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Drivers of the real effective exchange rates in high and upper-middle income countries

Sofoklis Vogiazas[1], Constantinos Alexiou[2] and Orafiri C. Ogan[2]

[1]Black Sea Trade and Development Bank, Thessaloniki
[2]Cranfield University, Cranfield, UK

Abstract

This paper revisits the nexus between real effective exchange rate and total factor productivity by controlling for trade openness, financial development and natural resources rents. We use a sample of 60 high-income and upper-middle income countries over the period 1995-2015 and employ the GMM estimation framework. Our results advance the empirical knowledge on the drivers of real effective exchange rate by providing robust evidence that the impact of total factor productivity is not uniform across different country clusters. We find that in high-income countries, increasing productivity causes the real effective exchange rate to depreciate hence becoming more trade competitive while the opposite is true for upper-middle income countries. Furthermore, financial development and natural resources rents have no meaningful impact in the case of upper-middle income countries but retain a significant effect in high-income countries. Trade openness plays a key role in explaining the variation in real effective exchange rate in both country clusters.

***Keywords**:* Real effective exchange rates; total factor productivity; financial development; high-income countries; middle-income countries.

***JEL**: F31; F41; O47; O57.*

Introduction

The effect of real exchange rates movements in economic activity has been at the centre stage of both theoretical and empirical research in the post-Bretton-Woods era. In this context, fluctuations in the real effective exchange rate (REER) are associated with an economy's competitiveness and growth. Similarly, total factor productivity as well as financial development play a key role in determining economic growth. Notwithstanding the empirical contradictions among economists, the importance of productivity for the long-run economic growth is documented in neoclassical theories of economic growth (see Solow, 1956) and numerous variants suggesting that a long-term steady-state growth can be achieved by a constant growth of the exogenous technological progress.

The most widely used theoretical framework for interpreting real exchange rates is the Balassa-Samuelson (BS) model according to which sectoral factor productivity is responsible for persistent fluctuations in real exchange rates between two countries[1]. Nonetheless, the empirical studies on the determinants of the real effective exchange rates present mixed, even contradicting results suggesting that additional research is required (Chinn, 2006; Gantman and Dabós, 2018).

This paper revisits the investigation of real effective exchange rate drivers by classifying countries on the basis of income level to economies to facilitate a comparative analysis. For this reason, we use the new country classifications by income level 2017-18 assigned by World Bank[2]. Our dataset consists of a sample of 37 high-income countries and 23 upper-middle income countries over the period 1995 to 2015. Apart from the novel empirical framework utilized in this study, our contribution rests in its comparative nature. Specifically, the generated results point to a non-uniform effect of both total factor productivity and financial development on real effective exchange rates.

The rest of this paper is organized as follows. Section 1 provides the contextual underpinnings of analysis adopted in this study, whilst section 2 elaborates on the literature review revolving around real exchange rate determination. Section 3 touches on the dataset and the methodological framework used whilst section 4 presents and discusses the empirical results. Finally, section 5 provides some concluding remarks.

1. Theoretical Underpinnings

It is widely established that the exchange rate is closely associated with the concept of purchasing power parity (PPP), suggesting that the exchange rates between two given currencies are determined by the relative price level of their respective countries. More specifically, if one country experiences a higher inflation rate than another, the former would experience a decrease in the demand for its goods, whilst the latter would see its demand increase. Inevitably, the corresponding changing patterns in the demand of these countries would impact the value of their currencies. In the country with higher inflation rates, the currency will tend to depreciation and *vice versa*.

[1] In line with BS, this arises from higher wages resulting in higher prices to transfer the cost burden to the consumer.

[2] Based on this new classification, the upper-middle income countries are those with GNI/Income between 3,956 and 12,235 in current US Dollars while the high-income countries are those that pass the GNI/Income threshold of 12,235 US Dollars.

