationship was significant and from this finding it can be inferred that externally controlled branch plants may not be providing the appropriate work experience for entrepreneurship in particular localities.

The importance of plant size structure is indicated to be of importance because employment in small establishments (X9) was found to have a highly significant positive relationship with new firm formation rates, whilst employment in large establishments (X10) had a significant negative relationship with new firm formation rates. Both these relationships were in the hypothesised direction and they indicate that areas with a high proportion of small establishments are highly conducive to enterprise development.

In terms of occupational variables, Table 3 shows that TTWAs with a high proportion of managers and professionals (X11) had a significant positive relationship with new firm formation rates, whilst TTWAs with a high proportion of manual employees (X12) had a significant negative relationship with new firm formation rates. Both these variables were in the hypothesised direction and they

indicate that managers and professionals gain the appropriate work experience and opportunities which may enable them to establish new firms of their own. Moreover, Table 3 indicates that high new firm formation rates were significantly associated with TTWAs which had a high proportion of self-employed persons (X13). This result was as hypothesised and from it can be inferred that the greatest pool of new firm founders outside the manufacturing sector exists among the economically active self-employed persons.

Both the 'turbulence' measures were positively associated with firm formation rates in the direction hypothesised. Also, from Table 3 it is apparent that whilst the manufacturing establishment closure rate (X14) was statistically associated with formation rates the employment loss rate in manufacturing establishment closures (X15) was not. However, from this evidence it can be reasonably suggested that 'push' factors in certain TTWAs have led to a situation where enterprise formation is undertaken.

Contrary to expectations it was found that the proportion of persons being owner-occupiers (X17) had a weak negative relationship to new firm formation rates. This may be due to the fact that TTWAs in urban South Wales which have recorded low levels of new firm formation have relatively high levels of owner-occupation. Whilst in the remainder of Great Britain areas with high levels of prosperity are generally associated with high levels of owner-occupation unlike in Wales (Central Statistics Office, various issues). From this evidence it can be concluded that the surrogate variable chosen to reflect personal capital availability in labour markets was not an appropriate one in the context of Wales.

With regard to the variables covering aspects of local and regional market demand it was found that percentage manufacturing employment change (X19) had a statistically significant relationship with new firm formation rates, whilst percentage total employment change (X18) and percentage population change (X20) did not have significant relationships with new firm formation rates. However, all three variables were positively associated with new firm formation rates and were in the direction hypothesised. From this evidence it can be reasonably be inferred that new firm formation rates are influenced by the level of final and intermediate demand in the local and regional economy.

Table 3 indicates that a negative relationship between the percentage change in unemployment (X22) and the rate of new firm formation. This relationship was not in the direction hypothesised and it was not statistically significant. From this result it can be inferred that an increase

in unemployment in a labour market did not markedly stimulate new firm formation. In fact, this finding supports Blinks and Jennings (1986) claim that rising unemployment is a factor which discourages new firm formation.

Moreover, it was decided to construct a multiple regression model on the basis of the six factors found to be most significantly associated with new firm formation rates. One surrogate variable per factor was chosen and the statistical interrelationships between these surrogate variables are detailed in Table 4. Using the backward elimination multiple regression method the initial model contained six independent variables - land area density, 1971 (X1), percentage manufacturing employment in small plants with 25 or fewer employees, 1985 (X9), percentage of economically active persons being manual employees (SEGs 9, 10 & 11), 1971 (X12), percentage of economically active persons being self-employed, 1971 (X13), high rate of manufacturing closures, 1979-1983 (X14) and a high rate of manufacturing employment change, 1971-1981 (X19) - were reduced to a final model.

(Insert Table 4)

The final model contained three independent variables - land area density, 1971 (X1), percentage of economically active persons being manual employees (SEGs 9, 10 & 11), 1971 (X12) and percentage manufacturing employment in small establishments with 25 or fewer employees, 1985 (X9) (Equation 1). This equation was statistically significant with a low standard error value and a very high adjusted R^2 value of +0.88. It can be inferred from Equation 1 that rural TTWAs with proportions of manual employees and small establishments are conducive to new firm formation. However, an examination of the residuals from the final backward elimination regression model showed that the model produced markedly better than predicted residual values in the Ebbw Vale, Bargoed, Cardiff, Barmouth, Pontypool and Shotton TTWAs and markedly worse than predicted residual values in the Denbigh, Aberdare, Pontypridd and Llanelli TTWAs. From this evidence it can be suggested that a variety of other factors (and surrogate variables) had had a more direct influence on the formation rates in the TTWAs stated above than the ones included in the final model alone. Further detailed analysis at a micro-level could explore and unravel in greater detail the reasons for these contrasts

Equation 1

$$Y = \begin{array}{cccc} -2.32 & +0.29(X1) & +0.05(X12) & +0.10(X9) \\ (-2.61) & (3.72) & (3.23) & (2.87) \\ & ** & ** & * \end{array}$$

Adjusted R² = +0.88 Standard Error of the Estimate = 0.26

Notes: * Significant at p < 0.05
 ** Significant at p < 0.01
 For the equation the figures in brackets are t values.

