The Real Exchange Rate and Development

Theory, Evidence, Issues, and Challenges[1]

Firat Demir

Department of Economics

University of Oklahoma

Norman, Oklahoma, USA 73072

E-mail: fdemir@ou.edu

Arslan Razmi[2]

Department of Economics

University of Massachusetts at Amherst

313 Crotty Hall, Amherst, USA 01003

Email: arazmi@econs.umass.edu

[1] Acknowledgments: We thank Salimeh Abedini Birang for excellent research assistance. For financial support, Firat Demir thanks University of Oklahoma Senior Faculty Summer Fellowship.

[2] Corresponding author.

The Real Exchange Rate, Economic Development, and Structural Change:

An Overview of Existing Literature

Abstract

This paper surveys the theoretical and empirical literature on the effects of the real exchange rate (RER) on international trade, economic development and growth. We summarize the main conceptual issues, discuss the relevance of the RER as an instrument of development policy, provide an overview of the macroeconomic and microeconomic mechanisms that link the RER to trade and long run growth and development, analyze the challenges – especially the disconnect between theory and data -- that often arise in empirical applications, and present new avenues for future research. In the process, we present some updated estimates and illustrative figures. The mechanisms through which the RER influences long-run growth and structural change outcomes remains a promising area of research and the relevance of individual channels in different contexts deserves much more careful investigation. Greater data availability should help fill some of these gaps in our understanding.

Keywords: Real exchange rate, Economic development, Structural change, Economic growth, International trade

JEL Codes: F31, F43, E2, O11, O24

1. Introduction

The real exchange rate (RER) is one of the most – if not the most -- important relative price at the macroeconomic level. Studying the link between the level of the real exchange rate and longer-term development issues had, however, fallen out of fashion for a few decades until a recent revival. The main aim of this paper is to provide a broad survey of this recent body of literature, reconcile it with the earlier research, and provide an overview of the issues and challenges involved.

The two main channels through which the RER affects incomes, growth and development are the (short-run) Keynesian macroeconomic aggregate demand and trade channels and the (long-run) development channel. The first of these channels is also the most obvious one as the price of a country's currency is a major factor determining its international competitiveness. Although first formalized by David Hume, the emergence of research on this link between exchange rate movements and trade dates back earlier to the Mercantilists, and continues through to the Gold Standard and the ensuing Bretton Woods years, which were marked by debates centered around issues such as elasticity optimism/pessimism, the effect of secular trends in terms of trade on economic development, and the role of the exchange rate in maintaining internal and external balances. The second channel works through structural change caused by both demand and supply side factors in the form of employment and output shifts toward higher productivity and increasing return sectors, learning-by-doing, profitability, saving, and investment changes, information-related market failures, and other externalities. While the role of exchange rate policy in affecting longer-run development received some attention in the post WWII Bretton Woods years, consistent with the overall spirit of the era, most analysis was skeptical of the idea. Furthermore, contrary to more recent research, many policy makers promoted selective overvaluation, rather than undervaluation, in order to bring down the costs of imported inputs. Thus, although the importance of the RER as

a development policy tool was recognized, its use was justified often on grounds other than competitiveness or export sector profitability. Moreover, empirical studies that were based on limited data from that period yielded conflicting results that were justifiably criticized in a classic paper by Orcutt (1950).

Most macroeconomics and development literature during the trade and financial liberalization period of the 1980s also tended to ignore the role of exchange rate as a development policy tool. In most growth literature, for example, the level of the RER is not of first order importance at all.[3] This is in spite of the work on the East Asian development experience by scholars such as Amsden (1989) and Wade (1990) who noted the importance of exchange rate policy for policy makers in South Korea and Taiwan, two of the Asian growth miracles. The picture has changed, however, in recent years, and the role of the RER in influencing output growth and development is now at the center of much debate. Subsequent studies, both theoretical and empirical, have mostly provided support for the use of RER undervaluation as an effective developmentalist policy with noticeable effects on both the level of economic activity and long run economic growth. The effect is also shown to be the opposite for RER overvaluations, which are found to slow down growth, particularly in developing countries. This literature has also evolved over the years. While the earlier literature was mostly focused on aggregate country level analysis, more recent work has frequently involved firm and product level studies, highlighting the importance of the trading environment, productivity, product quality and variety, technology and skill intensity, and income levels of importers and exporters in shaping the effects of exchange rate.

[3] In Barro and Sala-i-Martin (2004) the exchange rate appears only on three occasions, all related to growth regressions but not in any of the growth models or policy discussions.

This paper attempts to provide a broad survey of the literature on the RER as an instrument of development policy. The focus is on long-run development issues. We discuss the conceptual issues, summarize major approaches taken to measuring the RER, explore the theoretical channels linking exchange rate policy to development, provide an overview of the empirical literature, and highlight some of the complications that arise when exposing theory to data.

Several qualifications are in order. First, we are concerned with the level and not the volatility or uncertainty of the RER. Second, we do not cover the large literature that attempts to address exchange rate determination or the pros and cons of different exchange rate regimes. Third, given our focus on development, we ignore short-run fiscal and monetary policy issues. Fourth, due to space limitations we do not fully discuss the effects of methodological diversity on empirical analysis of the RER and development, including the estimation methods.

The rest of this paper is organized as follows. Section 2 discusses whether the RER is a policy variable that can be managed. Section 3 summarizes RER measures used in the literature and their relative strengths and weaknesses. Section 4 surveys the theoretical channels that link RER to growth, development, and structural change. The penultimate section provides an overview of related empirical literature, presents some new estimates, and reports the relevant findings. Finally, the concluding section summarizes the lessons learnt and supplements the previous sections in suggesting avenues for future research.

2. Is the Real Exchange Rate a Policy Variable?

Before examining various effects of exchange rate movements on economic activity, we need to address the questions of whether the RER is actually a policy variable and, if so, to what extent policy can influence it in the desired direction. Traditionally the literature understated the role of policy in managing the exchange rate over extended periods of time, especially in the presence of

international capital mobility. A body of research going back to Mussa (1986) shows, however, that the RER tracks the nominal exchange rate rather closely, which suggests that targeting the latter may effectively target the former as well, at least in the short- and medium-run. This is not surprising in the presence of nominal rigidities. Policy can influence the path of the nominal exchange rate through fiscal or monetary policy. The former acts by affecting both the volume and composition of aggregate expenditure, given that government spending is typically biased towards non-traded goods relative to private spending. Monetary policy, on the other hand, is seen to act through three main channels; the portfolio channel, the signaling channel, and by altering the proportion of "chartists" versus "fundamentalists" in the foreign exchange market.

Do policy makers actually make use of the instruments at hand to influence the RER? Calvo and Reinhart (2002), coined the term "fear of floating" after showing that, in the aftermath of the Asian crises in 1997-98, developing countries have systematically intervened in the foreign exchange market to manage the behavior of exchange rates. Furthermore, Levy-Yeyati et al. (2013) convincingly show that sterilized interventions that aim to maintain competitive exchange rates or to avoid overvaluation do affect the RER in the short- and medium term. Given the RER behavior noted by Mussa (1986), this has implications for the influence of policy on RER.

It may, of course, be easier to target a RER level under certain conditions compared to others (Kaldor, 1971). As Frenkel and Rapetti (2014) point out, the key is that the constraint for sterilized interventions changes from foreign exchange reserves in the case of external deficits to domestically issued sterilization bonds in the case of surpluses. The former constraint places an obvious finite limit as reserves cannot be negative. However, in the latter case the constraint may often be milder and depends on the depth of domestic financial markets, the credibility of monetary institutions, the level of public debt, etc. Insofar as an undervalued RER is associated with current account

surpluses, the open economy trilemma may be negotiable for longer in the latter case. China, with its successful history of undervaluation and sterilized interventions provides an illustration.

While it is not the main focus of this paper, one may also think about whether exchange rate policy is a substitute or a complement to other interventionist tools such as monetary, fiscal and trade policies (Kaldor, 1971; Guzman et al., 2018). Fiscal expansion, for example, can help investment recover in times of aggregate demand shortage. As discussed earlier, however, if the goal is to shift resources in favor of the tradable sector, then fiscal expansion may undermine this objective through both income and substitution effects. Moreover, the effect on the trade balance is also likely to be negative. Monetary policy generates its own tradeoffs. While sustained RER manipulation would require complementary monetary policies, the use of such policies alone could raise time inconsistency and inflation control issues that eventually undermine long-run growth.

Why use RER rather than other available policy instruments? Real undervaluation works as an export subsidy and an import tariff. Given that trade liberalization since the 1980s and evolving WTO rules have narrowed the scope for direct trade interventions through tariffs, quotas and export subsidies, the RER can be used as an alternative to such interventions (Rodrik, 2008). An advantage of using policies such as tariffs or direct subsidies is that these directly affect the targeted sectors. This also acts as a disadvantage, however, once we consider the political economy dimension since the winners are smaller subsets within the economy. RER policy, on the other hand, shifts relative prices in favor of the tradable sector as a whole, which helps ameliorate fissures and regulatory arbitrage between industries. It may not be feasible or desirable to tackle individual problems such as availability of electricity, transportation infrastructure, and corruption one at a time, and the RER can be used as an alternative mechanism to uniformly subsidize industrial sectors.

To encapsulate, even if one accepts the efficacy of the RER as an effective tool for structural change and growth, such a policy does not work in a vacuum, and has to be supplemented by the appropriate monetary, fiscal, and trade policies to address conflicting objectives (Kaldor, 1971; Rapetti, 2013; Guzman et al., 2018).

3. Exchange Rate Measurement: Which Exchange Rate?

The choice of the right exchange rate to use while analyzing international trade and development is not a straightforward one. Since we are interested in long-run development issues, one question is how to define the long-run RER? Another is how to empirically implement the conceptual definition? Yet another is what variables to use to estimate the long-run level and misalignment? In this section we briefly discuss various factors that determine the type of exchange rate that is chosen in the literature, beginning with a review of the conceptual issues and then turning to the even messier side of applied analysis with measurement challenges.

3.1. Conceptual issues: Specialized vs dependent economy models

The definition of the relevant RER depends, among other factors, on the structure of the economy, its size in international markets, and the structure of its trade. The simplest and most widely used definition compares an aggregated measure of the price level of domestic goods to that of international goods. Suppose that the home country and the rest of the world each produce one good that is tradable, and the two goods are imperfect substitutes. Additionally, both countries set prices in their domestic currencies and have infinite price elasticity of export supplies so that they can change exports in response to demand at given price levels. These are assumptions that most likely apply to large economies that produce differentiated goods and where the producers are operating at less than full capacity. Suppose also that producers set the same prices for their

respective goods (P and P^*, respectively) in domestic and international markets. Then, the external RER (RER_{ext}) is defined as follows:

$$RER_{ext} = eP^*/P \tag{1}$$

where e is the nominal exchange rate (the price of foreign currency in terms of domestic currency).

Sometimes, especially while analyzing primary commodity exporters or when implementing trade-related empirical exercises, the RER is defined as the terms of trade (RER_{tot}). If P_X and P_M represent aggregate export and import prices, respectively, then we get:

$$RER_{tot} = eP_X/P_M \tag{2}$$

Economies in the real world produce and consume both tradable and non-tradable goods, and aggregate price indexes are weighted averages of the prices of both kinds of goods. Consider a domestic economy and a foreign one, each producing a tradable good and a non-tradable one. Suppose α (α*) is the weight assigned to tradable goods while specifying an aggregate price index for the home (foreign) country. Then, using a Cobb-Douglas specification, we get the internal RER:

$$RER_{int1} = e(P^*_T)^{\alpha}(P^*_N)^{1-\alpha}/(P_T)^{\alpha}(P_N)^{1-\alpha} \tag{3}$$

In the "dependent economy" framework, it is typically assumed that the economy is a price taker in international markets (both because of the its economic size and the assumption that the goods it produces have close substitutes in international markets). The economy, therefore, faces perfectly elastic export demand and import supply curves, i.e., the international terms of trade are exogenously determined. Prices for goods that are not internationally tradable, on the other hand, are determined by domestic supply and demand. It is easy to show that, if the law of one price holds for traded goods, the indexes are identically constructed in the two countries, and the (exogenous) prices of goods in the rest of the world are normalized to unity, then equation (3) reduces to:

$$RER_{int2} = P_T / P_N \quad (4)$$

Thus, the relevant RER, which induces substitution in consumption and production, is the relative price of traded goods in terms of the non-traded good, i.e., the internal RER: the underlying infinite price elasticities of export demand and import supply suggest a longer-run perspective and, given their economic size and structure, are particularly relevant for developing economies.

Before we turn to measurement issues, let us briefly consider the small open economy assumption that motivates the dependent economy framework.

