The Political Economy of Exchange Rate Undervaluation - A panel data analysis of the relationship between Real Exchange Rates and Income Distribution

Abstract

The impact of exchange rates in economic growth is a long-standing issue in international macroeconomics debated both in policy as in academic circles. In the past decade, the topic has received renewed attention following empirical contributions by several prominent authors from different theoretical backgrounds relating Real Exchange Rate Undervaluation to higher Economic Growth, mainly for the case of developing economies. However, an overlooked aspect in the literature has been the effect, of pursuing such strategy, on the Functional Income Distribution of these economies. In particular, this paper investigates the relationship between Real Exchange Rate Undervaluation and Wage Share of GDP, with panel data econometric modelling framework in a data set encompassing 92 developed and developing economies from 1970 to 2014. The preliminary results suggest that countries classified, by the literature, as having Undervalued Real Exchange Rates tend to exhibit, on average, lower shares of GDP going to Wages and a moves within countries of its Real Exchange Rate towards level regarded as 'undervalued' are associated with a redistribution of income from wages to profits in countries with high degrees of capital account openness.

1. Introduction

The impact of exchange rates in economic growth is a long-standing issue in international macroeconomics debated both in policy as in academic circles. In the past decade, the topic has received renewed attention following empirical contributions, from authors from different schools of thought, relating Real Exchange Rate Undervaluation to higher Economic Growth, mainly for the case of developing economies. The theoretical justification given by this literature (e.g. Rodrik (2008), Eichengreen (2008) or Guzman et. al (2018)) has mainly emphasized Real Exchange Rate Undervaluation may help to foster growth by increasing the competitiveness of tradable sectors which would have higher productivity levels and would be the locus of technological spillovers, learning by doing and where increasing returns to scale would be more prominent. The fact that the relationship is stronger and more robust for the case of developing economies due to the fostering competitiveness of tradable sector suffer disproportionately from the government or market failures that keep poor economies from converging towards higher incomes. However, an overlooked aspect in the literature has been the effect, of pursuing such development strategy, on the Functional Income Distribution of these economies.

Therefore, the aim of my research is to critically review different approaches present in the literature to define Real Exchange Equilibrium (from which countries Real Exchange Rate misalignments are subsequently derived), with particular focus on what are the implications for the income distribution of a country which is considered to have an 'undervalued' currency through traditional mainstream metrics, such as Purchasing Power Parity adjusted for Harrod-Balassa-Samuelson effect (adjusted-PPP) and Behavioural Equilibrium Exchange Rates (BEER). Subsequently, departing from Shaikh (1999, 2016) contribution, I derive a simple model that relates the Real Exchange Rates and Functional Income Distribution in an economy with free mobility of capital.

However, as is known (at least) since Sraffa's (1960), outside the realm of the labour theory of value (which would only hold in special cases where profits are equal to zero or, when profits are positive, if capital-labour ratios are uniform across sectors) the relationship between relative prices (as is the case of Real Exchange Rates) and income distribution is a complex phenomenon with several indirect effects. Thus, even though, the direct relationship between Wage Shares and Real Exchange Rate levels[1] is univocally negative, the sign of the overall relationship cannot be universally determined.

[1] defined as $\frac{e}{e^*}\frac{p^*}{p} = \frac{domestic\ currency}{foreign\ currency} * \frac{foreign\ price\ level}{domestic\ price\ level}$

Therefore, to gain further insight on the topic, my research attempts to address the question from empirical point of view. Investigating, in particular the relationship between Real Exchange Rate Undervaluation (derived from an adjusted-PPP framework) and Wage Share in a panel data econometric modelling framework. The dataset encompasses 92 developed and developing economies, in the period from 1970 to 2010.

The group of countries with Real Exchange Rate levels classified as Overvalued have an average Wage Share level that is 4.4 p.p. higher than the average of the group of countries classified as having an undervalued Real Exchange Rate level. A relation that is observed throughout the entire distribution of the two groups and it's robust to differences in the GDP per capita levels and different degrees of informality (which would tend to reduce wage share levels in low income economies).

Moreover, a move towards Real Exchange Rate Undervaluation is also associated with compression of the Wage Share levels within countries. A relationship that is stronger and statistically more robust to countries with higher degrees of Capital Account Openness (measured by Chinn and Ito's (2007) index), as captured by the inclusion of an interaction effect in the econometric specification. These results were also tested against the inclusion of other control variables present in the literature (such as terms of trade, share of savings and of government consumption in GDP) and in a GMM setting to control for endogeneity.

Lastly, when Wage Share is regressed directly against Real Exchange Rate level it turns out as insignificant, with an estimated coefficient close to zero. However, once the Wage Share variable is interacted with the Capital Account Openness index, both the main and interaction effect turn out to be statistically significant. Most importantly, they have opposite signs. While the main effect (which captures the relationship between Wage share and Real Exchange Rate, when Capital Account Openness index is equal to zero) is positive, the interaction effect is negative, with a coefficient 2x times higher than the one observed for the main effect. Thus, in relatively open economies Real Exchange Rate devaluation are associated with a Wage Share compression.

This series of results indicate that under free mobility of capital a development strategy based on devaluation of the country's Real Exchange Rate and/or sustaining it at 'undervalued' levels (as measure by traditional metrics) is associated with a compression of the Wage Share and, thus, a worsening of the country's income distribution in countries. This implies that policy makers are faced with a trilemma, ss they cannot simultaneously pursue 'currency undervaluation strategy' to spur economic growth, tackle income inequality by focusing in policies that redistribute income towards workers, while at the same time increasing or maintaining a high degree of financial integration through free mobility of capital movements.

To develop the point highlighted in this introduction the paper is structured as follows: in the following section, I review the literature on the relation between Real Exchange Rate Undervaluation and Economic Growth. The third section provides some preliminary evidence regarding the relationship between the Real Exchange Rate Undervaluation index, as calculated by the literature reviewed in section 2, and Wage Share. The fourth section provides a model which highlights the relationship between functional income distribution and real exchange rates. Section 5 discusses the empirical methodology, while section 6 describes the databases used. Section 7 present the results estimated using different specifications and control variables and, finally, section 8 brings the concluding remarks.