Finally, analyses were undertaken using a second dependent variable (Y2) which included in the formation rate denominator 20% of other non-manufacturing employment. The results for the analyses were in the same direction as those presented for the unadjusted new firm formation rate dependent variable (Y) but the significance of the relationships were reduced when the rural-urban bias in the dependent variable had been removed.

CONCLUSIONS

This paper has demonstrated that the reasons for spatial differences in new firm formation rates in Wales are complex. As indicated above they almost certainly relate to aspects of regional economic and social life that are of a long standing and deep-seated character. The analysis presented above has confirmed the importance of a number of factors already stated in the new firm literature. In fact, the postulated direction of a range of 'push' and 'pull' factors associated with various surrogate structural, social and locational variables in the above analyses have been shown to have some general applicability (Table 5).

(Insert Table 5)

For example, a strong rural-urban contrast in new firm formation rates was identified with rural TTWAs having conditions associated with them which are highly conducive to new firm formation. It has been established in the Welsh context that the second most important factor associated with high levels of new firm formation after various aspects of rurality was an established tradition of entrepreneurship in a TTWA, insofar as it is indicated by high levels of self-employment. Moreover, the results of this study suggest that the size distribution of enterprises in a TTWA (particularly small plants)

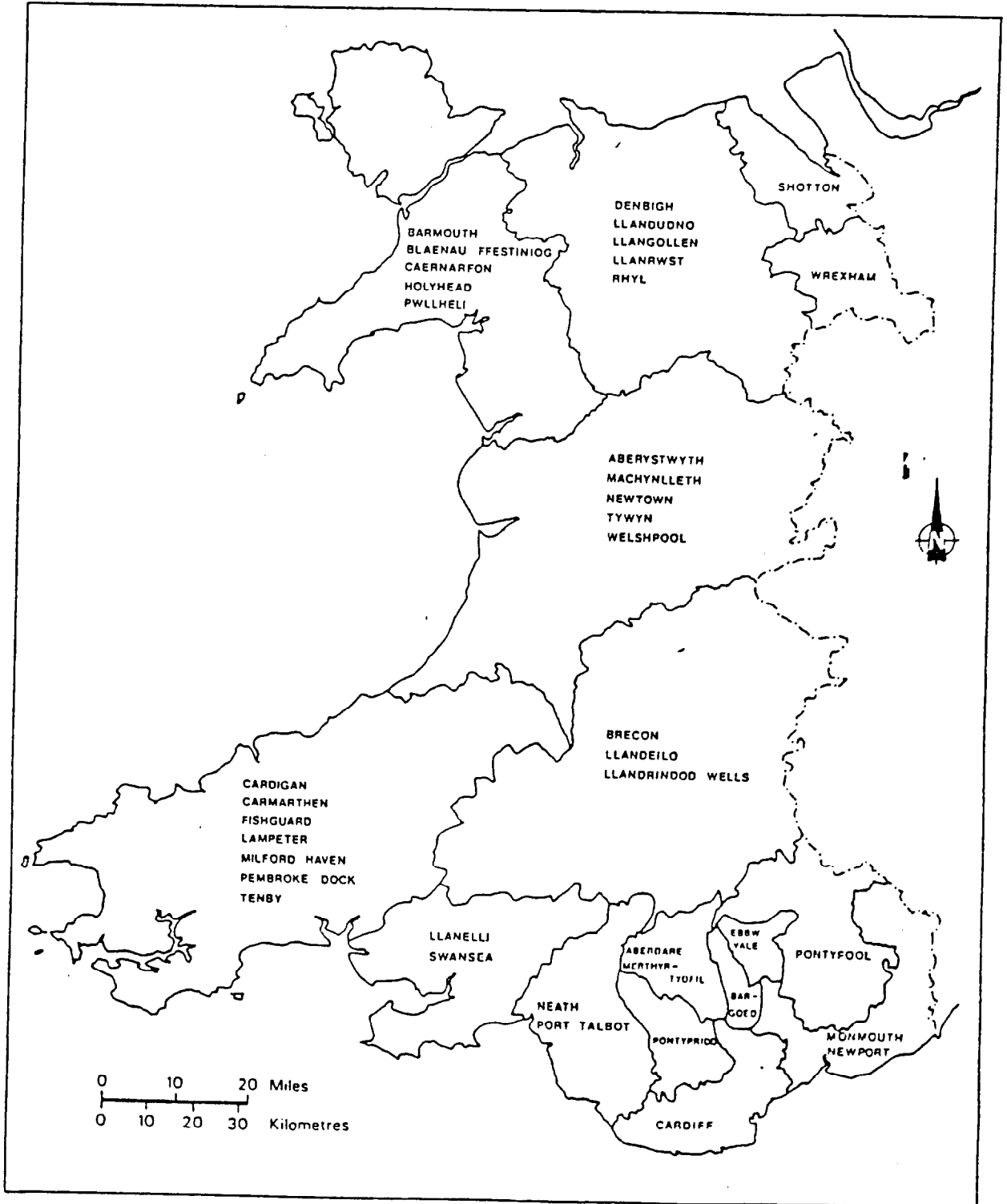
is a factor of greater importance than local occupational structures in understanding spatial differences in new manufacturing firm formation rates. Also, the impact of 'turbulence' or 'push' factors (as indicated by a manufacturing establishment closure rate), levels of final and intermediate demand in a labour market (as indicated by manufacturing employment change) and the level of external control in manufacturing establishments (as indicated by the level of foreign-ownership in manufacturing establishments) do have a role in 'explaining' contrasts in new manufacturing firm formation rates in Wales.