In this context, two different approaches have been put forward to justify different patterns of exchange rate movements, namely the Absolute or Strong PPP and the Relative or Weak PPP. The absolute version of PPP which is premised on the ‘law of one price’, states that the prices of traded goods between countries are the same when priced in the same currency on the condition of no transportation costs and no trade restrictions between countries. In the event where these assumptions do not hold then spatial arbitrage opportunities will arise.
According to Krugman and Obstfeld, (2006), in the real world, there are transportation costs that normally cause the prices of the same basket of goods to be different. In addition, tariffs on imports and restrictions to trade also affect the price of goods between two countries. Hence, the greater these costs, the less likely is that the costs of market baskets to be equalized.
The relative or weak PPP theory focuses on inflation rate differentials rather than absolute price levels. Therefore, inflation rate differentials between the two countries would determine the spot exchange rate changes over time between them as follows:

$$\frac{S_{t+1}}{S_t} = \frac{(1 + \pi_t)}{(1 + \pi_t^*)}$$

Where S_{t+1} and S_t are the spot exchange rate in period t and t+1; π_t^* and π_t are the foreign and domestic inflation rates, respectively. The above formula suggests that, if the domestic inflation rate exceeds foreign inflation rate, the foreign currency will appreciate by the same differential over the same period.

Given the failure of the theory when applied to real-world data, especially in the short-run, economists have adopted the approach of considering PPP as a “long-run” theory of exchange rate determination (Krugman and Obstfeld, 2006). Considering that, the theory would not need to hold at any particular point of time, rather it would be considered as target that the spot rate would follow.

This interpretation assumes that traders respond slowly to deviations in the prices between countries, given the issues of imperfect information, as mentioned above, in addition to long-term contracts (they must wait until the contract expires) and marketing costs (research and setup costs required to enter into a new market). Traders will eventually adjust the price differences, by selling high and buying low, but throughout this process, it is very likely that the PPP exchange rate will continue to change. This means that the spot rate will be continually adjusted, trying to reach a changing target. Despite the widespread use of PPP in exchange rate issues, the underlying relationship has been the subject of heated debate amongst academics and policymakers respectively.

The most widely used theoretical framework for interpreting real exchange rates is the BS model according to which sectoral factor productivity is responsible for persistent fluctuations in real exchange rates between two countries. According to BS model the absolute version of PPP is fundamentally flawed as it primarily relies on spatial arbitrage in an integrated, perfectly competitive world economy attempting to equalize the relative prices (across different currencies and locations) of a common basket of goods when quoted in the same currency.

Both Balassa and Samuelson identified an important factor responsible for the bias between exchange rates and relative prices. The core of their analysis was identifying productivity growth differentials between the tradable and non-tradable sectors as a key factor that disrupts a country's internal price structure.

Balassa and Samuelson argued that even though a high-income country is technologically more advanced than a low-income country, the technological advantage, however, is far from uniform across sectors. The technological advantage of the high-income country is greater in the tradable sector than in the non-tradable sector. According to the law of one price, the prices of tradable goods will be equalized across countries. However, this would not be the case in the non-tradable sector as increased productivity in the tradable goods sector will cause real wages to go up, thereby, driving the relative price of non-tradable. In this context, long-run productivity differentials would cause trend deviations.

2. Literature Review

This section reviews the literature on the fundamental determinants of exchange rates. The first generation of New Keynesian models provided the leading paradigm in international economics and further developed by the seminal contributions of Mundell (1963) and Fleming (1962), and Obstfeld and Rogoff (1995). According to the "New Open Economy Macroeconomics" real exchange rate volatility can be explained by non-monetary factors such as productivity shocks, demand shocks and labor supply shocks. Trade and financial openness can also play a role in either smoothing out or amplifying the impact of shocks to real exchange rates. Consequently, by reducing frictions or transaction costs in the international exchange of goods and services, trade openness would either limit or exacerbate the impact of nominal or real shocks on real exchange rates (Obstfeld and Rogoff, 1995; Hau, 2000, 2002 cited in

Calderón and Kubota, 2018). Nonetheless, the empirical evidence on the relationship between trade openness and the real effective exchange rate has been mixed (Gantman and Dabós, 2018).