3.2. Are developing countries price takers in international markets?

With few exceptions, most countries are not large or specialized enough in most sectors to influence the world price of their exports (and especially) imports. To what extent can the typical country be treated as a price taker in international markets? The extent to which a country can be analyzed as a small open economy mainly depends on: (1) the degree of substitutability between its products and those of its trading partners, and (2) the market power that it has in different sectors. One way to approach this question is to directly estimate the relevant elasticities at the aggregate level. The empirical evidence on price elasticities of export and import demand in developed countries generally suggests that they are sufficiently high for the Marshall-Lerner condition to be fulfilled.[4] However the estimates vary and, for reasons identified originally by Orcutt (1950), aggregate estimates of trade elasticities are likely to be biased downwards and misleading. These problems are much better explored at the sectoral level, and thanks to wider data availability, it is now feasible to do so. Before we review sectoral estimates, however, it would be useful to look at some of these data. For example, given their nature, one would generally expect the degree of market power to

[4] See, for example, Bussiere et al. (2020), who finds that the Marshall-Lerner condition is almost universally satisfied.

be greater for economically large countries and the degree of substitutability to be greater for homogeneous goods than for differentiated goods. This suggests that it would be useful to look more closely at the relative composition of developing and developed country exports.

The higher share of differentiated goods in international trade, and the presence of imperfect competition and product differentiation make the demand for industrialized country exports of manufactures less than perfectly elastic. However, the same is less true for developing countries. First, as we show below, a higher percentage of developing country exports are homogenous primary goods. Second, their exports of manufactures are mostly low skill and not differentiated. To illustrate this point and following Lall (2000), we classify the technology-and-skill-intensity of exports in five product categories: high-skill intensive manufactures (*High-skill*), medium-skill intensive manufactures (*Medium-skill*), low-skill intensive manufactures (*Low-skill*), natural-resource-intensive manufactures (*Resource*), and primary products (*Primary*).[5] Figures 1 and 2 show that the median share of primary goods in total exports was 46% for low income countries, 23% for middle income countries and 8% for high-income OECD countries in 2017. In contrast, the median share of high-skill manufactures was only 1% for low income, 2% for middle income and 10% for high income OECD countries in 2017. Figures 1 and 2 also show that differences in the export structures across these three groups of countries have been persistent across decades. Particularly, the share of primary goods is significantly higher among low- and middle-income countries than high-income countries.

<Insert Figures 1-2 Here>

[5] We provide details of product classification in the Appendix.

Another way to gauge the nature of international demand for products is to examine how closely substitutable a country's exports are for exports from other countries. By definition, differentiated products tend to have fewer substitutes than homogeneous goods. Figure 3 shows the median export shares of differentiated products (using the Rauch, 1999 conservative definition) within each income group and confirms the high level of heterogeneity in export structures between these country groups. In 2017, the median share of differentiated goods in high income OECD countries' export baskets was 76% while the same number was 45% for middle-income and 26% for low-income countries.

<Insert Figure 3 Here>

Regarding econometric evidence, using the Rauch (1999) classification, Broda and Weinstein (2006) and Soderbery (2018) find that the average elasticities of substitution are much higher for commodities than for reference-priced goods, which in turn are higher than those for differentiated goods. Likewise, Fontagne et. al. (2019) shows that trade volume responses to bilateral tariffs are larger for homogeneous than for differentiated products (using the Rauch, 1999 classification). Finally, turning to market power, Soderbery (2018) derives inverse export supply elasticities for disaggregated trade flows and find that importing countries that are larger in terms of GDP, tend to have greater market power. Moreover, their estimates yield supply elasticities for differentiated goods that are, on average, around three times larger than for homogeneous goods.

3.3. The measurement of domestic and international prices

The choice of price indexes to calculate RER is generally dictated by theoretical considerations and data availability. If the objective is to capture international price competitiveness on the demand side, then the producer price index (PPI) and wholesale price index (WPI) often best capture tradable goods prices. Alternatively, unit labor costs in the tradable sector provide an informative

measure. In a dependent economy framework, the ratio of tradable-nontradable good prices is often proxied by the ratio of PPI (or WPI) to CPI. However, empirical work is often constrained by more limited data availability for PPI/WPI and unit labor cost series. Therefore, aggregate-level studies typically opt to use CPI to calculate the RER series. Using IFS (2019) data and based on the external RER in Eq. (1) (i.e., eP^*/P), the data coverage drops from 8,576 for 189 countries with CPI-based RER (for 1950-2019) to 2,738 for 85 countries with the PPI-based RER (for 1950-2018).

3.4. How to measure exchange rate misalignments?

How to evaluate deviations from the "equilibrium" value of the RER and how to define this equilibrium? An early answer came from Nurkse (1945) who defined the equilibrium exchange rate as one that maintains external and internal balance.[6] The former, in turn, implies current account imbalances that can be financed by normal capital flows while the latter reflects full employment and equilibrium in the market for non-tradable goods. Later work has introduced the related notion of "fundamental equilibrium exchange rate" (FEER) which is the level that is "expected to generate a current account surplus or deficit equal to the underlying capital flow over the cycle, given that the country is pursuing internal balance as best it can and not restricting trade for balance of payments reasons" (Williamson, 1985, p. 14). Finally, there is the "behavioral equilibrium real exchange rate" (BEER) which introduces behavioral content that explains RER misalignment in terms of deviations of the actual exchange rate from its long-term equilibrium value. These values are derived from reduced form estimates based on a vector of medium- and short-run fundamentals such as real interest rate differentials, the terms of trade, productivity, and fiscal policy that cause short-run deviations from long-run trend values. The emergence of models

[6] For further discussion, see Krugman (1990).

with intertemporally optimizing representative agents has led to the extension of BEER models along this dimension.

For our purposes, the most crucial distinction is between the short-run effects of RER changes on the macroeconomy and the long-run developmental effects of RER misalignment. Variables such as nominal wages, inflation, the stock of net foreign assets, or the capital stock that may reasonably be considered pre-determined in the short-run are usually treated as endogenous over longer periods. Longer-run estimates of misalignments, therefore, often control for the evolution of these variables.

The simplest approach to incorporating long-run considerations -- one that involves rather light data requirements -- is to consider deviations from the Balassa-Samuelson adjusted RER. Balassa (1964) and Samuelson (1964) suggested that, due to their higher relative productivity in the traded goods sector which translates into higher economy-wide wages, higher income countries tend to have higher aggregate prices. Thus, one usually estimates Eq. (5) below where Y_{it} is the real GDP per capita of country i at time t, ln represents natural logarithms, and f_i and f_t are the country and time fixed effects.

$$lnRER_{it} = \alpha + \beta lnY_{it} + f_i + f_t + u_{it} \tag{5}$$

After running this regression, one can then calculate the RER undervaluation (i.e. misalignment) using the difference between the observed and predicted RER as follows:

$$lnUndervaluation = lnRER_{it} - ln\widehat{RER}_{it} \tag{6}$$

where $ln\widehat{RER}_{it}$ is the predicted value of *lnRER* from Eq. (5), and *lnUndervaluation* is the degree of misalignment: a positive value implies undervaluation. If averaged over 5-year or longer time periods, this approach should also minimize the influence of cyclical fluctuations.

Alternatively, as one could employ a more macroeconomic approach (either FEER or BEER) and incorporate other slow-moving variables such as the NFA position, the current account balance, the international terms of trade, share of government consumption, the national saving rate, and relevant demographic factors. Data availability becomes an issue here as many developing countries do not report high quality data at the desired frequency.

How do commonly used RER measures match up when we use real world data? For comparison, we calculated the RER misalignment using 5 models: 1) the basic Balassa-Samuelson method, 2) Net foreign assets (divided by GDP, NFA) adjusted Balassa-Samuelson, 3) NFA and (log) terms of trade adjusted Balassa-Samuelson method, 4) NFA, (log) terms of trade and government consumption (divided by GDP) adjusted Balassa-Samuelson method, and 5) the panel cointegration method including (log) real GDP per capita and NFA.

We present the RER misalignment for Japan and Mexico with respect to the US calculated by these five methods and using the PWT 9.1 with year and country fixed effects in Figures 4 and 5. Notice that when we add more controls, the sample period drops from 1950-2017 to 1970-2015. However, the addition of these extra controls does not seem to make a big difference in the misalignment measure. As Table 1 shows, all five series for the full sample of countries are highly correlated (significant at 1% level) with each other, though less so for the 5th method (cointegration).

<Insert Figures 4 & 5 Here>

<Insert Table 1 Here>

In estimating the misalignment measures, another issue is to decide on the relative price index specified on the left-hand side of Eq. (5). As mentioned earlier, the ratio of the PPI (or WPI)

to the CPI may be appropriate for the internal RER but in practice, the relative CPIs are almost always used given their wider data availability. A second issue is to decide on the data source for the RER and national income data, which can influence the misalignment measurement significantly. Figure 6 shows the RER misalignment for Mexico using equation (5) from IFS (2019) and PWT 9.1. While the two series are highly correlated (0.96), they differ substantially in some sub-periods. We should also note that the exclusion of country fixed effects influences the misalignment measures significantly. The correlation between RER misalignment measures with and without country fixed effects is only 0.47 (using Eq. 5 and misalignment measure (1) with the PWT 9.1).

<Insert Figure 6 Here>

4. Exchange Rate and Development

The exchange rate barely makes an appearance in the standard growth models. This is true for both mainstream and heterodox growth models, although for different reasons. In the former, it is mostly because of the dominance of the idea of monetary neutrality. A nominal variable such as the exchange rate should not be expected to affect real outcomes, especially in the long-run. If policy can only influence the nominal but not the real exchange rate, then there is no reason to consider the exchange rate as relevant to long-run development policy. Take, for example, the canonical Solow growth model or the family of endogenous growth models. Since there is no obvious association between the stocks of factors of production and the exchange rate, the latter is not a variable of interest in the determination of the steady state growth rate.[7] Similarly, in non-mainstream growth models, such as those belonging to the Post-Keynesian tradition, the exchange

[7] Although it may affect the transitional dynamics through the savings channel.

rate has not typically played a major role because of a skepticism towards the role of relative price changes. The Balance of Payments Constrained Growth (BPCG) model perhaps best illustrates this neglect. In spite of the central role of open economy issues in this model, the RER is often ignored, in applied practice if not in theory, on the grounds that the level of the RER is not important (although often the *rate* of exchange rate change is incorporated).

Over the years, however, a body of literature has emerged that analyzes the various theoretical mechanisms and channels through which the real and nominal exchange rate can influence the long-run trajectory of structural change and development.[8] The rest of this section summarizes this literature. It begins with an overview of the channels that link the RER to trade and demand growth in the short run, and then shifts the focus to longer-run issues.

4.1. The short-run macroeconomic channels

The trade effects of exchange rate changes were a subject of intense debate during the post WWII decades identified with import substitution policies. In particular, whether undervaluation helps or hurts industrialization efforts was under scrutiny. On the one hand, it was emphasized that overvalued RER could be used as an additional subsidy for industrial sectors by lowering the cost of imported intermediate and capital goods. On the other hand, it would impose a cost on exporters and import-competing industries by hurting international competitiveness.

As we see below, underlying much of this debate was the so-called "elasticity pessimism" view that held that trade demand elasticities are much too small to have significant effects on trade volumes. This debate has increasingly shifted in favor of the pro-undervaluation camp especially after the successes of the East Asian tigers under export-led development model as well as the

[8] For a recent review of RER and industrial policy, see Bresser-Pereira and Rugitsky (2018).

failures in many cases of ISI programs in Latin America and the Middle East. International organizations such as the IMF also played a key role in this transition during stabilization programs as they frequently focused on exchange rate devaluations as a tool for expenditure switching policies to achieve current account balance.

4.1.1. Income and substitution effects on trade values

The most direct channel through which the RER affects the external balance is through the income and substitution effects. As discussed earlier, the traditional approach to analyzing this linkage is the classic Marshall-Lerner condition, which assumes infinite elasticities of export and import supply.[9] In its simplest form, assuming initially balanced trade, the sum of export and import demand elasticities should be greater than one for a devaluation to improve the trade balance.

More recent models of trade behavior take into account the degree of exchange rate pass through, pricing to market, supply bottlenecks, and related issues. Production in many developing countries, for instance, relies largely on imported intermediate inputs, which do not have domestically produced substitutes. This will negate some of the effect of exchange rate movements on trade volumes. Furthermore, micro level empirical studies suggest that higher productivity firms, and firms within global supply chains have a higher share of imported inputs that are of higher quality and cost more (Kugler and Verhoogen, 2009; Manova and Zhang, 2012). Real depreciation will increase the cost of imported inputs for these higher-end firms, and thus dampen the reallocation of resources from nontraded to traded good sectors, or from traded primary to manufacturing sectors. This effect is mitigated, however, if it is the large importing firms are the ones that happen also to be the large exporting firms. Blaum (2017), for example, finds that large

[9] One can relax these assumptions by generalizing to the Marshall-Lerner-Robinson-Bickerdike condition.

devaluations are characterized by increased aggregate shares of imported inputs in total input spending, and that these facts are explained by the expansion of exporters, who are intensive importers (see also Amiti et al., 2014). Similarly, if the exchange rate pass-through into the foreign currency export price is low, perhaps because the economy is small in its export markets, the immediate effect of nominal exchange rate movements on the volume of exports will be weak, limiting the effect on trade balance (measured in foreign currency terms).