On the basis of the analysis it can be reasonably concluded that the factors associated with the new firm formation process are numerous and it has been their individual and combined influences that have resulted in there being marked spatial differences in new firm formation rates in Wales. It must be acknowledged that aggregative correlation and regression analyses have identified some of the important factors associated with the process of new firm formation that are amenable to measurement but they have not isolated all proximate causes. As indicated above new firm formation is a complex process and many factors will only emerge through in-depth investigation at micro-level. Therefore, there is a need to test the applicability of the presented hypotheses and surrogate variables through fieldwork in different labour markets in Wales.

Finally, the results of this study have also indicated that social as well as structural and locational factors must be taken into account when new firms regional policies are being devised. It has been shown that small and new firms policies are likely to bear greater fruit in some regions than in others (Storey, 1982, p.194-95). Therefore, in the cause of 'geographical welfare' there could be case for extra assistance to be directed to those labour markets which have a range of factors which make them less likely to generate a large number of new firms. In order to make appropriate policy decisions there needs to be more direct evidence about the sort of entrepreneurs who take up the benefits of new and small firms assistance before reaching any firm and final conclusions with regard to policy implications in order to remove social and spatial bias in new firm formation rates.

Figure 1

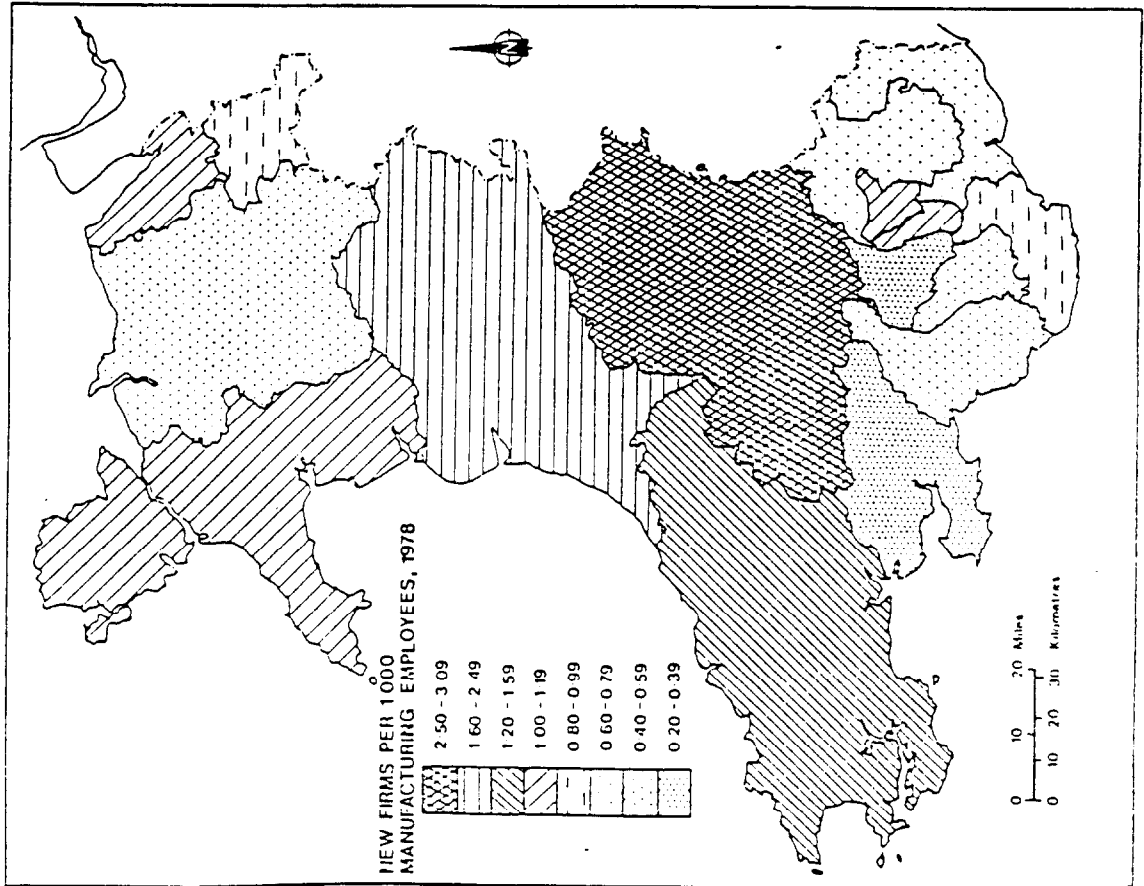
WELSH OFFICE AGGREGATION OF 1978 TTWAs



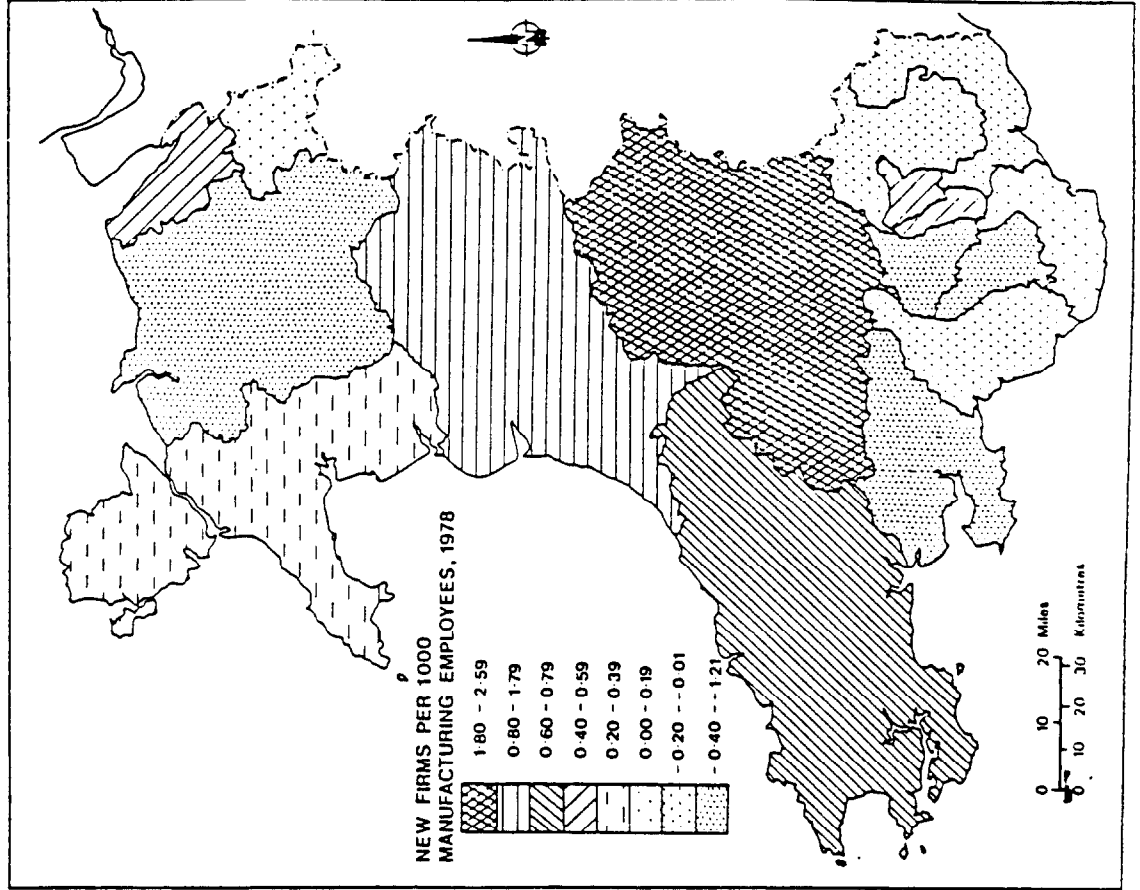
Source: Industry Department, Welsh Office, Cardiff

Figures 2a and 2b

NEW MANUFACTURING FIRM FORMATION RATES IN WALES, 1979-1983.