2. Literature Review- From Real Exchange Rate and Economic Growth nexus to Income Distribution aspects

While the detrimental economic effect of exchange rate overvaluations has been for long a relatively well recognize issue among economists[2], with (mostly) developing countries in such situations often experiencing sooner or later balance of payment/currency crisis. The effects of maintaining currency Real Exchange Rates at undervalued levels on economic growth has been a more contentious issue. While it has been claimed that undervalued Real Exchange Rates was one important tool in the economic development of the so called East Asian Tigers (Amsden, 2001), other authors claim that it was institutional factors that played a key role. The topic has received renewed attention over the past decade following contributions from prominent authors, Dani Rodrik (2008) and Barry Eichengreen (2008), and since then a growing body of literature have tried to tackle this relation. Eichengreen (2008) provides, as well as new evidence, a thorough review of the literature[3]. Even though he asserts that the available evidence is not overwhelming, he concludes that keeping competitive levels and avoiding excessive volatility of exchange rates are important for growth. He regards it as a facilitating condition that enables countries to capitalize on solid fundamentals such as disciplined workforce, high savings rate, or its status as destination of foreign direct investment (FDI).

Rodrik's (2008) paper is primarily aimed at presenting new empirical evidence and, as remarked by Rapetti et. al. (2012), is among the first to explicitly test for asymmetries of the effect of exchange rate undervaluation in developing and developed countries. The definition of developed and developing countries is arbitrarily given by a threshold level of GDP *per capita* of

[2] Dollar (1992), Sachs and Warner (1995), Cavallo et. al (1990) and Goldfajn and Gupta (1999).
[3] Hence, the following literature review is aimed at more recent studies, reflecting more recent developments.

US$6000[4] and the empirical findings reveal a systematic positive relationship between undervaluation and growth within a country, which is stronger and more robust in the case of developing countries. A relation that is not exclusive to the experience of East Asian tigers, or due to overvaluation hindering economic growth. Rodrik (2008) argue that the mechanism through which maintaining a currency undervalued enhance economic growth is due to an increase of profitability in the production of tradables and, hence, produce a positive impact on the share of tradables in the economy, especially in the manufacturing industry. The reasoning provided to why this would be more relevant to developing countries would be that these countries suffer more dramatically from institutional weakness and market failures.

It calculates exchange rate misalignments based on a Purchasing Power Parities index adjusted for the Harrod-Balassa-Samuelson effect (from here onwards referred to as adjusted-PPP index) for a set of 184 countries over the period of 1950-2004 and tests the effect of exchange rate undervaluation in economic growth through a time fixed-effect panel model. To calculate the Real Exchange Rate, Rodrik (2008) uses the Exchange Rates ($XRAT_{it}$) and the Purchasing Power Parities (PPP_{it}) conversion factors from the Penn World Tables, all in logarithm form, expressed in terms of units of local currency relative to one US$ dollar.

$$\ln RER_{it} = \ln \left({XRAT_{it}}/{PPP_{it}} \right) \qquad (1)$$

in which subscripts *i* and *t* represent countries and year, respectively. If the above expression is bigger than 1, this would mean that the Real Exchange Rate of country *i* in year *t* would be more depreciated that what would be implied by the ratio of its price level and United States' prices, i.e. it's Purchasing Power Parity. However, as already mentioned, to take into account the differences among prices of non-tradables goods (which tend to be higher in richer countries, i.e. the Harrod-Balassa-Samuelson effect) Rodrik estimates his measure of Real Exchange Rate equilibrium by regressing Real Exchange Rates (RER) on GDP per capita ($RGDPpc_{it}$) in log terms:

$$\ln \widehat{RER}_{it} = \alpha + \beta \ln RGDPpc_{it} + f_t + \mu_{it} \qquad (2)$$

in which μ_{it} is the error term and f_t is a fixed effect for the time period. This latter term is equivalent to the introduction of dummies for each year and is introduced here to consider the fact that on average Real GDP per capita tend to grow over time for all countries. As such the estimate of β coefficient, in theory, captures only the variation of GDP per capita of country *i* relative to the average of the sample. Rodrik's Undervaluation ($Underval$) index is the

[4] In PPP dollars (in 2000's constant prices). An alternative threshold of US$8000 is also tested, but coefficients were lower and statistically less reliable.

difference between the actual Real Exchange Rate and the predicted Real Exchange Rate ($\widehat{RER}_{it}$):

$$RER\ Misalignment\ Index = \ln(Underval) = \ln RER_{it} - \ln \widehat{RER}_{it} \quad (3)$$

As such, ***negative*** values for $RER\ Misalignment\ Index$ represent an ***overvalued*** currency and ***positive*** values ***undervalued***. Thus, whenever $RER\ Misalignment\ Index$ is positive, it indicates that goods produced at home are relatively cheaper in dollar terms. Defined in this way the RER Misalignment Indexes are comparable overtime and taking in logarithm form enhances comparability across countries[5]. From this point, Rodrik (2008) and the literature of Real Exchange, use the index on a growth equation to try to capture the effect of Undervaluation in economic growth in panel data regressions with standard control variables.

Since then, several studies have addressed this question using different measures of Real Exchange Rate Equilibrium, different estimation techniques, conducting several other robustness checks, such as changing thresholds of developing countries, samples and databases, introducing different control variables, testing for non-linearities and so on. Other studies also using adjusted-PPP measures of Real Exchange Rates Equilibrium have confirmed Rodrik's results. Rapetti et. al (2012) extends Rodrik's (2008) analysis by testing different criteria to classify countries as developing and developed economies. Their results confirm the strong robust effect of exchange rates for developing economies. However, they also find a positive relation of exchange rate undervaluation and economic growth for very high-income countries. With the contrasting behaviour of middle-income economies being regarded as an empirical puzzle. Gala (2008) tests the effect of overvaluation on growth in a panel of 58 developing countries from 1960 to 1999, using an adjusted-PPP index he finds that overvaluation hinders economic growth. While Berg, Ostry and Zettelmeyer (2008) study claims that overvaluation affects the duration of growth spells adversely.