As mentioned earlier, for reasons that have to do with the composition of their exports (mainly primary commodities and agricultural products) and imports (non-substitutable intermediate inputs and capital goods), and the limited supply elasticities, there was considerable skepticism in the early post-WWII decades that the Marshall-Lerner condition was satisfied for most developing economies. It is now a widely recognized finding in empirical trade literature that estimates of aggregate trade elasticities are smaller, on average, than the corresponding microeconomic estimates at the industry/sector level. Although initially explored by Orcutt (1950), recent explanations have re-focused on the "heterogeneity bias." The output of sectors that have low price demand elasticities are likely to get greater weight (due to their greater price volatility) while estimating aggregate elasticities. Why would one expect price changes to be larger for inelastic products? Imbs and Mejean (2015) cite two major reasons: (1) firms facing elastic demand under imperfect competition will opt to vary their mark-ups to limit the price response to cost shocks, and (2) for economic reasons, policy makers tend to target inelastic products for tariffs. They also find that, based on US data, the sectoral data imply elasticities that are more than 3 times those derived from aggregated data.

4.1.2. The absorption approach and effects through the *composition* of absorption

Based on national income accounting, the current account is the mirror image of the gap between national income and expenditures (absorption). In many developing countries devaluation may result in a short-run contraction in the level of spending and economic activity through several channels, some of which we now discuss (see Krugman and Taylor (1978) for a formal treatment).

(1) Redistribution within the private sector (the "Diaz-Alejandro effect"): Given that domestic prices are a weighted average of domestic and imported good prices, devaluation increases domestic price levels and, assuming nominal wage rigidity, causes a reduction in real wages and redistribution in favor of owners of capital. Assuming that workers have a higher marginal propensity to consume than capitalists, decreasing real wages will lead to lower private spending, thus contracting domestic demand and output.

(2) Fiscal effects: If the country is a price taker in export markets so that the volume of exports is independent of the exchange rate, the value of exports in foreign currency becomes independent of the exchange rate. In that case, the real value of taxes paid by exporters (measured in domestic output units) increases after a devaluation and therefore reduces private disposable income and spending. The underlying assumption here is that the marginal propensity to consume for the public sector is near zero in the short run.

(3) Valuation effects: Returning to the Marshall-Lerner set-up, suppose a country has an initial trade deficit. The effect of a devaluation, in that case, will mechanically create a trade deficit, if we ignore all substitution effects and measure all quantities in terms of the domestic currency (because in this case the adverse valuation effect falls on imports, which are larger to begin with). The resulting decline in spending on domestic goods, again, has contractionary effects. This is related to the broader "Hirschman effect." Hirschman (1949), showed that, if we relax the assumption of

initially balanced trade, then the Marshall-Lerner condition is more likely to be satisfied, that is, the trade balance is more likely to improve following a devaluation if the economy devalues starting with a trade surplus and if all quantities are measured in domestic currency. Conversely, if all quantities are measured in foreign currency terms, then a devaluation is more likely to improve the trade balance if the economy starts with an initial trade deficit.

(4) The Laursen-Metzler effect: The standard Keynesian consumption function implies a declining average propensity to consume as income rises. An implication, in the imperfect substitutes framework, is that RER depreciation that lowers the terms of trade and thus reduces income in terms of the foreign good, may raise aggregate spending in terms of the domestic good. This, in turn, affects the current account negatively.

(5) Wealth effects: A nominal devaluation that increases domestic prices, reduces real money balances and real wealth. The resulting negative effects on domestic spending can cause the trade balance to improve even if devaluation leaves the terms of trade unchanged. The emphasis on the absorption effects of a higher price level has been a highlight of the monetary approach to the balance of payments (see Frenkel and Johnson, 1976).

To sum up, much of the short-run effects of exchange rate changes on output depend on the impact on the trade balance, either through trade values, or through the impact on domestic spending on domestic goods. The longer-run development-related analysis, where growth effects of investment, technological progress, and structural change come into play, is what we explore next.

4.2. The development channel

This section focuses on the effect of the RER on longer-run development, structural change and economic growth, and examines what Frenkel and Ros (2006) called, the "development channel."

The development process involves economic changes at both the micro and macro levels, and greater data availability over time has meant that analysis can be more fine-grained than in the past. As in the previous sub-section, we begin with a brief overview before discussing specific channels identified by the literature as potentially important for the development-RER nexus.

The earlier development literature did not view the RER as a viable industrial policy tool for structural change.[10] There has, however, been a resurgence in recent years of interest in the role of the RER as an instrument for development and the utility of, in the words of Amsden (1989), getting prices "wrong" (see Bresser-Pereira and Rugitsky (2018) for a review of these debates). This has followed the successful East Asian experience and is in contrast to the Washington Consensus that influenced policy worldwide over much of the post-1980s debt crisis period, and saw RER issue as mostly one of avoiding misalignment (both under and over valuation) and getting the (relative) prices to be consistent with their equilibrium values, howsoever defined. While there is still ongoing debate over the concept of equilibrium exchange rates and the mechanisms through which the RER can influence structural change and development, the bulk of recent work has found a positive relation between the degree of RER undervaluation, growth, investment, and economic diversification, especially in developing economies (Hausmann et al., 2005; Gala, 2008; Rodrik, 2005, 2008; Freund and Pierola, 2012; Razmi et. al., 2012; Rapetti et al., 2012; Di Nino et al., 2011; Levi-Yeyati et al., 2013; Missio et al., 2015; Guzman et al., 2018). This is not to say however that

[10] There were, of course, exceptions. Kaldor (1971), for example, already emphasized the importance of exchange rate for manufacturing industries, which enjoy increasing returns: "The task of maintaining competitiveness through the choice of a favorable exchange rate is therefore of the highest importance to an industrial country from the point of view of its long-run growth potential and not only on account of its short- or medium-term effect on the level of employment" (Kaldor, 1971: 8).

the strength or even the direction of the development channel is independent of country and product characteristics. Next, we review the main channels through which the RER is expected to affect long run development and growth.

4.2.1. The profitability channel and reallocation of resources

Changes in the RER affect the relative profitability of the tradable sector. Assume for simplicity that the tradable sector is a price taker, at least in the long run, in the international markets. It is relatively straightforward to show that, under a broad range of plausible assumptions including any degree of nominal wage rigidity, a real devaluation reduces the product wage and increases the relative profitability of the tradable sector. This, in turn, would help the tradable sector expand over time as a result of investment and resource reallocation, including the development of infant industries. If there is something special about this sector, such as higher average productivity, the ability to expand without driving down prices (to the extent that these are internationally determined), the larger scope for learning-by-doing, more opportunities for technological innovation, or greater presence of (internal and external) economies of scale, then such resource reallocation places the economy on a higher growth trajectory. This is the classical development channel as structural change through industrialization and relocation of resources towards tradable goods with higher technology-and-skills content and increasing returns has been recognized as the main pathway to climb up the production ladder (Prebisch, 1950; Kaldor, 1966, 1971; Balassa, 1971). If RER policy can help reallocate resources towards sectors with learning spillovers and external economies, it is likely to be welfare improving (Ros, 2015, Ch.3; Guzman et al., 2018).

The link from real undervaluation to profitability and sustained development can work through different mechanisms. Before we turn to these mechanisms, an important caveat is in order. This has to do with the presence of comparative advantage and relative resource costs. Many

developing countries mainly export primary commodities and are price takers in these markets (see Figures 1-3). Increased profitability in these sectors may actually encourage specialization in commodities, leading to 'premature' deindustrialization and a re-primarization, with destructive effects on long run capital accumulation and growth, a process Ros (2013) called "Prebisch's nightmare."[11] Prebisch (1959), Ros (2013) and Guzman et. al. (2018) discuss this issue in detail and suggest that, if the idea is to boost diversification in the manufacturing sector, and not expansion of the tradable sector *per se*, then an undervaluation may have to be accompanied by a tax on commodities. This, in effect, creates a multiple RER regime through which policy makers can subsidize manufacturing firms.

The tension between non-produced natural resource endowments and the perceived desirability of industrialization is an important consideration that was addressed somewhat differently during the import substitution era. Rodrik (1986), for example, offers a theoretical model whereby disequilibrium exchange rates, both under and overvalued, can raise welfare by promoting structural change and industrial growth. Accordingly, changes in internal terms of trade in favor of industry is seen as the main development channel for structural change. In the presence of an inward oriented industrial sector and an export oriented agricultural sector, which was the typical duality in most developing countries at that time, the exchange rate serves as a double-edged sword: an overvalued currency imposes a tax on export-oriented agricultural sector but works as a

[11] Premature deindustrialization refers to declining share of industrial value added, investment and employment in a country before it becomes developed. Re-primarization refers to the specific case of semi-industrialized countries such as those in Latin America that experience a return to a primary good based specialization. For a discussion, see McMillan and Rodrik (2011), Ros (2013), Dahi and Demir (2016, ch.5).

subsidy for the domestic industrial sector by lowering cost of imported inputs, both intermediate and capital. The net effect could be a transfer of resources from agriculture to industry.

With growing trade and internal liberalization, developing economies are now much more influenced by international markets. This has led to theoretical models that treat traded goods prices as determined in international markets. The implications turn out to be quite different. Ros and Skott (1998), for example, build a two-sector model with a modern traded goods sector (utilizing capital and operating under increasing returns to scale) and a non-tradable sector, and examine the effects of RER on capital accumulation. In this setting, RER overvaluation causes a profit squeeze in the modern sector and leads to a lower capital stock equilibrium. Conversely, for a low-income economy, RER undervaluation can lead to a self-sustaining trajectory towards the higher capital stock equilibrium.

Rodrik (2008) posits that the tradable sector in developing economies is characterized by market failures and institutional weaknesses to a greater extent, which means that the tradable sector is below its optimal size, and this creates room for policy to remove the distortion. He shows, in an endogenous growth framework, that undervaluation helps address this issue by expanding the tradable sector. Likewise, Razmi et. al. (2012) emphasize productivity increases based on shifting of resources (including Lewisian surplus labor) from traditional to modern/industrial sectors. If the tradable sector is the modern/capital-intensive/high productivity one, then raising the profit rate through a devaluation boosts aggregate employment and productivity.

The presence of Arrow-type learning effects and related externalities makes intuitive sense for the manufacturing sector in developing economies. Rapetti (2013) posits the presence of external economies of scale to focus on the possible tradeoffs between domestic short-run demand management and longer-run growth. Consider a policy maker who attempts to internalize learning

externalities by boosting profitability in the modern tradable sector through nominal undervaluation. If this translates into real undervaluation on impact, one would expect non-tradable price inflation, due both to substitution effects and because of upward wage pressure. This causes a "horse race" between rising productivity (due to investment and increasing returns) and wages. Rapetti (2013) analyzes the conditions under which multiple equilibria arise, and aggregate demand policies can help policy makers move the economy to the high capital stock equilibrium over time.

A parallel strand of research comes from the "new" new trade theory" with a focus on firm-level responses to RER movements. Melitz and Ottaviano (2008), Berman et al. (2012) and Martin and Rodriguez (2004), for example, find that high-productivity exporters with lower demand elasticities respond to a RER depreciation by increasing their mark-ups rather than export volumes. Likewise, Chatterjee et al. (2013) show that, in response to a RER depreciation, high-productivity firms increase their product range and core product prices. This will effectively dampen the Keynesian macroeconomic channel. The findings from these studies suggest that firm heterogeneity determines how firms react to a positive profitability boost after a RER undervaluation/depreciation. High-productivity firms increase their mark-ups and range of products rather than export volumes. This boost to profits, in turn, is expected to increase capital accumulation in the long run. Low-productivity firms, however, will respond by having higher entry rates and export volumes as previously unprofitable firms will now be able to enter the export market. Another related body of literature, argues that the negative profitability effect of RER overvaluation has a positive effect on traded good sector productivity by increasing competitive pressures. Ekholm et al. (2012), for example, finds that RER appreciation affected Norwegian manufacturing firms through export sales, imported inputs and import competition in the domestic market with a net gain in labor productivity and TFP for exporting firms.

Finally, one should note that the profitability channel is related to the Dutch disease and natural resource curse issues. An exogenous shock such as natural resource discovery, a large terms of trade shock favoring primary goods, or a surge in capital inflows can affect the RER. The research on Dutch disease essentially underlines the concern that RER overvaluation can cause a profitability squeeze in the non-primary traded goods sectors and lead to deindustrialization, with a decreasing share of non-primary traded goods in total value added and employment (Ros, 2015, ch.4; Guzman et al., 2018).[12] The mechanism is typically seen to work through two channels: (1) the spending effect: an exogenous shock that boosts the purchasing power of spenders through income and wealth effects generates excess demand in the goods market, leading to real appreciation, (2) the resource effect: the movement of labor, capital, and other resources towards the expanding commodity sector at the expense of other sectors in the economy. The first effect tends to expand the non-tradable sector while the second tends to contract it. The cases of Latin America and sub-Saharan Africa during the 2000s highlight the deindustrializating effects of overvaluations in the aftermath of a positive terms of trade shock (Ros, 2013).