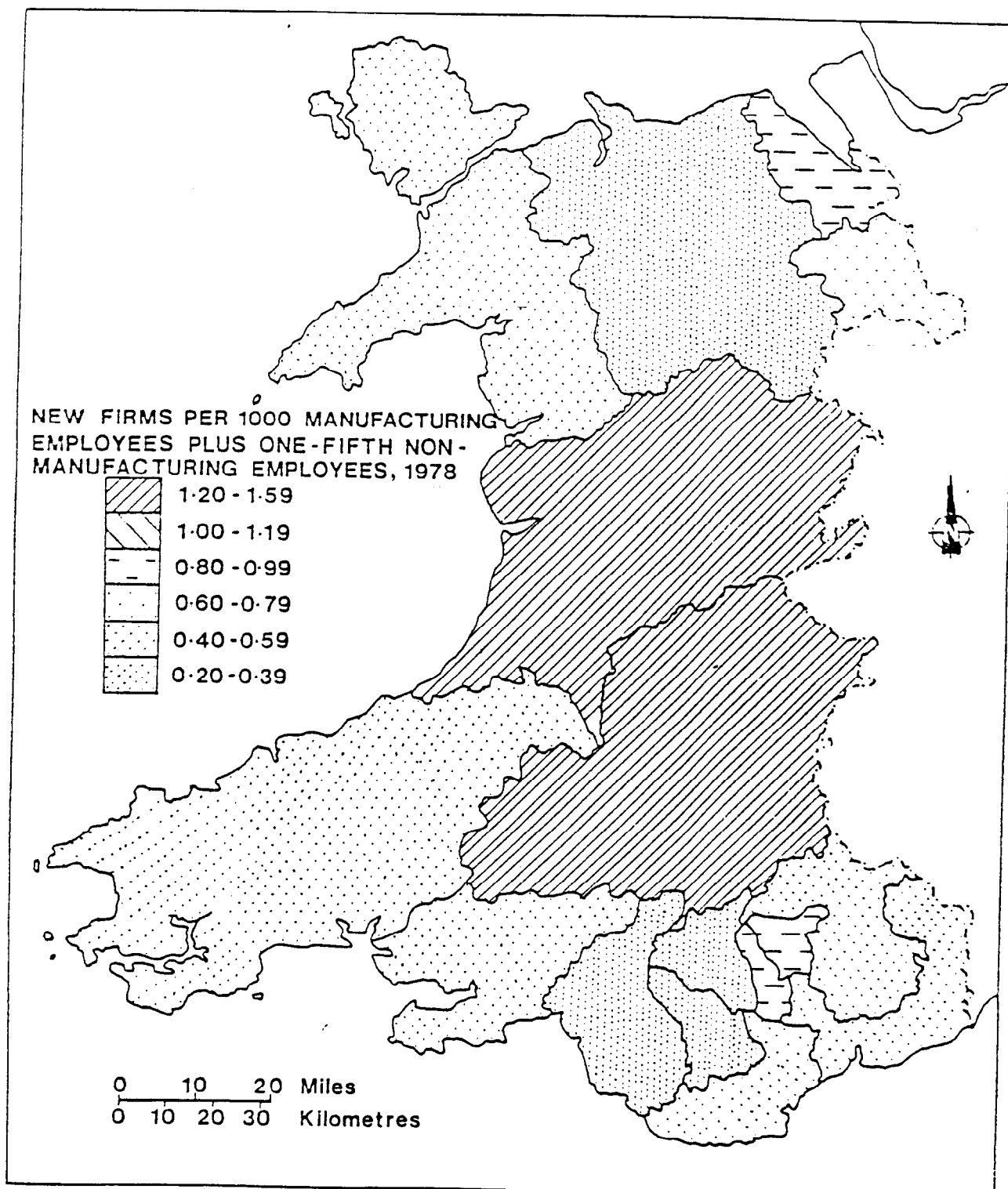
NEW MANUFACTURING FIRM FORMATION RATES IN WALES, 1979-1983: ACTUAL MINUS EXPECTED.



Source: Industry Department, Welsh Office, Cardiff, and Welsh Economic Trends, No.8 1982/83 Welsh Office, Cardiff

Figure 3

NEW MANUFACTURING FIRM FORMATION RATES IN WALES, 1979-1983.