The claim that real exchange rate undervaluation (overvaluation) enhances (hinders) economic growth has also been supported in studies using different approaches to estimate real exchange rate "equilibrium". Berg and Miao (2010) and MacDonald and Vieira (2010) tackles the topic with a different misalignment concept, which relies on the notion of the fundamental equilibrium real exchange rate (FEER). In this framework, real exchange rate equilibrium is the one consistent with internal and external balance, reflected by price stability, government balance and current account positions.

---

[5] In which units of account can differ considerably.

Bereau et. al. (2012) and Couharde and Sallenave (2013) both uses behavioural equilibrium exchange rate (BEER) approach to estimate real exchange rate equilibrium. In this approach long-term movements in the real exchange rate are mainly related to relative sectoral productivity differentials, the outstanding stock of net foreign assets, terms of trade (ToT), government consumption and total investment as shares of GDP and an openness index. As with the adjusted-PPP framework, the residuals for each country in each period taken from the predicted vs. actual Real Exchange Rate is taken as their measure of misalignment. Using non-linear panel smooth transition regressions techniques, their findings confirms previous results from the literature of the positive (negative) effect of undervaluation (overvaluation) in economic growth. Couharde and Sallenave (2013) findings, however, shows important non-linearity's with only modest undervaluation's being positive for growth.

Also, in a BEER framework, Nouira and Sekkat (2012) conduct panel cointegration regressions in order to deal with non-stationarity of the variables of interest. Differently from other studies, their findings contradict previous research as they find that currency undervaluation don't have statistically significant effect on growth once overvaluation episodes are excluded. Thus, it would be that only overvaluation which hinders economics growth, rather than undervaluation promoting growth. Schroder (2013) finds that deviations from equilibrium Real Exchange Rate reduces economic growth in system-GMM, in which Real Exchange Rate misalignments are individually estimated (contrary to the panel-data approach of most other studies) based on FEER framework for 63 developing countries over the period 1970–2007.

As Eichengreen (2008) remarks, while reviewing previous related empirical work, that this literature takes real exchange rate as exogenous, while in practice the relation tested is susceptible to simultaneity bias. In the above literature this problem has been mainly tackled by the use of Generalized Method of Moments (GMM) models. However, the appropriate treatment would be the use of Instrumental Variables, i.e. the use of a variable (instrument) that is correlated with the real exchange rate but that (theoretically) cannot help to explain growth. This is precisely the approach taken by Habib et.al (2017) which revisits the case of real exchange rate and economic growth using external instruments. Using two different country specific instruments: (i) global capital flows interacted with individual countries' financial openness; (ii) the growth of official reserves. The authors' findings suggest that real appreciation (depreciation) reduces (raises) significantly economic growth in developing economies and, only, for pegged currencies[6].

[6] i.e. currencies which are maintained pegged to another country's currency.

Some studies try to disentangle the relationship between Real Exchange Rate levels and economic growth by adding additional control variables (Goncalves and Rodrigues, 2017; Ribeiro et. al, 2017) or by exploring its effects on different components of GDP (Gluzmann et. al;2012). Goncalves and Rodrigues (2017), using a newer version of the Penn World Tables (PWT 9.0) that covers the period from 1950 to 2014, claim that Real Exchange Rate misalignments becomes non-significant once controlled for the saving rate. While Ribeiro et. al (2017) find also that the that Real Exchange Rate misalignments becomes non-significant once controlled for the changes in the Wage Share. Lastly, Gluzmann et. al (2012) explore the effect of undervalued currency on different components of GDP, as well as in employment, and finds that undervaluation is positively associated with economic growth due to its effect in stimulating greater domestic savings and investment, as well as employment.

Underlying these studies, however, is the notion that the real exchange rate is a policy variable, when in fact it is in fact a relative price (which in the way Rodrik defines it mainly captures the differences in the relative price of nontraded goods), a fact that is recognized by both Eichengreen and Rodrik in their papers. Rather than being directly a policy variable, they are the outcome of other policies and processes occurring in the economy. As Rodrik (p.406, 2008) remarks:

> "maintaining real undervaluation requires either higher saving relative to investment or lower expenditure relative to income. This can be achieved through fiscal policy (a large structural surplus), incomes policy (redistribution of income to high savers through real wage compression), saving policy (compulsory saving schemes and pension reform), capital account management (taxation of capital account inflows, liberalization of capital outflows), or currency intervention (building up foreign exchange reserves)."

And in fact, when Rodrik investigates the determinants of Real Exchange Rate undervaluation he finds it to have statistically significant associations with lower levels of terms of trade, of Capital Account Openness and Foreign Direct Investment Inflows, with higher levels of government consumption over GDP and Savings ratio[7]. Despite mentioning real wage compression as a mechanism to achieve a Real Exchange Rate Undervaluation Rodrik (2008) doesn't test it, perhaps owed to the fact that at the time the available version of the Penn-World Tables (PWT 6.2) didn't include information on wages. However, since PWT 8.0 information regarding the Wage Share has been included.

[7] See Table 10 Rodrik (p.407, 2008)

As such, the main objective of this paper is to test the role played by income distribution in explaining Real Exchange Rates under/overvaluation levels, as defined by the adjusted-PPP used by Rodrik (2008) and, subsequently by most of the literature.

3. RER Undervaluation and Wage Share: Preliminary Evidence

The regression to estimate the RER based solely on the Real GDP per capita (equation 2) yields a similar coefficient (-0.186) when compared to the ones reported by Rodrik (2008), -0.24 (based on data from PWT 6.2), and Goncalves and Rodrigues (2017), -0.19 (based on PWT 9.0). Using the predicted values for the Real Exchange Rate based on the regression (as defined in equation (3)) presented in the table 1 (below), I derive the estimates of Undervaluation analogous to Rodrik (2008) to, then, proceed with the analysis comparing the derived Real Exchange Rate misalignments, and the, respective, countries Wage Share. The correlation coefficient between this Undervaluation index and Wage Share levels of countries assumes a value of -0.17. Implying that a higher Wage Share are negatively correlated with 'Undervalued' Real Exchange Rates. It's fairly moderate association, although it has the expected negative sign.