4.2.2. Higher savings and investment

As discussed in section 4.1.2, this aspect of RER undervaluation/depreciation was first highlighted by Diaz Alejandro (1965). He, however, emphasized the short-run contractionary impact of the redistribution from low-propensity to save workers' wages to profits. In contrast, Kaldor (1971) emphasized the positive effects of competitive exchange rates through exports growth on manufacturing sector investment and productivity with significant long run growth effects. Levi-Yeyati et. al. (2013) relate RER to the balance sheet channel and longer-run growth. Accordingly,

[12] See Harding and Venables (2016) for a comprehensive survey.

if higher savings enable financially constrained tradable goods firms to invest more through larger supply of internal funds and/or through lower cost of capital and greater credit availability, then devaluations could be expansionary over the long run. Razmi, et. al., (2012) also highlight the impact of undervaluation and higher profitability on investment in a Keynesian framework with an independent investment function. Conversely, a body of literature that developed following the Asian crisis of 1997-98, identified the negative balance sheet effects on investment and output (see Krugman, 1999 and Frankel, 2005). With a substantial proportion of their liabilities denominated in foreign currency, developing country firms can find themselves insolvent following large depreciations. This can then negatively affect investment, exporting activity, R&D, output and long run growth (Cespedes et al., 2014; Serena and Sousa, 2017).

4.2.3. Structural diversification and product composition of trade

The process of industrialization appears to involve diversification in its early and middle stages (see Imbs and Wacziarg, 2003 for economic structure and Cadot et. al., 2011 for export structure). In cases where learning externalities increase private costs, RER policy can help countries acquire new sectors, which previously they did not have a comparative advantage in, and maintain them permanently. Krugman (1987) highlights this argument in a Ricardian framework with a continuum of goods and shows how a temporary real devaluation can help achieve permanent diversification. Razmi (2013) advances a similar argument in a model with surplus labor.

4.2.4. Balance of payments-related constraints on growth

Perhaps the most obvious linkage between the RER and growth goes through the balance of payments. The growth process for developing countries typically involves acceleration of capital goods and intermediate input imports. This high income-elasticity of imports can result in foreign exchange shortages and, in the presence of managed (flexible) exchange rates, pressure on reserves,

culminating in many cases in balance of payments crises and stabilization programs. While this link was recognized in early post-WWII literature (see, for example, the two gap models developed starting with Chenery and Bruno, 1962), the Post Keynesian BPCG model (Thirlwall, 1979) has zoomed in on this point. This framework, however, assumes infinite supply elasticities of export and import, which is unlikely to be a plausible assumption for most products exported by developing countries. Moreover, relative prices matter, by construction, only in terms of rates of change and not levels. This is in tension with the presence of learning externalities, resource reallocation, capacity growth, and other long-run development considerations which may enable a country to export increasing volumes at a given international relative price (see Razmi, 2015 for a critique of the BPCG model). The balance of payments constraint itself, however, remains important as the Latin American debt crises of the 1980s, the Mexican crisis of 1994, and the Asian crises of 1997-98 were all preceded by overvalued RERs.

4.2.5. North vs. South asymmetries

Differences in the pattern of specialization and the composition of trade are likely to condition the effects of RER undervaluation across countries. Systematic differences in price elasticity of demand, in particular, mean that RER changes are likely to have smaller effects in the short- to medium-run on the volumes of higher-skill, more sophisticated and newer technology goods such as those exported by the North than the lower-skill intensive and less heterogeneous goods exported by the South. Based on Vernon (1966), it is also likely that price elasticities are lower in the early stages of a product's life cycle for new and technology intensive goods, which are mostly invented and produced in the North. Furthermore, Northern producers enjoy higher mark-up rates than Southern ones given their higher average productivity levels. Due to the presence of large reservoirs of underemployed labor, the profitability effect of RER undervaluation is likely to be higher in

Southern countries. Southern countries also suffer from a variety of market and government failures as well as structural constraints on their economic policies, which can make RER an easy second-best policy tool to support traded goods sectors and industrialization. This may explain why RER undervaluation is found to have a significantly positive effect on growth and investment only among the developing country samples. Caglayan et al. (2013) and Caglayan and Demir (2019) also provide evidence showing how countries' development levels and the technological composition of their exports shape the effect of RER depreciation on exports. It is important to keep in mind, however, that many primary good exporters may be less likely to benefit through the development channel from RER undervaluation as they face supply side rigidities.

5. Empirical Issues

The empirical work on the Keynesian trade channel is rich, examining various effects of exchange rate movements on trade flows, both at the macro and micro levels, and both aggregate and disaggregate levels. Given the availability of a large number of papers on the trade-RER relationship, we will focus mostly on the empirical studies of the development channel. As discussed earlier, there has been a renewed attention on the role of exchange rate in long term growth and structural change in recent years. However, most of these studies focus on the effects of exchange rates on growth without identifying the channels through which the development effect materializes. The empirical methodologies and estimation methods are also quite mixed. First, whether the observed growth effects are driven by a reallocation of resources towards increasing return activities, increasing savings, higher investment, or some other channel needs to be explored more carefully. Reallocation of resources towards different tradable sectors may not have the same development effects. High skill manufactures, for example, are quite different from low skill ones. A competitive RER will benefit all tradable sectors, including those in agriculture and natural

resources. Thus, rather than encouraging reallocation towards increasing return industries and enabling diversification, a competitive RER could lead to primarization and specialization in traditional and resource-intensive low return activities. Second, as pointed out by Henry and Woodford (2008), there is the question of how to and for how long to maintain RER undervaluation for it to be growth enhancing. Third, the relationship between RER and growth is a two way one and studying it requires appropriate estimation methodologies as correlation does not imply causality. Fourth, the definition of undervaluation is not straightforward and it is hard to get a consensus on how to estimate the equilibrium RER. Fifth, the cutoff point for developed vs. developing country incomes is not an obvious one. As highlighted by Henry and Woodford (2008), the reported positive effects of RER undervaluation on growth are sensitive to this cutoff point. We will now review each of these issues. Table 2 provides a selective review of empirical studies on the topic.

<Insert Table 2 Here>

5.1. Identification of the development channel

As highlighted earlier, much of the literature on the development channel consists of aggregate studies without a clear identification of the relevant channels. Dollar (1992), Hausmann et al. (2005), Gala (2008), Levy-Yeyati et al. (2013), Prasad et al. (2007), Rodrik (2008), Berg and Miao (2010), Di Nino et al. (2011), Berg et al. (2012), Rapetti et. al. (2012), and Habib et al. (2017) find a significantly positive effect of RER undervaluation on growth but mostly in developing countries.[13] Razin and Collins (1997) and Aguirre and Calderón (2005), on the other hand, find

[13] For a review, see Williamson (2013), Eichengreen (2008), Ros (2015) and Guzman (2018). For the earlier literature, see Razin and Collins (1997).

asymmetric effects of RER misalignment on growth; moderate undervaluations are found to promote growth, while larger undervaluations or overvaluations undermine it. In the opposing camp, Schroder (2013) finds that RER misalignment, both under- and over-valuation, is harmful for growth in developing countries. Likewise, Nouira and Sekkat (2012) find no support for the positive effect of RER undervaluation on growth in developing countries and suggest that the previously reported positive effects are likely to be caused by other complementary policies rather than the RER itself.

As for the channels, Prasad et al. (2007) find that RER appreciation causes a growth slowdown in exporting sectors as well as the manufacturing industries and their finding is consistent with Rodrik (2008) who shows that RER undervaluation increases the share of industry in GDP and total employment and reduces that of agriculture. Galindo et al. (2007), Einchengreen (2008), Demir (2010) and Caglayan and Demir (2014) also report that RER undervaluation/depreciation increases industrial employment while Demir (2013) reports insignificant effects on firm level industrial employment growth. As for sectoral unemployment, Frenkel and Ros (2006) finds a negative effect of RER appreciation on industrial unemployment in Latin America with a two-year lag. Rodrik (2008) finds evidence that the positive growth effect of RER on growth is through a sectoral reallocation towards industry. In a similar token, Levy-Yeyati et al. (2013) shows that RER undervaluation increases growth through its positive effect on domestic savings and a redistribution from labor to capital, which is consistent with the insights of Diaz-Alejandro (1965) and Kaldor (1971). Likewise, Eichengreen (2008) finds that a higher and more stable RER favors tradable sector employment growth. McMillan and Rodrik (2011) also shows that RER undervaluation favors structural change in favor of modern tradables and encourages the flow of labor to high--productivity activities. Other studies such as Rebelo and Vegh (1995) also find that RER

appreciation leads to reduction in manufacturing value-added. Regarding long run investment, Razmi et. al. (2012) and Libman et al. (2019) discover a positive and symmetric effect of lagged RER undervaluation on investment growth but mostly in the case of developing countries. Regarding productivity effects, Aghion et al. (2009), Caglayan and Demir (2014) find that RER depreciation increases labor productivity growth while Fuentes et al. (2006) and McLeod and Mileva (2011) reports similar effects for the case of TFP growth. Furthermore, Aghion et al. (2009) also shows that the negative effect of RER overvaluation is mostly limited to countries with low financial development.

As discussed earlier, RER can affect long run growth through changes in trade structure as well. This is the export-led growth channel, which is often confused with the short-run export-growth channel. Colacelli (2010) discovers that most trade responses to RER at the country level come from the extensive margin by increasing the variety of exported goods as new exporters enter, and more so for more sophisticated products. These effects of RER are also found to be stronger among high-income exporters, partly thanks to better credit availability. Colacelli's results suggest that a minimum level of development may be required for the development channel to operate. Freund and Pierola (2012) argue that RER depreciation in developing (but not in developed) countries stimulates a reallocation of resources towards exportables and facilitates entry into new export products and markets while enabling sustained manufacturing export surges. Cimoli et al. (2013) also reports that RER undervaluation favors export diversification which, in turn, is associated with an upgrading in the technological intensity of exports and higher economic growth. Di Nino et al. (2011) find that RER undervaluation helps increase exports of industrial goods more than primary goods, and also increase export variety. Goya (2018) confirms these findings and

shows that depreciated and stable RER encourages wider export variety, particularly in goods with higher technological intensity.

Using 28 individual country panels, Caglayan et al. (2013) studies the effects of RER in first and second moments on bilateral South-North and South-South bilateral manufactured goods exports. The empirical results, however, are inconclusive, highlighting the importance of country and trading partner heterogeneity. In a follow up study, Caglayan and Demir (2019) examine the effects of bilateral real exchange rate changes (both in first and second moments) on trade structure by disaggregating exports based on their technology and skill content. Their findings suggest that RER depreciations have a positive and significant effect only on exports of medium and low-skill and resource-intensive manufactures but not on high-skill manufactures or primary goods. They show that the positive effect of RER depreciation is conditional on both the direction and the product composition of trade. For example, for high skill goods, RER has a positive effect only for exports of South to North but not in any other direction. Likewise, for primary goods, only Northern exports to South respond positively to RER depreciation.

Some recent studies of the link between RER changes and export diversification and structural change have focused on firm-level effects. Iacovone and Javorcik (2008), for example, find that export diversification is preceded by a rise in firm investment and that export discoveries are more frequent in the immediate period after devaluations. Highlighting firm heterogeneity, Caglayan and Demir (2014) show that RER appreciation hurts productivity of inward oriented firms' while benefiting export-oriented firms. Regional heterogeneity may also be important as Alfaro and Cunat (2019) find that firms in export-oriented emerging Asia are more likely to engage in R&D and experience productivity growth following depreciations compared to firms in Latin American and Eastern European countries.

As an exploratory exercise, we replicate the growth regression of Rodrik (2008) using Eq. (7) where we test the effect of RER undervaluation on real GDP per capita growth.

$$Growth_{it} = \alpha + \beta lnRGDPPC_{it-1} + \gamma lnUnderval_{it} + f_i + f_t + \varepsilon_{it} \quad (7)$$

where *Growth* represents 5-year (geometric) average growth rates of real GDP per capita (output-side real GDP per capita at chained PPP's in mil 2011 US$) using PWT 9.1 data, $RGDPPC_{it-1}$ is the lagged level of real GDP per capita, $Underval_{it}$ is the five-year average of annual RER undervaluation based on Eq. 6 , f_i and f_t are country and year fixed effects, and ε_{it} is the error term. Figure 7 shows the distribution of the annual undervaluation measure with a mean of -0.182 and a standard deviation of 0.665. All variables are averaged over 5-year periods between 1950-1954 and 2015-2015, yielding 14 time periods (we exclude growth rates for 2015-2017 for not having full five-year observations).[14]

<Insert Figures 1-2 Here>

Columns (1)-(3) in Table 3 replicate Rodrik (2008) benchmark estimates and restrict the time period to 1950-2004, leaving out Iraq, North Korea and Laos. Column (4)-(7) includes full sample period and all countries. In columns (2)-(3) and (6)-(8) we divide the sample into developed and developing using different cut-off points. Overall, we can qualitatively replicate Rodrik (2008)'s findings for GDP growth rates where the reported γ to be 0.017 for the full sample, 0.03 for the developed and 0.026 for the developing country sample. The differences likely result from the use of different generations of the PWT (i.e. 6.2 in Rodrik (2008) vs. 9.1 here). The significant effect of RER undervaluation on growth for the full sample comes from the developing country group, independent of whether we use Rodrik's sample (columns 2-3) or the full sample (columns

[14] The (logarithmic) growth rates are calculated using five-year average incomes.