Total factor productivity (TFP) has also been a key explanatory variable for REER in the literature. For instance, Lee and Tang (2007) examine the effect of productivity growth in a panel of OECD economies with floating exchange rates, and find conflicting evidence for the impact of labor productivity as opposed to TFP on the real exchange rate. The authors find that higher TFP causes the real exchange rate to depreciate, suggesting that the conventional view on the effect of productivity may need further refinement; whether productivity growth leads to appreciation or depreciation of the real exchange rate depends on the measure of productivity used (Lee and Tang, 2007). Moreover, Peltonen and Sager (2009) find that the real exchange rate depreciations and productivity gains in the tradable sector go hand in hand for a sample of developing countries on the contrary to what is anticipated in light of the BS model.

Dumrongrittikul (2012) structural VECM results on 14 Asian developing economies suggest that trade liberalization generates permanent depreciation of the real exchange rates. In particular, the evidence suggests that trade liberalization and government consumption have a strong effect on real exchange rates, while the effects of traded-sector productivity shocks are much weaker. Berka et al. (2014) study on the link between real exchange rates and sectoral total factor productivity for Eurozone countries finds that real exchange rate patterns closely accord with an amended BS interpretation, both in cross-section and time series. Unlike other studies, Berka et al. (2014) find little relationship between productivity levels and the real exchange rate among high-income countries. Furthermore, Diallo (2014) finds that real effective exchange rate volatility negatively affects TFP on a sample of developed countries but also that real effective exchange rate volatility acts on TFP according to the level of financial development.

In a study that comprises of 83 countries spanning the years 1960-2000, Aghion *et al*. (2009) suggest that real exchange rate volatility can have a significant impact on productivity growth. However, the effect depends critically on a country's level of financial development; exchange rate volatility acts negatively on productivity growth in countries with low levels of financial development while it has limited effect on countries with high levels of financial development. In addition, Agbola and Kunanopparat (2005) established that in the period from 1990 to 2003, monetary shocks, high debt, foreign reserves and economic development were the most important exchange rate determinants in Thailand. Using a panel of 53 commodity-exporting countries, Al-Abri (2013) finds a negative effect of trade openness and a positive influence of terms-of-trade, real output growth, private credit and inflation on exchange rate volatility.

Studies such as Uz and Ketenci (2008) and Candelon et al. (2007) utilise panel cointegration techniques to identify the determinants of real exchange rates. For instance, Candelon et al. (2007) results indicate that trade openness, inflation and productivity levels are significant exchange rate determinants in a sample of European countries.

In a study of six Asian economies, Drine and Rault (2004) find no evidence in support of the BS hypothesis. The latter is also supported by Dumrongrittikul (2012) who posits that for developed countries, productivity growth in the tradable goods sector leads to currency depreciation hence, contradicting the BS hypothesis, but in the case of high-growth developing economies currency tends to appreciate, hence the BS hypothesis holds. In other words, on the empirical front the evidence on the effects of productivity growth on real exchange rates movements is scarce or at best, inconclusive especially in the case of high-income or developed economies. Yet, this linkage is of utmost importance, although a very complicated (Özbilgin, 2015).

The inherent complexity of the channels through which exchange rate movements are transmitted to the economy especially after the collapse of fixed exchange rate regime established in Bretton Woods, poses a challenge for academics and policymakers in their pursuit to establish a framework of analysis that is insensitive to sample composition, model specification and data construction (Von Hagen and Zhou, 2007). Inevitably, research in the area of exchange rate determination is still growing which in conjunction with the dynamic and hence volatile elements of exchange rate policy provide the impetus for further exploration (Russell, 2012; Chinn 2003).

Despite the fact that a feedback mechanism between real exchange rate, productivity, and financial development appear to exist, the evidence on the theoretical and empirical front remains inconclusive.

3. Data and Methodology

The dataset consists of 37 high-income countries and 23 upper-middle income countries over the period 1995-2015 using annual observations. The variables used and the respective data sources are presented in table A in the appendix. In classifying the countries between high-income and upper-middle income we use the new country-classification by income level 2017-18 as assigned by World Bank[3]. In all estimations, the dependent variable is the real effective exchange rate (REER) sourced from IFS IMF, which is calculated using the following general formula:

$$\text{REEL}_{country\ i} = \sum_{j=1}^{N} \text{trade weight (country j) X Real Exchange Rate (country j)}$$

Where country j = 1,2,...N are country i's trading partners.