Table 1: Fixed Effect Model- Real Exchange Rate X Real GDP per Capita

Dependent Variable: ln (Real Exchange Rate)				
	Estimate	Robust Std. Error	t value	Pr(>|t|)
ln (Real GDP per capita)	-0.1864	0.0247	-7.538	<2.2e-16***
Time fixed effects	Yes			
Country fixed effects	No			
Nº of Countries	182	Nº of observations	1877	
Multiple R-squared	0.193	Adjusted R-squared:		0.187
F-statistic	445.6 on 1 and 1863 DF	p-value:		< 2.22e-16

Source: Author's elaboration based on Penn-World Table Version 9.0

Using this RER misalignment Index to separate the sample into two groups- Undervalued and Overvalued sheds some light on the relationship (Table 2 below). The average Wage Share of countries with Overvalued Real Exchange Rate was of 56.67%, while for Undervalued Real Exchange Rate observations the average Wage Share was 52.01.%. However, given the standard deviations of the Wage Share in both groups further testing is required to see if the difference in the Average Wage Share each group is statistically significant. Furthermore, there isn't much difference between the two groups Real GDP *per capita* both in terms of average and distribution.

Table 2: Descriptive Statistics

	No of Observations	Wage Share		ln RGDP per Capita	
		Mean	Standard Deviation	Mean	Standard Deviation
Overvalued RER	401	0.5667	0.1128	9.254	1.3264
Undervalued RER	357	0.5201	0.1326	9.182	0.9216

Source: Author's elaboration based on Penn-World Table Version 9.0

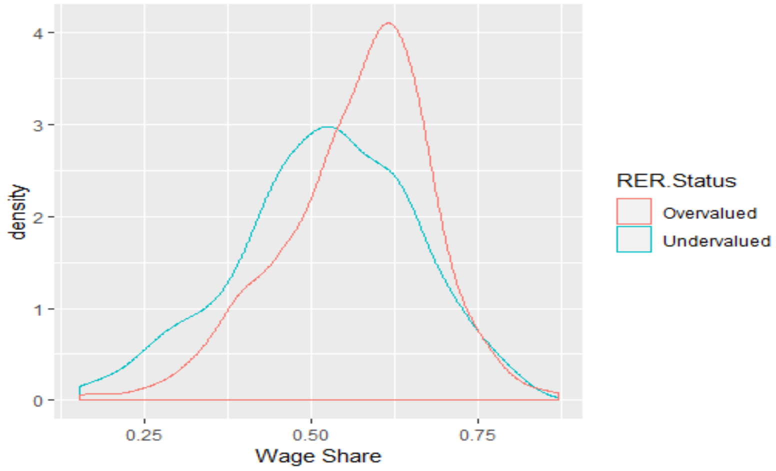
As can be seen in the data presented in Table 3 and Figure 1, the group of countries with an 'Overvalued' RER tends to have higher Wage Share levels than the group of countries with an 'Overvalued' RER at all points of the distribution. However, two points require further investigation. One is the fact that the Overvalued RER contains more observations (401) than the 'Undervalued' group (357), the second concerns to the distribution across time of these observations. Wage Share levels have been falling in the past decades, especially in developed countries. Thus, if observations classified as 'Overvalued' RER are disproportionally coming from years from the beginning of my sample, these results might be biased.

Table 3: Distribution of the variables of interest for each group

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
'Overvalued' RER						
Wage Share	0.164	0.504	0.588	0.567	0.644	0.871
Ln GDP per capita	5.885	8.206	9.804	9.254	10.329	11.324
'Undervalued' RER						
	Min.	**1st Qu.**	**Median**	**Mean**	**3rd Qu.**	**Max.**
Wage Share	0.151	0.440	0.526	0.520	0.619	0.815
Ln GDP per capita	6.081	8.622	9.192	9.182	9.709	11.960

Source: Author's elaboration based on Penn-World Table Version 9.0

Figure 1: Distribution of Wage Share levels in each group



Source: Author's elaboration based on Penn-World Table Version 9.0

Thus, to further assess the generalizability of these results I report the results of t-tests (Table 4 below) conducted to assess if the Average Wage Share of the two groups are different from the Average Wage Share for the whole sample. In the first row is the results of the one-sided t-test comparing if the Average Wage Share of the Overvalued RER group (56.67%) is greater than Average Wage Share for the whole sample (54.39%). In the second, I repeat the same test to see if the Average Wage Share of the Undervalued RER group (52.01%) is smaller than Average Wage Share for the whole sample. The null hypothesis being that the means are equal. The results confirm with 99% of confidence that the Average Wage Share of the Overvalued RER (Undervalued RER) group is higher (lower) than the Average for the Total Sample. Consequently, due to these tests having more restrictive hypothesis, it is safe to say that Average Wage Share of the Overvalued RER group is higher than the Average for the Undervalued RER group[8].

Table 4: t-test for Average Wage Share difference

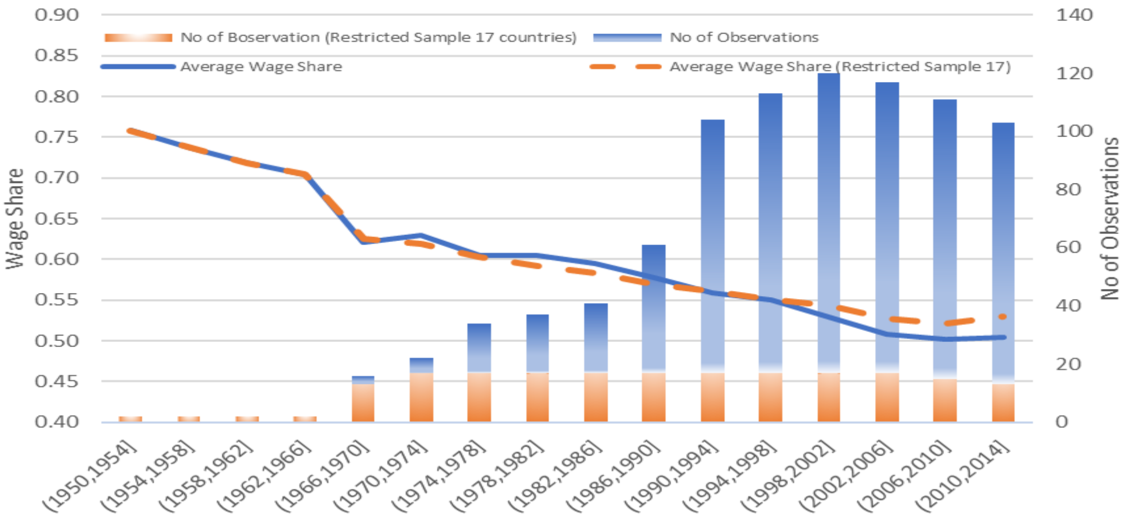
One-sided t-test	Group Mean	Total Sample Mean	99% confidence interval:		t-stat	df	p-value
Overvalued RER	0.5667	0.5448	0.5536	Inf	3.89	400	5.796e-05
Undervalued RER	0.5201		Inf	0.5365	-3.52	356	0.0002427

Source: Author's elaboration based on Penn-World Table Version 9.0

[8] Results using logarithm form of the Wage Share to deal with possible bias due to non-normality of the distribution, also rejected the null hypothesis. Indicating that the Average Wage Share on the Overvalued RER (Undervalued RER) group are higher (smaller) than the Average of the Total Sample.