5-6). In fact, the effect is highly significant for developing countries, using the $6,000 real GDP per capita threshold, which is the World Bank cut-off point for high income countries in 1987. In column (7) we repeat the exercise for the full sample but using an average income cut-off of $6,000 for the full time period. In column (8) we repeat the exercise using World Bank high income cut-off for 2015. The results are quite robust, suggesting a significantly positive effect of RER undervaluation on growth in developing but not in developed countries.

5.2. Temporary vs persistent RER undervaluation

The issues of how to maintain RER undervaluation and for how long are not well-addressed by the empirical research (Henry and Woodford, 2008). The answer to the first will depend on institutional capabilities, fiscal capacity, and other relevant policy choices such as exchange rate regimes and capital account openness (see Williamson, 2013 and Guzman et al., 2018 for further discussion). The second question of how long is also not well-discussed and empirical work on it is hard to find. The existing work on RER, investment, productivity, and growth shows some delayed effects from RER depreciation/undervaluation (see, for example, Eichengreen, 2008; Razmi et al., 2012, Caglayan and Demir, 2014) but does not fully address the question of how persistent RER undervaluation should be for it to be effective.

5.3. Endogeneity, correlation and causality

The endogeneity problem is a well-recognized challenge when estimating the effect of the RER on growth as it is relatively easy to show the overdetermined relationship between the two (Henry and Woodford, 2008; Nouira and Sekkat, 2012). Given the paucity of plausible instruments, most attempts to correct for endogeneity at the aggregate level rely on internal instruments (Gala, 2008; Rodrik, 2008; Aghion, 2009; Razmi et al., 2012; Schroder, 2013). A related issue is the difference between correlation vs. causality and the omitted variable bias whereby both economic growth and

RER undervaluation are driven by a third missing variable such as an activist industrial policy involving various macro and microeconomic interventions. The few studies that try to address these issues using methods other than GMM include Bussiere et al. (2015) who use a propensity score matching method and Habib et al. (2017) who use external IVs for identification. Another way the literature has tried to address the identification problem is by disaggregating the data and adopting firm, industry, product or destination-product level analysis whereby the RER can be taken as exogenous (Eichengreen, 2008; Demir, 2010, 2013; Ekholm et al., 2012; Caglayan et al., 2013; Martin and Mayneris, 2015; Chen and Juvenal, 2016; Caglayan and Demir, 2014, 2019; Alfaro et al., 2018; Serena and Sousa, 2017), or by including other control variables that are potentially endogenous (Rodrik, 2008; Aghion et al., 2009). It should be noted, however, that the potential effects of endogeneity are likely to understate the effect of real undervaluation on growth. This is because growth, to the extent that it influences the RER, is likely to appreciate it (i.e., one would expect a negative correlation between the RER and growth).

5.4. Is it really misaligned?

As discussed earlier in Section 3, there is no consensus in the literature over what constitutes undervalued and therefore there is a proliferation of RER misalignment measures. As a result, Rodrik (2008) and Di Nino et al (2011), for example, experiments with various measures of RER, including PWT, IMF, CPI and WPI based measures, with and without the Balassa-Samuelson adjustment. Alternatively, Razin and Collins (1997) and Aguirre and Calderón (2005) adopt a fundamentals-based equilibrium RER. The lack of consensus over the identification of RER misalignment itself is a serious challenge for scholars and also policy makers.

5.5. Asymmetric effects

The developmental effects of RER misalignment can be asymmetric so that undervaluations and overvaluations have heterogeneous effects. Furthermore, the degree of misalignment maybe more important than whether the RER is under or overvalued. While most studies assumed a symmetrical effect, a few including Razin and Collins (1997), Aguirre and Calderón (2005), Nouira and Sekkat (2012), Rapetti et. al., (2012), and Habib et al. (2017), among others, consider both nonlinearities and asymmetries in the RER effect.

5.6. How to define developing countries?

The reported positive effects of RER undervaluation on growth can be sensitive to the definition of the developing country sample. Moving the cutoff point from $6,000 to $8,000, for example, affects the results reported by Rodrik (2008) significantly (Henry and Woodford, 2008; Rapetti et al., 2012; Di Nino et al., 2013). Table 3 also shows the sensitivity of coefficient estimates to income cut-offs, time periods and the data source. Should one use the country classification based on income or development levels at the beginning (Habib et al., 2017), middle (Rodrik, 2008), the end, or the average of the sample period, and should one use a static or dynamic classification of developing countries are questions that need to be addressed as they affect the empirical results significantly (Rapetti et al., 2012).

6. Concluding remarks

While the main focus and the identification of transmission channels from the real exchange rate to development outcomes have changed over multiple waves, the interest in the issue has not died out. On the contrary, we have experienced a renewed and growing attention to the macro and micro effects of RER both at the aggregate and firm levels since the late 2000s. The earlier literature,

mostly during the Bretton Woods period focused on the Keynesian macro effects through the short-run trade channel. More recent literature, since the 2000s, however, has increasingly focused on long-term development channels, with a variety of mechanisms analyzed whereby the RER affects long run growth and development. The theoretical literature offers a variety of demand and supply side mechanisms with sometimes positive and sometimes negative effects, conditional on the structure of the economy (including its level of development, factor endowments, etc.), the time horizon considered (short-run vs. long-run), the level of aggregation, and the complementary policy framework. At the macro level, the literature has evolved over time into a more nuanced perspective whereby the presence of dual economic structures and externalities result in multiple equilibria. At the more micro level, richer theoretical frameworks and databases have led to contributions that take firm and country heterogeneity seriously. The outcome has been an efflorescence of work at the intersection of development, growth, and international economics that highlights the diverse effects of RER on trade and structural change.

In terms of empirical research, there is growing evidence highlighting the positive effects of undervalued RER on growth in developing countries but not in developed ones. However, this is not a strong consensus and there are skeptics. Similarly, the effects on trade flows appear to be conditional on trade structure as well as firm, industry and country characteristics. These findings have led to a renewed call for well-designed RER policies in developing countries to encourage structural change. However, there is no consensus on how to identify these industries and what kind of RER policies to be applied across different sectors. One of the key questions here is whether a single RER can achieve all the desired effects, and if not, what kind of complementary polices are helpful in different environments. There is also strong agreement on the need to avoid RER overvaluations as the effects of over and under evaluations can be asymmetric. Also, in the absence

of a widely agreed upon definition of RER misalignment, some of the results of empirical studies tend to be sensitive to the definition used as well as the source of the data employed.

Designing appropriate RER-related policy is easier said than done, due to both internal and external constraints. Internal constraints include, among others, institutional capacity, time consistency issues, and distributional tradeoffs. On the external front, commodity price cycles, financial account liberalization, and commitments following from free trade agreements, bilateral investment treaties, and international organizations such as the IMF and the WTO make it difficult for countries to design policies to subsidize the tradable sector through RER policy. There is much to be explored in this domain and the coming years promise to provide new insights into the various mechanisms that constrain or amplify the effects of persistent real exchange rate movements.

References

Aghion, P., Bacchetta, P., Ranciere, R. and Rogoff, K. 2009. Exchange rate volatility and productivity growth: The role of financial development. *Journal of Monetary Economics* 56(4): 494–513.

Aguirre, Á. and Calderón, C., 2005. Real Exchange Rate Misalignments and Economic Performance. Working Paper 315. Economic Research Division, Central Bank of Chile, Santiago.

Alfaro, L., Cuñat, A., Fadinger, H., and Liu, Y. 2018. The Real Exchange Rate, Innovation and Productivity: Heterogeneity, Asymmetries and Hysteresis. NBER Working Paper 24633.

Amiti, M., Itskhoki, O. and Konings, J. 2014. Importers, Exporters, and Exchange Rate Disconnect. *American Economic Review* 104(7): 1942-78.

Amsden, A. 1989. *Asia's Next Giant: South Korea and Late Industrialization*. Oxford: Oxford University Press.

Balassa, B. 1964. The purchasing power parity doctrine: a reappraisal. *Journal of Political Economy*, 72: 584–596.

Balassa, B. 1971. *The Structure of Protection in Developing Countries*. Baltimore and London: The Johns Hopkins Press.

Barro, R., and Salai-i-Martin, J. 2004. *Economic Growth*. 2nd Edition, MIT Press.

Berg, A., and Miao, Y. 2010. The Real Exchange Rate and Growth Revisited: The Washington Consensus Strikes Back? IMF Working Papers. March 1. WP 10/58.

Berg, A., Ostry, J. D. and Zettelmeyer, J. 2012. What makes growth sustained? *Journal of Development Economics* 98(2): 149-166.

Berman, N., Martin, P., and Mayer, T. 2012. How do different exporters react to exchange rate changes? Theory, empirics, and aggregate implications. *Quarterly Journal of Economics* 127(1): 437-492.

Blaum, J. 2017. Importing, Exporting and Aggregate Productivity in Large Devaluations. 2017 Meeting Papers 1412, Society for Economic Dynamics.

Bresser-Pereira, L.C. and Rugitsky, F. 2018. Industrial policy and exchange rate scepticism, *Cambridge Journal of Economics* 42(3): 617–632.

Broda, C. and Weinstein, D.E. 2006. Globalization and The Gains From Variety, *Quarterly Journal of Economics* 121(2): 541-585.

Bussière, M., Gaulier, G. and Steingress, W. 2020. Global Trade Flows: Revisiting the Exchange Rate Elasticities. *Open Economies Review* 31, 25–78.

Bussière, M., Lopez, C. and Tille, C. 2015. Do real exchange rate appreciations matter for growth? *Economic Policy* 30(81): 5–45.

Cadot, O., Carrère, C. and Strauss-Kahn, V. 2011. Export Diversification: What's Behind the Hump? *The Review of Economics and Statistics* 93(2): 590-605.

Caglayan, M. and Demir, F. 2014. Firm Productivity, Exchange Rate Movements, Sources of Finance and Export Orientation. *World Development* 54: 204-219.

Caglayan, M., and Demir, F. 2019. Exchange rate movements, export sophistication and direction of trade: the development channel and North–South trade flows. *Cambridge Journal of Economics* 43(6): 1623-1652.

Caglayan, M., Dahi, O. and Demir, F. 2013. Trade Flows, Exchange Rate Uncertainty and Financial Depth: Evidence from 28 Emerging Countries. *Southern Economic Journal* 79(4): 905-927.

Calvo, G., and Reinhart, C.M. 2002. Fear of Floating. *The Quarterly Journal of Economics* 117(2): 379-408.

Cespedes, L. F., Chang, R. and Velasco, A 2004. Balance Sheets and Exchange Rate Policy. *American Economic Review* 94(4): 1183-1193.

Chatterjee, A. Dix-Carneiro, R. and Vichyanond, J. 2013. Multi-product firms and exchange rate fluctuations. *American Economic Journal: Economic Policy* 5(2): 77-110.

Chen, N. and Juvenal, L. 2016. Quality, trade, and exchange rate pass-through. *Journal of International Economics* 100(C): 61-80.

Chenery, H. and Bruno, M. 1962. Development alternatives in an open economy: the case of Israel. *Economic Journal* 72(285): 79-103.

Cimoli, M., Fleitas, S. and Porcile, G. 2013. Technological intensity of the export structure and the real exchange rate. *Economics of Innovation and New Technology 22*(4): 353-372.

Colacelli, M. 2010. Intensive and extensive margins of exports and real exchange rates. Unpublished mimeo.

Dahi, O. and Demir, F. 2016. *South-South Trade and Finance in the Twenty-First Century: Rise of the South or a Second Great Divergence*. Anthem Press.

Demir, F. 2010. Exchange Rate Volatility and Employment Growth in Developing Countries: Evidence from Turkey. *World Development* 38(8): 1127-1140.

Demir, F. 2013. Growth under Exchange Rate Volatility: Does Access to Foreign or Domestic Equity Markets Matter? *Journal of Development Economics* 100(1): 74-88.

Di Nino, V., Eichengreen, B., and Sbracia, M. 2011. Real exchange rates, trade and growth: Italy 1861-2011. Economic Hosory Working Papers, Banca D'Italia. No. 10.

Diaz Alejandro, C. 1965. *Exchange Rate Devaluation in a Semi-Industrialized Country*. Cambridge, United States: MIT Press.

Dollar, D. 1992. Outward-Oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976-1985. *Economic Development and Cultural Change* 40(3): 523-544.

Eichengreen, B. 2008. *The real exchange rate and economic growth (English)*. Commission on growth and development working paper; no. 4. Washington, DC: World Bank.

Ekholm, K., Moxnes, A. and Ulltveit-Moe, K. H. 2012. Manufacturing restructuring and the role of real exchange rate shocks. *Journal of International Economics* 86(1): 101-117.

Fontagne, L. Guimbard, H. and Orefice, G. 2019. Product-Level Trade Elasticities. CEPII Working Paper No 2019-17.

Frankel, J. A. 2005. Contractionary Currency Crashes in Developing Countries. *NBER Working Paper No. w11508*, Washington, DC.

Frenkel E. and Rapetti M. 2014. The Real Exchange Rate as a Target of Macroeconomic Policy. MPRA Paper no. 59335, Munich.