Given that the REER is used to measure the value of a specific currency vis-à-vis an average group of other major currencies by taking into account changes in relative prices, it follows that an increase in REER indicates a real appreciation of a country's home currency, implying that exports become more expensive and imports become cheaper; therefore, an increase indicates a loss in trade competitiveness. As the REER which measures the development of the real value of a country's currency against the basket of the trading partners of that country, is a frequently used variable in both theoretical and applied economic research and policy analysis.

Selection of Variables

Total Factor Productivity: In terms of the causality running from productivity to the real exchange rate, the mechanism implied by the BS model provides the theoretical underpinnings. In the production function, the total factor productivity (TFP) is a multiplicative scale factor which reflects the general level of productivity or technology in the economy. The state of technology embodies the effects of scientific advances, R&D, improvements in management methods, and ways of organizing production that raise the productive capacity of the economy. Furthermore, technological progress enables an economy to use fewer resources per unit of output and to develop substitutes. Chowdhury, (2012) refers to TFP as a technology-induced productivity improvements that enhance factor availability.

In growth accounting terms, total factor productivity (TFP) is a measure of how effective an economy is at producing economic output with a given amount of inputs. Across developed and developing countries, a great deal of the difference in per capita income is due to total

[3] On the new classification by World Bank see https://blogs.worldbank.org/opendata/new-country-classifications-income-level-2017-2018

factor productivity variation (Hall and Jones, 1999). Moreover, sustained growth over time in per capita income requires growth in total factor productivity (Solow, 1957). In addition, TFP, in part, reflects the differences in policies and institutions (Acemoglu, Johnson, and Robinson, 2004).

Higher productivity in the form of reduced cost and prices of goods in the tradable sector will ultimately lead to depreciation in the exchange rate. Slowing productivity growth is both a matter of declining technological progress and a lack of skills necessary to adopt existing technologies (Baily and Montalbano 2016).

According to the Rybczynski theorem (Edwards, 2006), the supply effects of technological progress counterbalance the demand effects. Nonetheless, if technological improvements increase the level of income for a selected country, a currency appreciation will most likely occur. This will be as a result of increased demand for an-tradable as well as its price. Thus, it can be deduced that the demand effects of technological progress dominate supply effects usually referred to as the Ricardo-Pigou-Balassa-Samuelson effect (Edwards, 2006). The growth in the real GDP of each country should have a positive impact on the real effective exchange rate. However, we have opted to exclude GDP from our baseline model to avoid endogeneity issues. Instead we perform GMM regressions with the growth in GDP being the only determinant of REER besides its lagged values.

Figures 1 and 2 present the growth in REEL vs the growth in TFP for both country clusters. It becomes evident that the relationship is negative which aligns with the observation by Lee and Tang (2007), that "when TFP is used to measure productivity, the classical positive association dissipates".

INSERT FIGURES 1 AND 2 HERE

Trade Openness: In open economies, a change in the exchange rate will have a greater impact on the price level than in closed economies. This is measured by the sum of imports and exports as a percentage of GDP. A proxy for this variable is somewhat customary in the empirical literature. The use of this variable represents global integration. However, there is no general consensus on the definition of trade openness.

Despite the fact that trade openness will most likely lead to currency depreciation by decreasing the price of non-tradable to tradables, there are studies, however, suggesting otherwise

(Edwards, 2006). This is hypothesized by Chowdhury (2012) who suggests that the positive effect of trade tariffs on the current account balance position will lead to a currency appreciation. On the other hand, if trade tariffs have negative impact on the current account balance position, the demand for non-tradables will decrease as well their price leading to currency depreciation. Therefore, the overall effect of trade openness on the exchange rate is unclear. In this study, we expect the coefficient for trade openness to be positive or negative contingent on whether the substitution or income effects prevail. Even though theory suggests that there is a negative relationship between exchange rate volatility and international trade, the empirical literature suggests that this theoretical argument might not always be true, see Kroner and Lastrapes (1993) and Baum and Çağlayan (2010).

Financial Development: The mainstream view suggests that the development or deepening of a country's financial sector should boost productivity growth by allocating resources efficiently and facilitating investment and innovation. However, financial sectors are also prone to booms and busts, which can leave deep scars on the productive tissue of the economy. At the same time, globalisation has resulted in the correlation of exchange rates with the stock market.
There is no general consensus on what measures adequately financial development. In our study we proxy financial development by the ratio of private credit as a share of GDP for both country groups and by market capitalisation for the high-income countries due to missing observations in the middle-income countries' group.