However, as mentioned, Wage Share levels have been falling in the past decades, and indeed in the sample there is a declining trend in the average wage share in each period, which is not due to the mere inclusion of more countries in the database. Indeed, when one look at the average Wage Share of a restricted group of 17 countries for which there are observations for all periods between 1966-1970 to 2002-2006 the Wage Share declines in line with the trend observed to the entire sample (see Figure 2 below). Anyways, considering the downward trend in the average Wage Share in the hole sample it is possible that an uneven distribution across time of the observations between the two groups might be the cause of the difference in the Wage Share levels observed. However, one should bear in mind that the regression from which the RER misalignments have been derived did control for time fixed effect, as such this shouldn't be a major issue[9].

Figure 2: Average Wage Share in each period (full Sample of countries X restricted sample)



Source: Author's elaboration based on Penn-World Table Version 9.0

4. The Model

As already mentioned, the Real Exchange Rate is not a policy variable *per se* that can be determined by monetary policy alone, nor simply by the financial market. It is rather the nominal exchange rate (E) multiplied by the ratio of price index between the domestic country (P_A) and a foreign country (P_B):

$$RER = {P_A * E}/{P_B} \tag{4}$$

Taking the logs of the above expression:

$$rer = p_a + e - p_b \tag{5}$$

[9] For details regarding the distribution across time of the observations of each group see figure A.2 in the appendix.

If we assume that the price index of a country is composed of three types of commodities domestic tradable, non-tradable and imported tradable one can express, following Alberola et.al (1999), the price index of each country by the following expressions:

$$p_A = (1-\alpha_A^{NT}-\alpha_A^{M})p_A^T + \alpha_A^{NT}p_A^{NT} + \alpha_A^{M}(p_B^T - e) \qquad (6)$$

$$p_B = (1-\alpha_B^{NT}-\alpha_B^{M})p_B^T + \alpha_B^{NT}p_B^{NT} + \alpha_B^{M}(e + p_A^T) \qquad (7)$$

Where α_A^{NT} and α_B^{NT} represent the share of non-tradables in the price index of countries A and B, $\alpha_A^{M}$and α_B^{M} the share of imported tradables coming from the other country, with the share of domestic tradable being derived as a residual $(1-\alpha_i^{NT}-\alpha_i^{M})$. Substituting the terms in equation (5) by (6) and (7):

$$rer = (1-\alpha_A^{NT}-\alpha_A^{M})p_A^T + \alpha_A^{NT}p_A^{NT} + \alpha_A^{M}(p_B^T - e) + e - ((1-\alpha_B^{NT}-\alpha_B^{M})p_B^T + \alpha_B^{NT}p_B^{NT} + \alpha_B^{M}(e + p_A^T)) \qquad (8)$$

Rearranging the terms and separating the weights of non-tradables from tradables commodities one arrives at the following expression:

$$rer = \underbrace{\alpha_A^{NT}(p_A^{NT}-p_A^T) - \alpha_B^{NT}(p_B^{NT}-p_B^T)}_{Harrod-Balassa-Samuelson\ effect} + \underbrace{(1-\alpha_A^{M}-\alpha_B^{M})(p_A^T + e - p_B^T)}_{relative\ price\ of\ domestic\ to\ foreign\ tradables} \qquad (9)$$

To get to a result in which the Real Exchange Rate is determined only by the price ratio of non-tradables and to tradables (i.e. capturing what has been dubbed in the literature as the Harrod-Balassa-Samuelson effect), more simplistic presentations of this decomposition[10] don't differentiate tradables produced domestically from tradables produced abroad[11] and by assuming that the under condition of free trade with negligible transportation costs, the price of all tradable commodity (when expressed in common currency) equalize (i.e. the Law of One Price holds) the last term collapses to zero (i.e. relative price of domestic to foreign tradables).

In a more general setting, as presented above where each country produces different tradable commodities, to achieve the same result one needs much stronger propositions. Rather than assuming that free trade leads to the equalization of the same commodity in two countries, one needs to assume that either (i) the nominal exchange rate adjusts to equalize aggregate price indexes of the tradable sector (which is equivalent to assume that the Purchasing Power Parity holds for tradables), (ii) that the weights that the tradable commodity produced in each country enters the price index of each country is the same[12], which would only hold in case if $\alpha_A^{NT} = \alpha_B^{NT}$. Thus, implying that tradables goods produced in the foreign country (B) are

[10] See for example Min, Shin and MacDonald (2015).
[11] So α_A^{M} and α_B^{M} don't appear in the decomposition.
[12] That is, if $(1-\alpha_A^{NT}-\alpha_A^{M}) = \alpha_B^{M}$ and $(1-\alpha_B^{NT}-\alpha_B^{M}) = \alpha_A^{M}$

consumed domestically (A) in the same proportion in each country. However, this scenario is more exception than rule, happening mainly by fluke. Considering that in reality countries at different levels of development have different consumption baskets, the relative weights are different in each country, implying that the change in the relative prices of the tradables each country produces will have an effect in the Real Exchange Rate (rer) between them.