Source: Industrial Department, Welsh Office, Cardiff, and Welsh Economic Trends, No.8, 1982/83, Welsh Office, Cardiff

Table 1: Factors Identified by the New Firm Literature which are Associated with either being Positively or Negatively Associated with the Rate of New Firm Formation in Labour Markets

Factors	Surrogate variables	Hypothesis positively/negatively associated with new firm formation
1. Rurality	X1 High land area density (or low population density)	Positively
	X2 High % of population in agriculture	Positively
2. Entry into industry	X3 High % of population in easy entry industries	Positively
	X4 High % of population in heavy industries industries	Negatively
	X5 High % of population in mining and quarrying industries	Negatively
3. Industrial specialisation	X6 High total employment entropy specialisation statistic	Positively
	X7 High manufacturing employment entropy specialisation statistic	Positively
4. Degree of local autonomy	X8 High % of total manufacturing employment in foreign-controlled plants	Negatively
5. Size of 'incubator' firm	X9 High % of total manufacturing employment in plants employing 25 or fewer employees	Positively
	X10 High % of total manufacturing employment in plants employing 500 or more employees	Negatively
6. Occupational experience	X11 High % of population in managerial and professional groupings	Positively
	X12 High % of population in manual groupings	Negatively
7. Self-employment	X13 High % of population being self-employed	Positively
8. Turbulence	X14 High rate of manufacturing establishment closures	Positively
	X15 High employment loss rate in manufacturing establishment closures	Positively
9. Education	X16 High % of population with higher degrees	Positively
10. Access to capital	X17 High house-owning population	Positively
11. Market demand	X18 High rate of change in manufacturing employment	Positively
	X19 High rate of change in total employment	Positively
	X20 High rate of change in population growth	Positively
12. Premises	X21 Availability and low cost of premises	Positively
13. Unemployment	X22 High % change in the rate of unemployment	Positively

Sources: Cooper (1971); Johnson and Cathcart (1979); Cross (1981); Fothergill and Gudgin (1982); Storey (1982); Gould and Keeble (1984); Gudgin and Fothergill (1984); Lloyd and Mason (1984); O'Farrell and Crouchley (1984); Whittington (1984); and Storey and Jones (1987).

Table 2: The Formation of New Manufacturing Firms Without Origin in Wales, 1979-1983

TTWA aggregations	Number of new firms 1979-83 (1)	Expected number of new firms 1979-83 (2)	Unadjusted firm formation rate (UF) (3)	Expected firm formation rate (EF) (4)	Actual minus expected firm formation rate (UF-EF)	Adjusted firm formation rate (5)	New firm employment, 1983
1. Aberdare	7	14	0.36	0.72	-0.36	0.28	120
2. Aberystwyth	11	3	2.39	0.65	1.74	1.22	200
3. Bargoed	10	6	1.14	0.68	0.46	0.85	290
4. Barmouth	9	6	1.02	0.68	0.34	0.51	120
5. Brecon	*	*	*	*	*	*	95
6. Cardiff	29	25	0.83	0.71	0.12	0.45	535
7. Cardigan	10	5	1.55	0.77	0.78	0.60	160
8. Denbigh	*	*	*	*	*	*	75
9. Ebbw Vale	11	7	1.11	0.70	0.41	0.87	435
10. Llanelli	15	33	0.33	0.73	-0.40	0.23	205
11. Monmouth	23	24	0.70	0.73	-0.03	0.53	450
12. Neath	23	29	0.57	0.72	-0.15	0.44	420
13. Pontypool	13	15	0.63	0.73	-0.10	0.50	320
14. Pontypridd	14	21	0.50	0.74	-0.24	0.39	325
15. Shotton	26	16	1.18	0.73	0.45	0.95	465
16. Wrexham	13	12	0.81	0.75	0.06	0.62	265
Total Wales	224	224	0.72	0.72	0.00	0.50	4,460

- Notes:
- (1) Includes only those establishments at which employment reached eleven or more employees.
 - (2) Expected number of new firms is the total manufacturing employment in TTWA i in 1978 divided by total manufacturing employment in Wales in 1978, and this value is then multiplied by the total number of ENMWO for Wales over the 1979-1983 period.
 - (3) Unadjusted firm formation rate is the surviving number of ENMWO formed 1st January 1979 to 31st December 1983 in TTWA i per 1,000 manufacturing employees in TTWA i in 1978.
 - (4) Expected firm formation rate is the expected number of ENMWO formed 1st January 1979 to 31st December 1983 in TTWA i per 1,000 manufacturing employees in TTWA i in 1978.
 - (5) Adjusted firm formation rate is the surviving number of ENMWO formed 1st January 1979 to 31st December 1983 in TTWA i per 1,000 manufacturing employees plus 20% non-manufacturing total employees in TTWA i in 1978.
 - (*) One TTWA aggregation contained less than five new manufacturing firms.