Total Natural Resources Rents: Although it seems intuitive that countries endowed with more natural resources should be wealthier, the relation between resource endowment and growth is not so straightforward. In terms of the impact of oil price on the exchange rate, Hardman (2016) suggests that this remains an empirical issue especially in countries that are oil importers. Thus, in a broad context, this could apply to countries without a considerable comparative advantage in any natural resources category. Positive natural resources' shocks tend to lead to long-run currency appreciation (Algieri, 2011).

Methodological Framework

To address the small-sized panel issue, we use the GMM estimation methodology (see Holtz-Eakin, Newey and Rosen, 1988; Arellano and Bond, 1991) which also accounts for the issue of joint endogeneity of explanatory variables with the error term and the potential biases caused by country-specific effects and omitted variables. The use of panel data thus circumvents the omitted variable bias because it contains individual information on the variables and their intertemporal dynamics. A more detailed account on the adopted empirical approach can be found in Arellano and Bond (1991) and Roodman (2009).

In setting up the model for the estimation that will follow we envisage that the REER is a function of macroeconomic fundamentals thereby sanctioning a time-varying equilibrium path for the REER. The underpinning framework is broadly consistent with the macroeconomic balance approach. Within this context, the general model specification is expressed as follows:

$$\mathrm{REEL}_{it} = \alpha + \beta \mathrm{Y}_{it} + \gamma_t + \varepsilon_{it}$$

Where *REER* is the real effective exchange rate in log form in line with Gantman and Dabós (2018), Y_{it} is a vector of variables that includes the total factor productivity (TFP), trade openness or global integration (TR), financial development (PCB/MCAP) and the natural resources rents (TNR). The variables used in our estimations and the sources are presented in table 1 in the appendix.

4. Results and Discussion: High-Income versus Upper-Middle-Income Countries

The results in Table 1 which include a sample of 60 high-income and upper-middle income economies indicate a strong positive relationship between economic growth and the real effective exchange rate[4] which is broadly aligned with the empirical literature (Habib et al., 2016). The pairwise Granger causality tests as shown in Table 2 serve as robustness checks for our GMM estimations.

INSERT TABLES 1 AND 2 AROUND HERE

Table 3 presents the results of our baseline GMM model suggesting that in both country clusters, trade openness has a negative and significant effect on the REER which is in line with theoretical expectations and previous studies (Gantman and Dabós, 2018; Jääskelä and Smith, 2011). This result suggests that as an economy expands its trade as a share of GDP, there is a real depreciation of its currency, i.e. the lower the trade openness the higher the REER

[4] Typically the empirical studies explore the effect of RER on economic growth. As Habib et al. (2016) note, the issue of reverse causality between the exchange rate and growth is usually tackled with the use of GMM.

appreciation. Ultimately, in high-income countries, our results yielded more statistically significant variables including total factor productivity, trade openness, financial development, and natural resources. Notably, the contribution of natural resources rents was insignificant in the case of upper-middle income economies.

INSERT TABLE 3 AROUND HERE

Intuitively, we can reasonably claim that high-income countries are more productive compared to the less wealthy ones. In our paper, we used TFP which is perceived to be a key driver of growth. In the empirical literature, Kim and Lee (2008), and Enders and Müller (2009) document that productivity gains, or technology shocks, seem to cause the real exchange rate to appreciate. Equally, Enders et al. (2011) find that positive technological innovations cause the real exchange rate to appreciate in the short-run while Chowdhury (2012) establishes that technological and productivity improvements depreciate the Australian real exchange rate in the long-run which aligns with our results for the high-income countries. Also, Choudhri and Schembri (2010) note that the basic BS model needs modification given the negative results. What it all boils down to is that the effect of TFP on REER is not stable across countries' developmental level as documented by Márquez-Velázquez (2016). The findings of upper-middle countries are more consistent with the BS model as higher TFP leads to an appreciation in REER. In passing, we need to stress that our GMM-results reflect short-run effects.