To analyse the relationship between the evolution of relative prices of tradables produced in each country and functional income distribution, it is useful to resort to a classical political economy approach, in which long-run equilibrium relative prices are given by their costs of production, as advanced by Shaikh (1999, 2016)[13]. Starting from a simple two country economy and two-tradable commodities only, the price system in autarky (i.e. without international trade) is presented in the following form:

$$p_A^1\,E \;= (p_A^2\,E\,a_A^1 + p_A^1\,E\,w_{rA}^1 l_A^1) * (1 + r_A) \qquad (10)$$

$$p_A^2\,E \;= (p_A^2\,E\,a_A^2 + p_A^1\,E\,w_{rA}^2\,l_A^2) * (1 + r_A) \qquad (11)$$

$$p_B^1 \;= (p_B^2\,a_B^1 + p_B^1\,w_{rB}^1\,l_B^1) * (1 + r_B) \qquad (12)$$

$$p_B^2 \;= (p_B^2\,a_B^2 + p_B^1\,w_{rB}^2\,l_B^2) * (1 + r_B) \qquad (13)$$

In which E is the nominal exchange rate expressed in terms of units of currency of country B expressed in terms of unit of currency of Country A $\left(E = \frac{units\ of\ currency\ of\ country\ B}{unit\ of\ currency\ of\ country\ A}\right)$. Where subscripts A and B stand for the domestic and foreign country, respectively' superscripts *1* and *2* represent each tradable good; p_i^j represents the prices; a_i^j represents the technical coefficient of intermediate inputs used in the production; w_{ri}^j is the real wage rate; l_i^j is the labour coefficients for each commodity *j* produced in country *i*; and r is the profit rate.

Following standard assumption that the opening up of international trade leads to a complete specialization between countries. And, due to having lower reproducible costs in each sector, country A ends up exporting commodity 1 and country B exporting commodity 2 and that, thus, each determine the international current price in each of the commodities it exports. In this scenario, the above price system collapses to those equations which arise from international competition between capitals, i.e. equations (10) and (13) in the above system. Further, if one takes the standard assumption that under free trade conditions and negligible transportation costs that tradable goods are subject to the Law of One Price (i.e. $p_A^1 * E = p_B^2$)

[13] A non-exhausting list of empirical applications of this framework covering both developed and developing countries, covering Japan, USA, Greece, Turkey and México is Shaikh and Antonopoulos (2013), Ruiz-Napoles (2010), Antonopoulos (1999), Martinez-Hernandez (2010, 2017) and Ersoy (2010).

the system above can be rewritten in terms of relative prices by dividing both equations by p_B^2 as:

$$p_A^1 * E \Big/ p_B^2 = \left(a_A^1 + \left(p_A^1 * E \Big/ p_B^2\right) w_{rA}^1\, l_A^1\right) * (1 + r_A) \tag{14}$$

$$1 = \left(a_B^1 + \left(p_A^1 * E \Big/ p_B^2\right) w_{rB}^1\, l_B^1\right) * (1 + r_B) \tag{15}$$

Furthermore, if we consider that contemporary capitalism most economies operate not only under relatively free trade conditions, but also under conditions of relative free mobility of capital. As such, one can assume that the competition among international capitals leads towards a tendency of equalization of the profit rate between sectors and countries ($r_A = r = r_B$):

$$p_A^1 * E \Big/ p_B^2 = \left(a_A^1 + \left(p_A^1 * E \Big/ p_B^2\right) w_{rA}^1\, l_A^1\right) * (1 + r) \tag{16}$$

$$1 = \left(a_B^1 + \left(p_A^1 * E \Big/ p_B^2\right) w_{rB}^1\, l_B^1\right) * (1 + r) \tag{17}$$

Following the Pasinetti (1973) vertically integrated sectors approach, Shaikh (1999, p.5) provides a different formulation for the above expression. A price of any commodity produced in any country i can be split into its different constituent elements, that is, into its direct unit labour costs (DULC), $p_i^1 w_{r\,i}^1 l_i^1$, in the case of the consumption good; direct unit profits (DUP), $1 + r$; and unit input costs (UIC),$p_i^1 a_i^1$. However, this last element is nothing but the price of some bundle of goods, and can, therefore, be split into its constituent elements (DULC, DUP, UIC), where the UIC can be decomposed again into its different constituent elements. As this process continue, the residual (UIC) will get smaller and smaller. If enough rounds of this procedure are undertaken, the price of the commodity (that we started this decomposition with) can be expressed as the sum of direct and indirect unit labour costs and its direct and indirect profit margins. Factoring out the former allows us to express the price of *any* commodity as the product of its vertically integrated unit labour costs (*viulc*= *v*) and its vertically integrated profit-wage ratio[14]:

$$p_A^1 * E \Big/ p_B^2 = \left(v_{rA}^1 * E \Big/ v_{rB}^1\right) \underbrace{\left[(1 + \pi_{rA}^1) \Big/ (1 + \pi_{rB}^1)\right]}_{Z_{ck} \approx 1} \tag{18}$$

In which π represents the vertically integrated profit-wage ratio; v_{rcA} and v_{rkB} are the vertically integrated unit labour costs. As Shaikh (2016, chapter 9) demonstrates, even in the case of large deviations in direct measures of the profit-wage ratio, in the case of vertically integrated profit-

[14] For a demonstration of this 'Smithian' decomposition used, please, see Shaikh (2016, p.385 to 387).

wage ratios the deviations tend to be much smaller, due to the highly sectoral interconnectedness of the modern economy. Thus, Z_{ck} term would tend to be close to unity[15].

Taking the log of the above expression, one arrives at an expression for the last term present in equation (9), which captures the relative price of domestic to foreign tradables:

$$p_A^1 - e - p_B^2 = v_{rA}^1 + e - v_{rB}^1 - \underbrace{((1+\pi_{rA}^1) - (1+\pi_{rB}^1))}_{Z_{ck}\approx 1} \quad (19)$$

In conclusion, in this setting, the (international) profit rate of regulating capitals and international terms of trade (i.e. real exchange rate) are determined for any given levels of national real wages and productivity. Inserting (19) into (9), we have:

$$rer = \underbrace{\alpha_A^{NT}(p_A^{NT} - p_A^T) - \alpha_B^{NT}(p_B^{NT} - p_B^T)}_{\substack{Harrod-Balassa-Samuelson\\ effect}} + \underbrace{(1-\alpha_A^M - \alpha_B^M)(v_{rA}^1 + e - v_{rB}^1 - \underbrace{((1+\pi_{rA}^1) - (1+\pi_{rB}^1)))}_{Z_{ck}\approx 1}}_{\substack{relative\ price\ of\ domestic\\ to\ foreign\ tradables}} \quad (20)$$

The final insight to understand the connection between Functional Income distribution and Real Exchange Rate is the connection between Wage Share and (direct or vertically integrated) Unit Labour Costs. Although at first sight Wage Share and (direct or vertically integrated) Unit Labour Costs at the aggregate level seems as different measures, they are intrinsically connected, with the latter variable being the same as the Wage Share multiplied by a price effect as Jesus and Kumar (2014) have demonstrated.