Sources: Industry Department, Welsh Office, Cardiff, 1985 and Welsh Economic Trends, No. 8, 1982/83, Appendix VI, Welsh Office, Cardiff.

Table 3: Correlation Coefficients between the Unadjusted Firm Formation Rate (Y) and Selected Independent Variables (n=16)

Factors	Independent variables	Pearson correlation coefficient (r)	Coefficient of determination	Significance of 't' values	Angle of slope (b)
1	X1 Land area density, 1971	0.90	0.81	7.86 ***	0.38
1	X2 Percentage in agriculture (SIC 1), 1971	0.86	0.74	6.29 ***	0.10
2	X3 Percentage in heavy industries - (SICs 4, 5, 6 & 10), 1971	0.20	0.04		-0.01
2	X4 Percentage in easy-entry industries (SICs 17, 18 & 19), 1971	0.41	0.17		0.05
2	X5 Percentage in mining and quarrying industries (SIC 2), 1971	-0.23	0.06		-0.02
3	X6 Total employment entropy specialisation statistic, 1971	0.49	0.24		2.52
3	X7 Manufacturing employment entropy statistic, 1971	0.35	0.13		1.12
4	X8 Percentage employment in foreign-owned manufacturing establishments, 1983	-0.53	0.28	2.35 *	-0.04
5	X9 Percentage employment in establishments with 25 or fewer employees, 1985	0.82	0.67	5.24 ***	0.10
5	X10 Percentage employment in establishments with more than 500 employees, 1985	-0.74	0.54	4.08 **	-0.02
6	X11 Percentage of economically active persons being managers and professionals (SEGs 1, 2 & 13), 1971	0.53	0.28	2.36 *	0.15
6	X12 Percentage of economically active persons being manual employees (SEGs 9, 10 & 11), 1971	-0.59	0.34	2.70 *	-0.04
7	X13 Percentage of economically active persons being self-employed, 1971	0.83	0.69	5.57 ***	0.11
8	X14 Number of closures, 1979-1983 per 1,000 manufacturing employees (1978)	0.69	0.47	3.55 **	0.76
8	X15 Employment loss in closures, 1979-1983 as a percentage of manufacturing employment stock (1978)	0.13	0.02		0.02
10	X17 Percentage owner-occupiers, 1971	-0.08	0.01		-0.01
11	X18 Percentage total employment change, 1971-1981	0.41	0.17		0.03
11	X19 Percentage manufacturing employment change, 1971-1981	0.63	0.40	3.06 **	0.02
11	X20 Percentage population change, 1971-1981	0.49	0.24		0.07
13	X22 Percentage change in unemployment, 1971-1981	-0.38	0.14		-0.01

Notes: * Significant at p<0.05;
 ** Significant at p<0.01;
 *** Significant at p<0.001.

Sources: Census of Population, 1971 and 1981 data, OPCS, Fareham and SASPAC; Department of Employment, 1971 ER2 data, Watford; the Health and Safety Executive, Cardiff; Industry Department, Welsh Office, Cardiff; and Welsh Economic Trends, No. 8, 1982/83, Welsh Office, Cardiff.

Table 4: Correlation Coefficients between Independent Variables in the Backward Elimination Method Regression Analysis (n=16)

Independent variables	X1	X9	X12	X13	X14	X19
X1 Land area density, 1971	1.00	0.88 ***	-0.76 ***	0.92 ***	0.60 **	0.78 ***
X9 Percentage employment in establishments with 25 or fewer employees, 1985	-	1.00	-0.90 ***	0.95 ***	0.63 **	0.84 ***
X12 Percentage of economically active persons being manual employees (SEGs 9, 10 & 11), 1971	-	-	1.00	-0.88 ***	-0.51 *	-0.79 ***
X13 Percentage of economically active persons being self-employed, 1971	-	-	-	1.00	0.61 **	0.90 ***
X14 Number of closures, 1979-1983 per 1,000 manufacturing employees (1978)	-	-	-	-	1.00	0.61 **
X19 Percentage total employment change, 1971-1981	-	-	-	-	-	1.00

Notes: * Significant at $p < 0.05$;
 ** Significant at $p < 0.01$;
 *** Significant at $p < 0.001$.