Furthermore, natural resources is found to be negative and 'weakly' significant only in the case of high-income countries. This may reflect the so-called 'Dutch disease' or 'resources curse' concepts encountered in the respective literature, implying that resource endowed economies might experience depreciating proclivity in their exchange rate, hence, offsetting the upward pressure on their currency due to high demand for their resources. Nonetheless, the marginal significance does not leave room for any safe conclusions.

The evidence on the financial development proxies appears to be mixed in the country clusters used. For instance, both proxies present a positive and significant effect on REER in the case of high-income economies. However, the impact of credit was insignificant in the case of the upper-middle income countries, suggesting a more intricate interaction between REEL and credit possibly via the inflation and interest rates' channels.

INSERT TABLES 4 AND 5 AROUND HERE

Although constrained by the small-sized panel, our results remain reasonably stable under the robustness tests performed using the pairwise Granger causality tests presented in tables 4 and 5. However, the results of the Granger causality tests suggest that the role of financial development seems to be more complex as the direction of causality in the case of market capitalisation for the high-income countries seems to run from REER to financial development. At the same time, the Granger Causality tests for the upper-middle income countries suggest that the null that credit does not homogeneously cause REEL can be rejected, suggesting that additional research is needed.

5. Concluding Remarks

The underlying drivers and mechanics in the determination of real effective exchange rates remain an unsettled issue for applied economists. In turn, exchange rate policymaking becomes a challenging task, especially in upper-middle income countries.

In this paper, we employed the GMM estimation framework that accounts for endogeneity issues jointly with the choice of regressors in a panel setting in our attempt to provide an insightful account of the narrative at hand. The consistency of the results obtained by the GMM framework is broadly supported by the pairwise Granger causality tests. Without claiming that our approach covers fully the underlying relationship, it provides a fair account of the role of the chosen determinants in the short-run.

Our results advance the empirical knowledge on the drivers of REER by providing robust evidence that TFP and trade openness are significant variables in explaining the variation in REER for both country clusters. Notably, the effect of TFP is negative in the high-income countries but positive in the upper-middle ones, suggesting that the actual mechanism in place merits further research. Furthermore, financial sector development and natural resources rents are found to be of utmost importance in explaining fluctuations in real effective exchange rates for the high-income economies. Certainly, the prevailing relationship between real exchange rate fluctuations and real variables depends critically on other factors not fully captured by our model such as the exchange rate regime.

In the short run, our results are consistent with the hypothesis which suggests that productivity growth is linked to the real effective exchange rate. In this respect productivity effects should be added to the list of criteria and consequences used in the evaluation of flexible versus fixed exchange rate regimes and the evaluation of sustained real exchange rate misalignments.

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APPENDIX

Table A. List of variables and sources used in the study.

Variables	Name	Sources
Real effective exchange rate index (2010 = 100)	REER	International Financial Statistics, International Monetary Fund.
Total Factor Productivity	TFP	Total Economy Database™
Trade (% of GDP)	TR	World Bank and OECD.
Total natural resources rents (% of GDP)	TNR	World Bank.
Market capitalization of listed domestic companies (% of GDP)	MCAP	World Federation of Exchanges database.
Private credit by banks to GDP (%)	PCB	International Financial Statistics, International Monetary Fund.

Table 1. GMM model estimations (GDP and REEL)

	High-Income Countries			Upper-Middle Income Countries		
Dependent Variables	Coefficient	Std. Error	Signif.	Coefficient	Std. Error	Signif.
REER(-1)	0.825808	0.0149981	***	0.805443	0.0246167	***
GDP	0.132838	0.00775166	***	0.110927	0.0258149	***
Cross-sectional units:	37			23		
Observations:	703			430		
Test for AR(1) errors:	z = -3.82395 [0.0001]			z = -2.5852 [0.0097]		
Test for AR(2) errors:	z = -3.41829 [0.0006]			z = -1.92277 [0.0545]		
Sargan test:	Chi-square(189) = 36.6324 [1.0000]			Chi-square(189) = 22.9229 [1.0000]		
Wald (joint) test:	Chi-square(2) = 3827.23 [0.0000]			Chi-square(2) = 2533.57 [0.0000]		

Notes: (***), (**), (*) denotes the rejection zone at the 1%, 5% and 10% level of significance respectively.
The results were obtained using two-step estimation with asymptotic standard errors.