On the one hand, Wage Share is normally calculated as the ratio of total labour costs to output both expressed in nominal terms (i.e. current price levels). On the other hand, Unit Labour Costs are usually calculated with the average money-wage in the numerator and with labour productivity in the denominator. While at the firm level this isn't problematic, as at firm level one can calculate labour productivity in physical terms (e.g. pencil per workers), at the aggregate level one cannot calculate in such a way. In order to get a measure of real output one need to use value added deflated by an appropriate price deflator divided by the number of workers. Therefore, the unit labour cost is also unitless measure[16] representing a share:

$$ULC = \frac{w_n}{VA_r/L} = \frac{w_n}{\left(VA_n/P\right)/L} = \frac{w_n \cdot L}{\left(VA_n/P\right)} = \left(\frac{w_n L}{VA_n}\right) P = s_W\, P \quad (21)$$

[15] It is important to bear in mind that here we are discussing vertically integrated profit-wage ratios (π_A, π_B), which are a weighted average of direct profit-wage ratio. Thus, as different vertically integrated profit-wage ratio will have many of the same direct profit-wage ratios (with different weights) their dispersion will tend to be much smaller. However, as Ruiz-Napoles (2004) comments the exact proportionality between relative unit labour costs and relative prices posed in the above expression would only hold if profits are equal to zero ($r_A = r_B = 0$) or, when profits are positive, if capital-labour ratios are uniform across sectors.

[16] As both the numerator and the denominator are expressed in monetary terms and their division crosses out the unit of account.

Where subscripts *r* and *n* represent real and nominal values, respectively, and s_w the wage share. The wage share present in databases are normally derived from the GDP calculation from the income perspective:

$$VA_n = W + \Pi = w_n L + r_n K \quad (22)$$

$$1 = \left(\frac{w_n L}{VA_n}\right) + \left(\frac{r_n K}{VA_n}\right) = s_w + s_k \quad (23)$$

With W representing total wages and Π total profits both expressed in monetary terms, while w_n and r_n are the money-wage rate and profit rate expressed in nominal terms.

5. Empirical Methodology

As the main aim is to analyse the relation between Income Distribution the Undervaluation measure derived using Rodrik's (2008) methodology (adjusted-PPP), from which the literature has derived positive growth effects, I first regress the adjusted-PPP undervaluation index derived from equation (2) on the Wage Share levels (labsh), which can also be linked to growth on a post-Keynesian framework. Considering that theoretical framework indicates that the relationship between functional income distribution and real exchange rates is dependent on conditions of free movement of capital, I introduce the Capital Account Openness index (KAOPEN) and the interaction term between wage share and Capital Account Openness as independent variables:

$$\ln(Underval)_{i,t} = \beta_0 + \beta_1 labsh_{i,t} + \beta_2 KAOPEN_{i,t} + \beta_3 labsh_{i,t} * KAOPEN_{i,t} + \mu_{i,t} \quad (24)$$

In which, the dependent variable ($\ln(Underval)_{i,t}$) is the logarithm of our analogous measure of Rodrik's (2008) Undervaluation index of each country i in each period t. I test the relationship using a variety of econometric panel data methods, starting from Pooled OLS and moving towards methods that seek to control for unobserved heterogeneity in the sample, such as Fixed Effect Model, First Differences estimator. To assess the possibility of endogeneity and simultaneity bias I estimate the above relationship including a lagged term of the dependent variable in the right-hand side of equation (25) with a General Method of Moments (GMM) estimator.

The inclusion of the interaction term follows the assumption embedded in the theoretical framework, which would imply that it is especially under condition of free mobility of capital that changes in relative prices are reflection of changes in the relative unit labour costs (as profit rates would always tend to be equalised). I latter introduce a set of additional control variables taken from the literature, namely:

Following the literature, I take period averages of 5 years. Beyond increasing the comparability of my results, the reasons for this is two folded. For the one hand, Real Exchange Rate deviations from its theoretical equilibrium value are an expected outcome in the short term but would according to traditional theory revert back to equilibrium levels over medium and long run periods. Also, it would be expected that only persistent undervaluation that would have an impact on growth. Moreover, taking yearly figure would make results much more sensible to measurement errors, and five-year averaging attenuates the errors (see Johnson et.al., 2009).

6. Database

The dataset used by Rodrik (2008), Rapetti et. al. (2012) and other studies were from the version 6.2 of the Penn-World Tables, in this version data on Functional Income Distribution was not available. Information regarding this topic was only incorporated to the database from version 8.0 onwards. The current, most up to date, version is version 9.0 (Feenstra et.al (2015)). It includes data from 1950 up to 2014. In total it covers 184 countries in total. However, not all of them have information on Wage Share (i.e. the sum of total labour compensation in a country's GDP). More complicated is the fact that in some countries the Wage Share values in the database are constant for several years in a row, indicating extrapolation by replication of previous years data by the providers of the database. This required some treatment in the database to clean the dataset from repeated observations. Also, it was observed that some countries presented figures with 'jumps' in the Wage Share of several percentage points, sometimes only to come back to previous levels in the next year, while normally variations in the Wage Share are rather small from year to year. The Wage share measure (labsh) available in the databases is adjusted for income of self-employed, which mitigates the issue of the varying degrees of informality in the countries. However, for many countries this income is not observed, and figures are imputed using specific criteria[17]

The model developed in section 4 of the real exchange rate implies that that the adjustment mechanism of Real Exchange Rate Misalignments is the unit labour costs under conditions of free trade[18] and the free mobility of capital[19]. Thus, the relationship between wage share/unit labour costs and the Real exchange rates should be mediated by the degree of openness in the current and capital account prevalent in each country in each period. In the literature several attempts have been conducted to develop indexes that try to capture the level

[17] For further detail see Feenstra et.al (2015)

[18] Which would force the equalization of the price of tradables, implying the validity of the Law of One Price (LoOP).