Frenkel, J. A. and Johnson, H. G. (eds) 1976. *The Monetary Approach to the Balance of Payments*, London: Allen & Unwin.

*F*renkel, J.A., and Johnson, H.G. (Eds.) 1976. *The Monetary Approach to the Balance of Payments*, George Allen and Unwin, London.

Frenkel, R. and Ros, J. 2006. Unemployment and the real exchange rate in Latin America. *World Development* 34(4): 631-646.

Freund, C. and Pierola, M. D. 2012. Export surges. *Journal of Development Economics* 97(2): 387-395.

Fuentes, R., Larrafn, M. and Schmidt-Hebbel, K. 2006. Sources of Growth and Behavior of TFP in Chile. Cuadernos de economfa, 43(127): 113-142.

Gala, P. 2008. Real exchange rate levels and economic development: theoretical analysis and econometric evidence. *Cambridge Journal of Economics* 32: 273-288.

Galindo, A., Izquierdo, A. and Montero, J. M. 2007. Real Exchange Rates, Dollarization, and Industrial Employment in Latin America. *Emerging Markets Review* 8(4): 284-298.

Goya, D. 2018. The exchange rate and export variety: A cross-country analysis with long panel estimators. Working Papers 2018-01, Escuela de Negocios y Economía, Pontificia Universidad Católica de Valparaíso.

Guzman, M. Ocampo, J. A. and Stiglitz, J. E. 2018. Real exchange rate policies for economic development. *World Development* 110: 51-62.

Habib, M.M., Mileva, E., and Stracca, L. 2017. The real exchange rate and economic growth: Revisiting the case using external instruments, *Journal of International Money and Finance* 73(B): 386-398.

Harding, T., and Venables, A.J. 2016. The implications of natural resource exports for nonresource trade. *IMF Economic Review* 64(2): 268–302.

Hausmann, R., Pritchett, L. and Rodrik, D. 2005. Growth accelerations. *Journal of Economic Growth* 10: 303-–329.

Henry, P., B. and Woodford, M. 2008. The Real Exchange Rate and Economic Growth. Comments and Discussion. *Brookings Papers on Economic Activity* Fall: 413-437.

Hirschman, A. O. 1949. Devaluation and the Trade Balance. *The Review of Economics and Statistics* 31(1): 50-55.

Iacovone, L. and Javorcik, B.S. 2008. Multi-product exporters: Diversification and micro-level dynamics. World Bank Policy Research Working Paper 4723.

Imbs, J. and Mejean. I. 2015. Elasticity Optimism. *American Economic Journal: Macroeconomics* 7(3): 43-83.

Imbs, J. and Wacziarg, R. 2003. Stages of Diversification. *American Economic Review* 1993: 63-86.

International Financial Statistics (IFS). 2019. International Monetary Funds. Online accessed October 1, 2019.

Kaldor, N. 1966. *Causes of the Slow Rate of Economic Growth of the United Kingdom*. Cambridge: Cambridge University Press.

Kaldor, N. 1971. Conflicts in national economic objectives. *Economic Journal* 81(321): 1-16.

Krugman, P. 1990. *Equilibrium Exchange Rates," in International monetary policy coordination and exchange rate fluctuations*. In W. H. Branson, J. A. Frenkel, and M. Goldstein (Eds.). Chicago: U. of Chicago Press, pp. 159-87.

Krugman, P. 1987. The narrow moving band, the Dutch disease, and the competitive consequences of Mrs. Thatcher: Notes on trade in the presence of dynamic scale economies. *Journal of Development Economics* 27: 41-55.

Krugman, P. and Taylor, L. 1978. Contractionary effects of devaluation. *Journal of International Economics* 8: 445-56.

Krugman, P. 1999. Balance Sheets, the Transfer Problem, and Financial Crises. *International Tax and Public Finance* 6: 459–472.

Kugler, M. and Verhoogen, E. 2009. Plants and imported inputs: New facts and an interpretation. *American Economic Review* 99: 501-507.

Lall, S. 2000. The technological structure and performance of developing country manufactured exports, 1985-1998. *Oxford Development Studies* 28(3), 337-370.

Levy-Yeyati, E., Sturzenegger, F. and Gluzmann, P. 2013. Fear of appreciation, *Journal of Development Economics* 101: 233-247.

Libman, E., Montecino, J.A. and Razmi, A. 2019. Sustained investment surges. *Oxford Economic Papers* 71(4): 1071-1095.

Manova, K., and Zhang, Z. 2012. Export prices across firms and destinations. *The Quarterly Journal of Economics 127*(1): 379–436.

Martin, J. and Mayneris, F. 2015. High-end variety exporters defying gravity: Micro facts and aggregate implications. *Journal of International Economics* 96(1): 55-71.

Martin, L. M. and Rodriguez, D. R. 2004. Pricing to market at firm level. *Review of World Economics* 140(2): 302-320.

McLeod, D. and Mileva, E. 2011. Real Exchange Rates and Growth Surges. Fordham Economics Discussion Paper Series, dp2011-04.

McMillan, M.S. and Rodrik, D. 2011. Globalization, Structural Change and Productivity Growth. NBER Working Papers 17143, National Bureau of Economic Research.

Melitz, M. and Ottaviano, G.I.P. 2008. Market Size, Trade, and Productivity. *The Review of Economic Studies* 75(1): 295–316.

Missio, F.J., Jayme, F.G., Jr., Britto, G. and Luis Oreiro, J. 2015. Real Exchange Rate and Economic Growth: New Empirical Evidence. *Metroeconomica* 66: 686-714.

Mussa, M. 1986. Nominal Exchange Rate Regimes and the Behavior of Real Exchange Rates: Evidence and Implications. *Carnegie-Rochester Conference Series on Public Policy* 25(1): 117-214.

Nouira, R. and Sekkat, K. 2012. Desperately seeking the positive impact of undervaluation on growth. *Journal of Macroeconomics* 34(2): 537-552.

Nurkse, R. 1945. Conditions of International Monetary Equilibrium. Essays in International Finance, No. 4. Princeton, NJ: International Finance Section, Princeton University.

Observatory for Economic Complexity. 2020. MIT. Accessed January 15, 2020.

Orcutt, G.H.1950. Measurement of Price Elasticities in International Trade. *Review of Economics and Statistics* 32: 117-132.

Prasad, E., Rajan, R. and Subramanian, A. 2007. Foreign capital and economic growth. *Brookings Papers on Economic Activity* 1: 1-57.

Prebisch, R. 1950. *The Economic Development of Latin America and Its Principal Problems*. UN document no. E/CN.12/89/Rev.1. Lake Success, N.Y.: United Nations.

Prebisch, R., 1959. Commercial Policy in Under-developed Countries. *American Economic Review, Papers and Proceedings* 492: 251-73.

Rapetti, M. 2013. Macroeconomic Policy Coordination in a Competitive Real Exchange Rate Strategy for Development. *Journal of Globalization and Development* 3(2): 1-31.

Rapetti, M., Skott, P., and Razmi, A. 2012. The real exchange rate and economic growth: are developing countries different? *International Review of Applied Economics*. 26(6): 735-753.

Rauch, P.E. 1999. Networks Versus Markets in International Trade. Journ*al of International Economics* 48: 7-35.

Razin, O. and Collins, S. 1997. Real exchange rate misalignments and growth. Working Paper 6174, National Bureau for Economic Research, Cambridge, Massachusetts.

Razmi, A, Rapetti, M., and Skott, P. 2012. The real exchange rate and economic development, *Structural Change and Economic Dynamics* 23(2): 151-169.

Razmi, A. 2013. The exchange rate, diversification, and distribution in a modified Ricardian model with a continuum of goods, *Manchester School* 81(3): 356-85.

Razmi, A. 2015. Correctly Analyzing the Balance of Payments Constraint on Growth. *Cambridge Journal of Economics* 40(6): 1581-1608.

Rebelo, S. and Vegh, C. A. 1995. Real effects of exchange-rate-based stabilization: An analysis of competing theories, NBER Macroeconomics Annual 10: 125-188.

Rodrik, D. 1986. Disequilibrium Exchange Rates and Industrialization Policy. *Journal of Development Economics* 23: 89-106.

Rodrik, D. 2008. The Real Exchange Rate and Economic Growth. In D. W. Elmendorf, N. G. Mankiw, and L. H. Summers (eds.), *Brookings Papers on Economic Activity* (Fall), 365-412, Brookings Institution.

Rodrik, D., 2005. Growth Strategies. In: Philippe Aghion & Steven Durlauf (ed*.), Handbook of Economic Growth* vol. 1, pp. 967-1014, Elsevier.

Ros, J. 2013. Latin America's Trade and Growth Patterns, the China Factor, and Prebisch's Nightmare. *Journal of Globalization and Development* 3(2): 1-16.

Ros, J. 2015. Development Macroeconomics in Latin America and Mexico. Essays on Monetary, Exchange Rate, and Fiscal Policies. Springer-Palgrave.

Ros, J., and Skott, P. 1998. Dynamic effects of trade liberalization and currency overvaluation under conditions of increasing returns. *The Manchester School* 66(4): 466-89.

Samuelson, P. A. 1964. Theoretical notes on trade problems. *Review of economics and statistics*, 46: 145-154.

Schroder, M. 2013. Should developing countries undervalue their currencies? *Journal of Development Economics* 105: 140-151.

Serena, J.M. and Sousa, R. 2017. Does exchange rate depreciation have contractionary effects on firm-level investment? BIS Working Paper No. 624.

Soderbery, A. 2018. Trade Elasticities, Heterogeneity, and Optimal Tariffs. *Journal of International Economics* 114: 44-62.

Thirlwall, A.P. 1979. The Balance of Payments Constraint as an Explanation of International Growth Rate Differences, *Banca Nazionale del Lavoro Quarterly Review*.

Vernon, R. 1966. International investment and international trade in the product cycle. *Quarterly Journal of Economics* 80(2): 190-207.

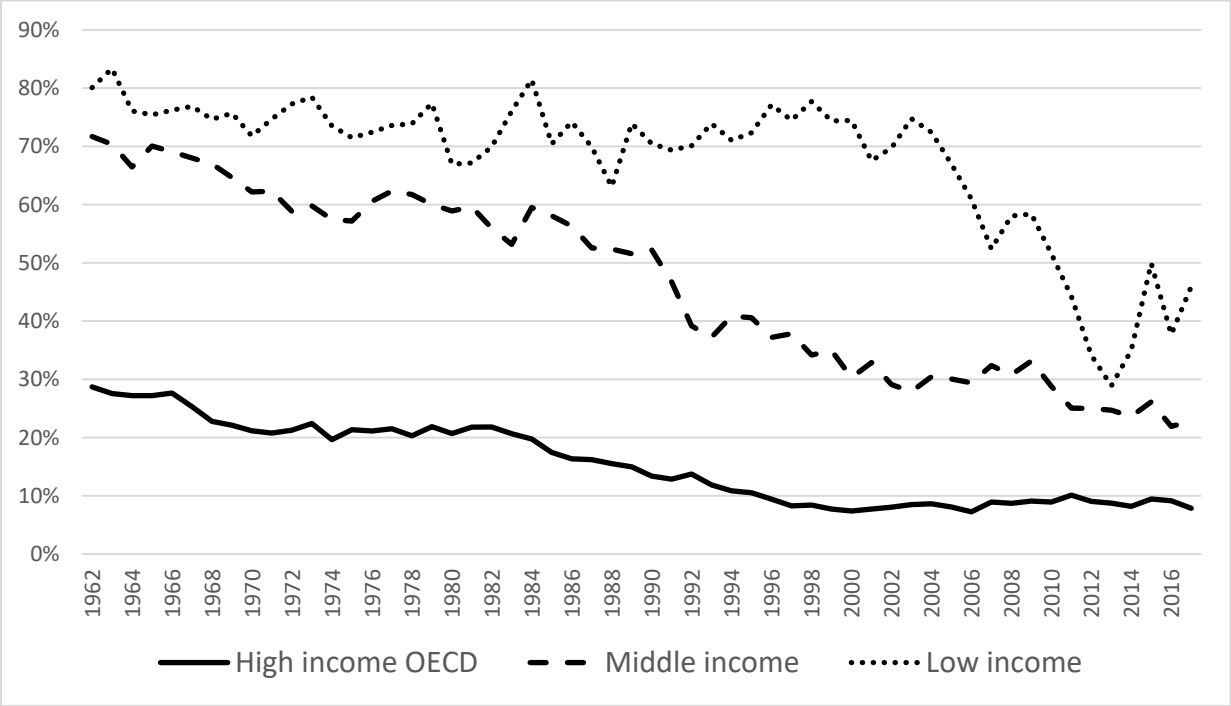
Wade, R. 1990. *Governing the Market*. Princeton: Princeton University Press.

Williamson, J. 1985. The Exchange Rate System. Washington: Institute for International Economics.

Williamson, J. 2003. Exchange rate policy and development, paper prepared for the International Policy Dialogue (IPD) Capital Market Liberalization Task Force, Columbia University, Barcelona, Spain, June 2–3.