Table 2. Pairwise Granger Causality tests (GDP and REER)

Null Hypothesis:	F-Statistic	Prob.
High-income countries		
REER does not Granger Cause GDP	2.34411	0.0967
GDP does not Granger Cause REER	0.77617	0.4606
Upper-middle income countries		
REER does not Granger Cause GDP	5.92289	0.0029
GDP does not Granger Cause REER	1.26990	0.2819

Note: The results for the pairwise Granger Causality tests suggest that we can reject the null that GDP do not homogeneously cause REEL in both country clusters but do not direct in the opposite direction.

Table 3. GMM model estimations (baseline model)

	High-Income Countries			Upper-Middle Income Countries		
Dependent Variables	Coefficient	Std. Error	Signif.	Coefficient	Std. Error	Signif.
REER(-1)	0.73372	0.01851	***	0.72016	0.06961	***
TFP	−0.00226	0.00030	***	0.00303	0.00124	**
TR	−0.00031	6.5063e-05	***	−0.00191	0.00069	***
TNR	−0.00102	0.00057	*	0.00099	0.00161	
MCAP	4.141e-05	1.999e-05	**			
PCB	0.00023	4.482e-05	***	−0.00023	0.00099	
Cross-sectional units:	34			17		
Observations:	502			313		
Test for AR(1) errors:	z = -3.18794 [0.0014]			z = -1.98101 [0.0476]		
Test for AR(2) errors:	z = -2.44981 [0.0143]			z = -1.74711 [0.0806]		
Sargan test:	Chi-square(189) = 33.6668 [1.0000]			Chi-square(182) = 14.4159 [1.0000]		
Wald (joint) test:	Chi-square(6) = 5889.32 [0.0000]			Chi-square(5) = 205.568 [0.0000]		

Notes: (***), (**), (*) denotes the rejection zone at the 1%, 5% and 10% level of significance respectively.
The results were obtained using two-step estimation with asymptotic standard errors.

Table 4. Pairwise Granger Causality tests for the High-income countries (baseline model).

Null Hypothesis:	F-Statistic	Prob.
REER does not Granger Cause TFP	8.76173	0.0002
TFP does not Granger REER	2.26573	0.1045
REER does not Granger Cause TR	7.25955	0.0008
TR does not Granger Cause LREER	0.28926	0.7489
REER does not Granger Cause TNR	0.96372	0.3820
TNR does not Granger Cause REER	1.45060	0.2351
REER does not Granger Cause MCAP	0.87562	0.4172
MCAP does not Granger Cause REER	3.63781	0.0270
REER does not Granger Cause PCB	2.77439	0.0631
PCB does not Granger Cause REER	0.96523	0.3814

Note: The results for the pairwise Granger Causality tests for the high-income countries suggest that we reject the null that TFP, TRADE, and PCB do not homogeneously cause REEL but do not direct in the opposite direction. In the case of TNR and REER, the results suggest that the null cannot be rejected in both directions while in the case of MCAP we reject the null that REEL does not Granger cause REER but we cannot reject the null in the opposite direction.

Table 5. Pairwise Granger Causality tests for the Upper-middle income countries (baseline model)

Null Hypothesis:	F-Statistic	Prob.
REER does not Granger Cause TFP	4.54495	0.0113
TFP does not Granger Cause REER	0.60267	0.5480
REER does not Granger Cause TR	9.53761	9.E-05
TR does not Granger Cause REER	0.23242	0.7927
REER does not Granger Cause TNR	4.47479	0.0119
TNR does not Granger Cause REER	5.48363	0.0045
REER does not Granger Cause PCB	5.74134	0.0035
PCB does not Granger Cause REER	1.60988	0.2011

Note: The results for the pairwise Granger Causality tests for the upper-middle income countries suggest that we reject the null that TFP, TR, and PCB do not homogeneously cause REEL but do not direct in the opposite direction. In the case of TNR and REEL, the results suggest that the null cannot be rejected in both directions.

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Vogiazas, Sofoklis

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