Sources: Census of Population, 1971 and 1981 data, OPCS, Fareham and SASPAC; Department of Employment, 1971 ER2 data, Watford; the Health and Safety Executive, Cardiff; Industry Department, Welsh Office, Cardiff; and Welsh Economic Trends, No. 8, 1982/83, Welsh Office, Cardiff.

Table 5: The Applicability of Surrogate Variables Hypothesised to be Associated with New Firm Formation Rates

Independent variables	Direction of calculated Pearson correlation coefficient (r)	Relationship in the hypothesised direction
<i>Significant at p<0.001</i>		
X1 Population density, 1971	+	YES
X2 Percentage in agriculture (SIC 1), 1971	+	YES
X13 Percentage of economically active persons being self-employed, 1971	+	YES
X9 Percentage employment in establishments with 25 or fewer employees, 1985	+	YES
<i>Significant at p<0.01</i>		
X10 Percentage employment in establishments with more than 500 employees, 1985	-	YES
X14 Number of closures, 1979-1983 per 1,000 manufacturing employees(1978)	+	YES
X19 Percentage manufacturing employment change, 1971-1981	+	YES
<i>Significant at p<0.05</i>		
X12 Percentage of economically active persons being manual employees (SEGs 9, 10 & 11), 1971	-	YES
X11 Percentage of economically active persons being managers and professionals (SEGs 9, 10 & 11), 1971	+	YES
X8 Percentage employment in foreign-owned manufacturing establishments, 1983	-	YES
<i>Not Significant</i>		
X20 Percentage population change, 1971-1981	+	YES
X6 Total employment entropy specialisation statistic, 1971	+	YES
X4 Percentage in easy-entry industries (SICs 17, 18 & 19), 1971	+	YES
X18 Percentage total employment change, 1971-1981	+	YES
X22 Percentage change in unemployment, 1979-1983	+	NO
X7 Manufacturing employment entropy specialisation statistic, 1971	+	YES
X5 Percentage in mining and quarrying industries (SIC 2), 1971	-	YES
X3 Percentage in heavy industries (SICs 4, 5, 6 & 10), 1971	-	YES
X15 Employment loss in closures, 1979-1983 as a percentage of manufacturing employment stock (1978)	+	YES
X17 Percentage owner-occupiers, 1971	+	NO

Appendix 1: Definition of Independent Variables

- X1 = usually resident population, 1971 in TTWA *i* as a proportion of the total land area of TTWA *i*
- X2 = percentage of total employment in TTWA *i* in agriculture (SIC 1), 1971
- X3 = percentage of manufacturing employment in TTWA *i* in low-entry barrier industries (SICs 17, 18 & 19), 1971
- X4 = percentage of manufacturing employment in TTWA *i* in heavy industries (SICs 4, 5, 6 & 10), 1971
- X5 = percentage of total employment in TTWA *i* in mining and quarrying industries (SIC 2), 1971
- X6 = entropy specialisation statistic for total employment in TTWA *i*, 1971
- X7 = entropy specialisation statistic for manufacturing employment in TTWA *i*, 1971
- X8 = percentage of manufacturing employment in TTWA *i* in foreign-owned manufacturing establishments, 1983
- X9 = percentage of manufacturing employment in TTWA *i* in manufacturing establishments with 25 or fewer employees, 1985
- X10 = percentage of manufacturing employment in TTWA *i* in manufacturing establishments with 500 or more employees, 1985
- X11 = percentage of total economically active persons in TTWA *i* being managers and professionals (SEGs 1, 2 & 13), 1971
- X12 = percentage of total economically active persons in TTWA *i* being manual employees (SEGs 9, 10 & 11), 1971
- X13 = percentage of total economically active persons in TTWA *i* being self-employed, 1971
- X14 = number of manufacturing establishment closures, 1979-1983 in TTWA *i* per 1,000 manufacturing employees, 1978 in TTWA *i*
- X15 = employment loss in manufacturing establishment closures, 1979-1983 in TTWA *i* as a percentage of manufacturing employees, 1978 in TTWA *i*
- X16 = percentage of total persons in TTWA *i* having a higher degree, 1978
- X17 = percentage of total residents in private households in TTWA *i* being owner-occupiers, 1981
- X18 = rate of change in total employment in TTWA *i*, 1971-1981
- X19 = rate of change in manufacturing employment in TTWA *i*, 1971-1981
- X20 = rate of change in total population in TTWA *i*, 1971-1981
- X21 = total industrial floorspace, 1978 in TTWA *i* as a proportion of the total usually resident population, 1971 of TTWA *i*
- X22 = rate of change in unemployment in TTWA *i*, 1979-1983.

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