World Bank 2020. World Development Indicators. Online Accessed February 1, 2020. https://atlas.media.mit.edu/en/resources/data/

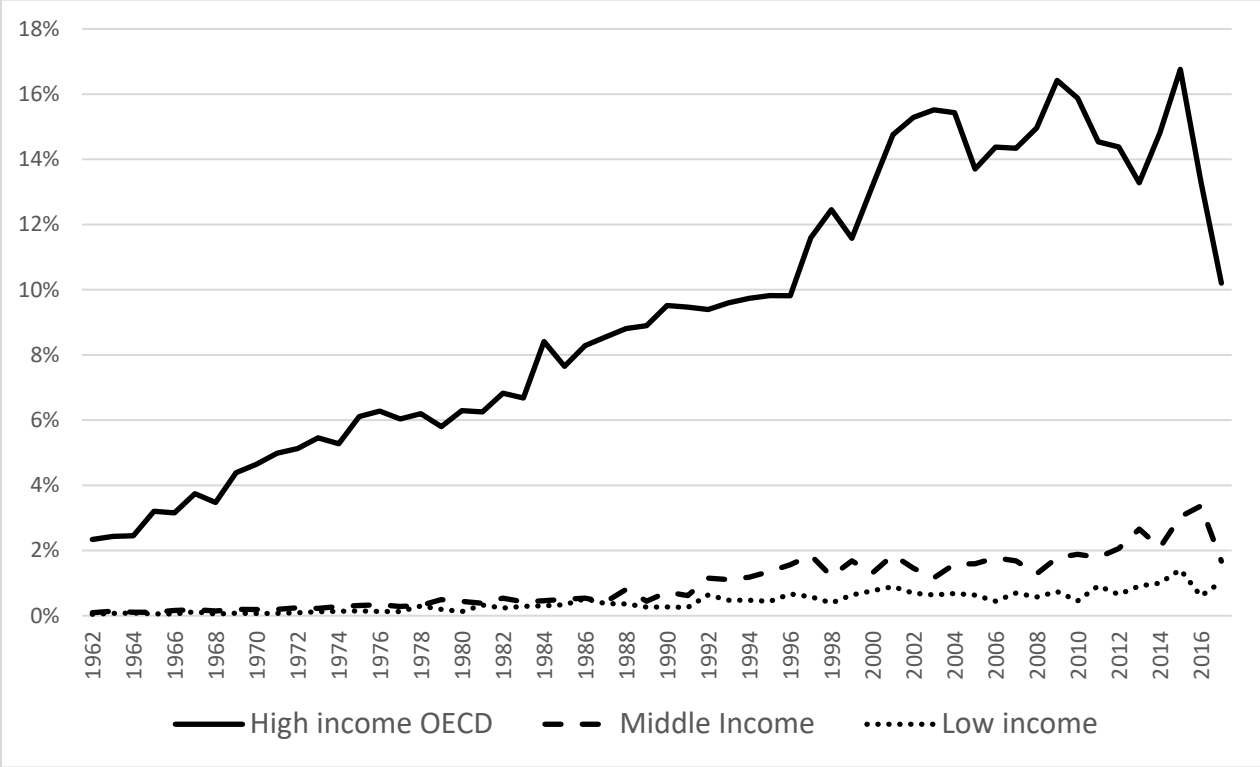
Figure 1: Median Share of Primary Goods in Total Exports



Notes: The data shows the median share of primary good exports in total exports of a given country within each group. Primary good classification is based on Lall (2000) and income classifications are from World Bank (2020).

Source: The Observatory of Economic Complexity (2020) and Authors' calculations.

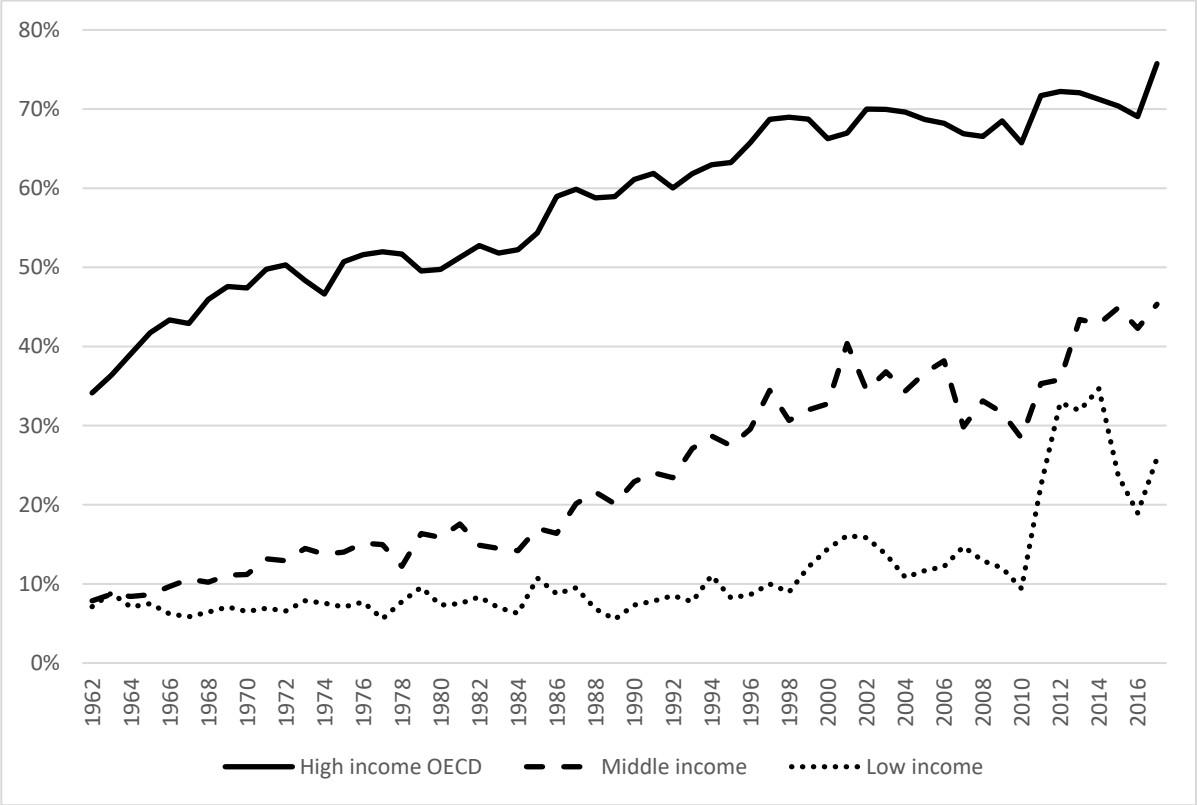
Figure 2: Median Share of High-Skill Goods in Total Exports



Notes: The data shows the median share of high-skill exports in total exports of a given country within each group. High-skill good classification is based on Lall (2000) and income classifications are from World Bank (2020).

Source: The Observatory of Economic Complexity (2020) and Authors' calculations.

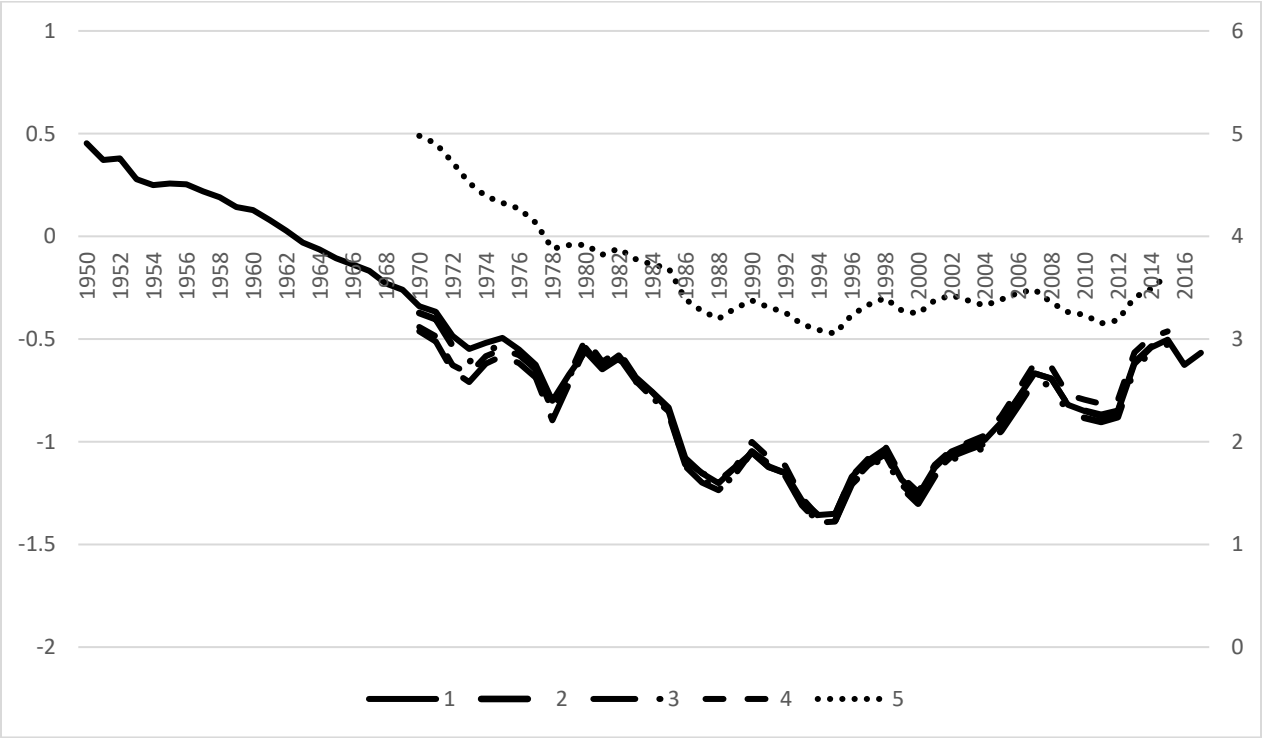
Figure 3: Median Levels of Differentiated Good Exports by Income Levels



Notes: The data shows the median share of differentiated goods in total exports of a given country within each country group. The classification for differentiated goods is based on Rauch (1999)'s conservative definition and income classifications are from the World Bank (2020).

Source: The Observatory of Economic Complexity (2020) and Authors' calculations.

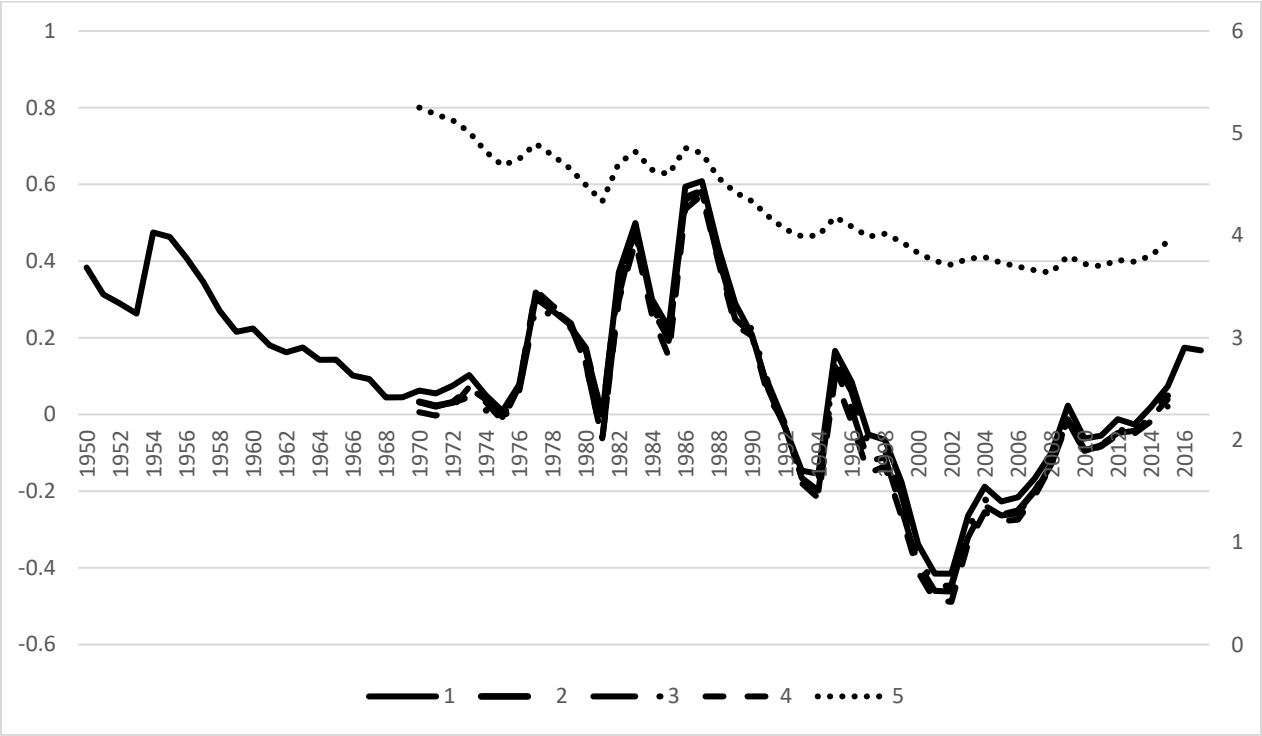
Figure 4: RER Misalignment, Japanese Yen



Notes: For Figures 4 and 5: The RER is calculated using the PWT 9.1 relative prices with pl_con (price level of CCON (PPP/xr), price level of USA GDPo in 2011=1). We took its inverse so that an increase in RER is a real depreciation. Therefore, an increase in the above figure is an undervaluation from the predicted equilibrium level of RER. Right axis is for misalignment measure 5.

Source: Authors' calculations.

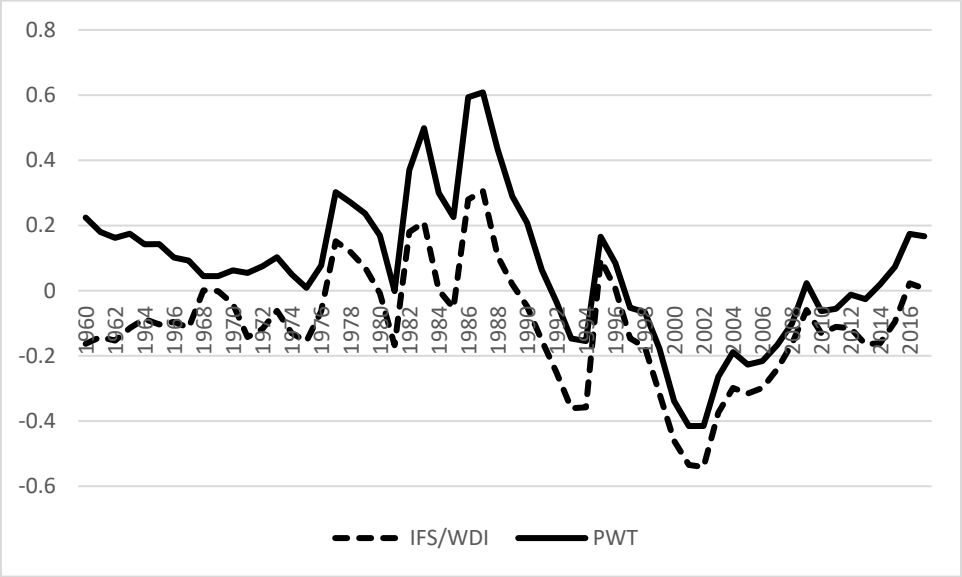
Figure 5: RER Misalignment, Mexican Peso



Notes: Refer to Figure 4 for variable definitions.

Source: Authors' calculations.

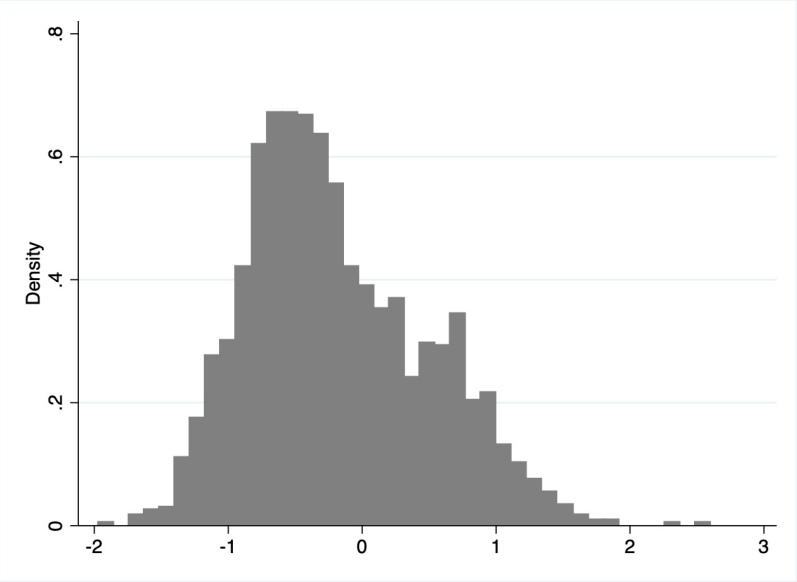
Figure 6: Misalignment using Different Data Sources: IFS vs. PWT for Mexican peso



Notes: RER using IFS data on CPI and World Bank data on real GDP per capita in constant 2010 US$. The nominal exchange rate is with respect to the US dollar. RER from PWT 9.1 is based on the price level of CCON (PPP/xr) and output-side real GDP at chained PPP's (in mil 2011 US$).

Source: Authors' calculations.

Figure 7: Distribution of Undervaluation



Notes: Numbers greater than zero indicate undervaluation as in Eq. 6.

Source: Authors' calculations based on PWT 9.1.

Table 1: Correlation Analysis of RER measures

Method	1	2	3	4	5
1	1				
2	0.999***	1			
3	0.995***	0.997***	1		
4	0.994***	0.995***	0.997***	1	
5	0.447***	0.430***	0.427***	0.449***	1

Notes: Simple correlation coefficient among five misalignment measures using PWT 9.1 and for full sample between 1950-2017.

Table 2: Review of Empirical Studies on RER and Development

Study author and date	Measure of exchange rate	Data description	Dependent variable	Estimation method	Effect of undervaluation/ depreciation
Rodrik (2008)	Specialized economy, EP*/P, Balassa-Samuelson corrected misalignment	PWT 6.2, all countries	5-year average GDP per capita growth & industrial output and employment shares	FE and GMM	Positive effects in developing countries.
Rapetti et al., 2012	Specialized economy, EP*/P, Balassa-Samuelson corrected misalignment	PWT 6.2, all countries	5-year average GDP per capita growth	FE and GMM	Positive effect in developing countries.
Gala (2008)	Specialized economy, EP*/P, Balassa-Samuelson corrected misalignment	WB, developing countries	Annual GDP per capita growth	GMM	Positive effect in developing countries.
Razmi et al. (2012)	Specialized economy, EP*/P, Balassa-Samuelson corrected misalignment	PWT 6.2, all countries	5-year average investment growth	GMM	Positive effect in developing countries.
Aghion (2009)	Specialized economy, EP*/P, Balassa-Samuelson corrected misalignment	PWT 6.1, all countries	Annual labor productivity growth	GMM	Positive effects in countries with low financial development.
Eichengreen (2008)	Specialized economy, EP*/P.	UNIDO, emerging market countries	Industrial value added and employment	FE	Positive effects.

Galindo et al. (2007)	Specialized economy, EP*/P.	UNIDO, 9 Latin American countries	Industrial employment	GMM	Positive effects when liability dollarization is low.
Demir (2010)	Specialized economy, EP*/P, and E.	Manufacturing firm survey, Turkey	Manufacturing employment growth	FE and GMM	Positive effects of RER, negative effect of its volatility.
Caglayan et al. (2013)	Specialized economy, EP*/P	COMTRADE, 28 Emerging markets	Manufactured exports	GMM	Mixed effects depending on country, direction of trade and financial development. .
Demir (2013)	Specialized economy, EP*/P	Manufacturing firm survey Turkey	Manufacturing employment growth	FE, GLS and GMM	Insignificant effect of RER, negative effect of its volatility
Caglayan and Demir (2014)	Specialized economy, EP*/P	Manufacturing firm survey, Turkey	Labor productivity growth	GMM	Positive effects of RER (more so for inward oriented firms), negative effect of its volatility.
Frenkel and Ros (2006)	Specialized economy, EP*/P	WDI, CEPAL, and PWT 6.1, 17 Latin American and Caribbean countries	Unemployment rate	OLS	Positive effect on employment.
Razin and Collins (1997)	Specialized economy, EP*/P, fundamentals corrected misalignment	World Bank, developing countries	Annual GDP per capita growth	OLS, GMM, Cointegration	Nonlinearities. Moderate to high (but not very high) undervaluations associated with growth
Aguirre and Calderon (2005)	Specialized economy, EP*/P, fundamentals corrected misalignment	IMF and WB	5 and 10-year average GDP per capita growth	GMM	Positive effect of moderate undervaluation and negative effect of both overvaluations (increasing in size) and high undervaluations.
Dollar (1992)	Specialized economy, EP*/P,	WB, developing countries	Annual GDP per capita growth and Investment/GDP ratio	OLS	Negative effect of RER misalignment.

Desai et al. (2008)	Specialized economy, EP*/P	Bureau of Economic Analysis and Worldscope, firm level	Firm level sales, assets, investment, profits, leverage.	FE	Positive effect on sales, assets, and investment of foreign firms and negative or no effect on domestic firms. Leverage increases for domestic but not foreign firms. Profits increase for both types of firms.
Kearns and Patel (2016).	Nominal effective exchange rate and debt-weighted exchange rate	BIS	Annual GDP growth, exports, imports, investment, public and private consumption.	Univariate autoregressive distributed lag model	Positive effects on growth through the trade channel and negative effect through the financial channel (supply and cost of foreign funding). The effects are stronger for emerging markets. Positive effects on investment, public and private consumption through the trade channel and negative effect through the financial channel.
Di Nino et al. (2013)	Specialized economy, EP*/P, Balassa-Samuelson corrected misalignment	PWT 7.0	5-year average GDP per capita growth (for panel), export growth (Italy)	FE, GMM	Positive effect on growth, stronger for developing countries. Positive effect on export growth and export values, especially for industrial than primary goods. Positive effects on extensive margins.
Alfaro et al. (2018)	Specialized economy, EP*/P.	Orbis, World bank Firm Dynamics database, PWT 8.0, firm level	Firm level R&D, productivity, cash flow, export entry rate.	Structural	In export-oriented emerging Asia, real depreciations increase firm probability to engage in R&D, faster growth of productivity and cash-flow and higher export entry rates. The effects are negative for firms in other emerging economies that are import dependent, and no significant average effects for firms in industrialized economies. Effects on physical TFP growth are non-linear and asymmetric.

Berman et al. (2012)	Specialized economy, EP*/P.	France, IFS, French Customs, BRN, PWT	Export volumes, export unit values, exporting probability	FE	Export unit values increase, especially for high productivity firms. Export volumes increase, less so for high productivity firms. Export probability increases.
Chatterjee et al. (2013)	Specialized economy, EP*/P.	Brazilian Customs data, PWT.	Core product prices, mark-ups, product scope, firm level.	FE	Increases core-product prices and mark-ups, more for more productive firms and firms with higher import costs. Increases product scope.
Habib et al. (2017)	Specialized economy, EP*/P, Balassa-Samuelson corrected misalignment	PWT 7.1	5-year average GDP per capita growth	IV	Positive effects, especially in developing countries.
Nouira and Sekkat (2012)	Specialized economy, EP*/P, fundamentals corrected misalignment	WB, developing countries	Annual and 5-year average GDP per capita growth	FE, GMM, cointegration	No robust effect.
Libman, Montecino, Razmi (2019)	Specialized economy, EP*/P, Balassa-Samuelson corrected misalignment	PWT 9.0	Investment surges	Probit	Increases the likelihood of investment surges, especially in manufacturing based countries.
Schroder (2013)	Specialized economy, EP*/P, fundamentals corrected misalignment	PWT 7.0, IMF, developing countries	5-year average GDP per capita growth	GMM	Both under and overvaluations harm growth.
Serena and Sousa (2017)	Nominal exchange rate	Firm level from developing countries,	Firm level investment.	FE-IV	Positive effect when debt is in domestic currency but negative effect when the debt is in foreign currency.
Freund and Pierola (2012)	Specialized economy, EP*/P,	PWT 6.3, COMTRADE	Manufacturing export surges and	FE	Export surges in developing (but less so in developed) countries

	Balassa-Samuelson corrected misalignment		new export products (5-year averages)		preceded by large devaluations that lead to export growth and diversification.
MacDonald and Viera (2010)	Specialized economy, EP*/P, fundamentals corrected misalignment	PWT 6.2	5-year GDP per capita growth	FE, RE, cointegration, GMM	Positive effect on growth, especially for developing countries.
Levi-Yeyati *et. al.* (2013)	Specialized economy, EP*/P, Balassa-Samuelson corrected misalignment	LYS dataset, PWT 6.3	Annual and 3-year average GDP per capita growth	FE-IV	FX intervention and undervaluation positively associated with growth

…

Table 3: RER Undervaluation and Growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Rodrik 1950-2004	Developing 1950-2004	Developed 1950-2004	Full Sample 1950-2014	Developing 1950-2014	Developed 1950-2014	Developing Mean6k	Developing 12,475k
$lnRGDPPC_{t-1}$	-0.033***	-0.048***	-0.061***	-0.031***	-0.040***	-0.046***	-0.031***	-0.034***
	(0.006)	(0.010)	(0.007)	(0.004)	(0.008)	(0.007)	(0.007)	(0.006)
$lnUnderval_{it}$	0.017***	0.041***	-0.003	0.012**	0.029***	0.001	0.021***	0.022***
	(0.005)	(0.008)	(0.007)	(0.005)	(0.008)	(0.007)	(0.007)	(0.006)
Observations	1,331	746	585	1,701	877	824	849	1,214
R-squared	0.419	0.486	0.523	0.338	0.424	0.478	0.372	0.385
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: ***, **, * refer to significance at 1%, 5%, and 10%, respectively. Robust standard errors are in parentheses.