[19] Which, due to equalization tendency of the profit rates between countries, would prevent changes in adjustment in relative prices being absorbed by changes in the profit rate.

of Openness of the current and capital account. Broadly, focusing on capital account openness measures, the available indicators can be categorized into three different categories: (i) *de jure* indicators; (ii) *de facto* indicators; (iii) hybrid indicators, with this last one being a combination of de jure and de facto measures.

De jure indicators describes practices that are legally recognised, which may impose restrictions to the free movement of financial flows. With most indexes being constructed based on information from IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).

Chinn and Ito (2006) is a De Jure measure based on IMF's Annual Report AREAER Categorical Table of Restrictions, covering 181 for the period ranging from 1970 to 2016[20]. The Table of Restrictions information is converted to binary (0/1) codes accounting for several categories of restrictions and uses principal component analysis to create an extensive aggregate measure of capital account openness (KAOPEN)[21]. However, due to the binary nature of the information contained in the Table of Restrictions, indexes based on it tends to groups together countries that are partly open, those that are substantially but not fully open, and those that are completely closed.

Moreover, *De jure* measures, in general, may not necessarily reflect a country's actual degree of financial integration, either because of lack of enforcement of the changes in legal restrictions or because change in controls in an area may cause a response in other trade and asset flows Also these indices are at times unable to capture the fact that even countries with relatively closed capital accounts became substantially more financially integrated over the past decades (Quinn et. al, 2011). Thus, a class of *De facto* and hybrid indicators have been developed that try to capture the observable phenomena of increased capital mobility by the evolution quantity-based or price-based variables, with some hybrid measures being also developed. In this work, however, I adopt *de jure* measures of financial openness, because, as Furceri and Loungini (2018) remarks, they are less sensitive to reverse causation issues in panel regressions.

As can be observed from the discussion in section 3, the Penn World Tables database countries coverage is not homogeneous across time, thus resulting in an unbalanced panel. Moreover, the number observations for the Real Exchange Rate, Real GDP per capita and of Wage Share levels observations differ considerably. Once the non-overlapping period averages

[20] On its latest release.
[21] Variables used are current account restrictions, export proceeds surrender requirements, and presence of multiple exchange rates, capital account restrictions (with this last one being used on five year rolling average to account for capital account openness transitions).

are taken, there are 2295 observations for the Real Exchange Rate and Real GDP per capita, while there are only 758 observations for the Wage Share variable[22]. To avoid the influence of outlier observations on the estimated results, Countries with a population below 1 million people in 2000 were excluded from the database. This procedure eliminates most of the countries which can be considered tax-havens, whose real exchange rate behaviour is expected to follow a dynamic of its own. I also exclude observations of countries with a Real GDP per capita lower than $1000 and above $60000. In the first case, as it has been argued in the literature, very poor countries are subject to considerable measurement error (especially on variable such as Wage Share). In the latter, this procedure excluded only middle-eastern oil exporting countries, which again represent specific cases whose Real Exchange Rate behaviour follow a particular dynamic that is expected to differ considerably from most countries. With these exclusions, our final data set is composed of 505 observations from 92 countries.

7. Results

The results on table 5 present some initial results, where the undervaluation index is regressed against the Wage Share and the Capital Account Openness Index from Chinn and Ito (2006) and an interaction term. Following the adopted theoretical framework, the interaction term is included because at higher levels of capital account openness the cost of adjustment of the change in relative prices is expected to be more strongly felt by workers, as a profit squeeze would entail capital flight under higher levels of openness. Thus, it is expected that the relationship between RER Undervaluation and compression of the Wage Share to be stronger in countries and periods where the level of capital account openness is higher.

In all panel-data specifications (OLS, Individual or Two-Ways Fixed Effects and First Difference) the coefficient of the main effect for the Wage Share is non-significant. However, considering that this is the effect when the Capital Account Openness Index is zero, this result comes as no surprise. The interaction term coefficient, though, is negative, as expected, and statistically significant. The magnitude of the interaction term ranges between two-fold (OLS, column 1) to six-fold (First Difference, Column 2) the magnitude of the Wage Share main effect, implying that the relationship between Wage Share levels and RER Undervaluation becomes negative at relatively modest levels of Capital Account Openness.

[22] for which there is also observations for the other variables, RER and Real GDP per capita.

The coefficients reported in both the Pooled OLS and in the fixed effect specifications are affected by both heteroskedasticity and serial correlation[23,24]. Although I report robust t-stats, another way to tackle the matter is to run de regression in terms of First Difference, in which results for Wooldridge's first-difference test discard the presence of serial correlation in the residuals[25] and, thus, it is my opinion the most robust results.

Table 5: Baseline Specification

	Dependent variable: ln Underval			
	Pooled OLS	Individual Fixed Effect	Two-Ways Fixed Effect	First Difference
	(1)	(2)	(3)	(4)
ln labsh	0.494	0.373	0.279	0.109
	t = 1.439	t = 1.612	t = 1.079	t = 0.745
KAOPEN	-0.160	-0.240	-0.185	-0.187
	t = -2.403**	t = -4.009***	t = -2.764***	t = -4.115***
ln labsh x KAOPEN	-1.074	-0.972	-0.932	-0.635
	t = -2.209**	t = -2.798***	t = -2.602***	t = -2.611***
Constant	0.102			
	t = 1.970**			
Observations	505	505	505	413
Adjusted R^2	0.094	-0.117	-0.171	0.033
F Statistic	18.412*** (df = 3; 501)	13.713*** (df = 3; 410)	9.412*** (df = 3; 402)	3.785** (df = 3; 410)

Note: *p<0.1; **p<0.05; ***p<0.0, t-stats reported are based on heteroskedasticity and cross-sectional dependence robust standard errors

7.2- Introducing Control Variables

The literature on the determinants of Real Exchange Rates[26] has also tended to emphasize, among other variables, the role of terms of trade, Savings Ratio to GDP, as well as Government consumption ratio to GDP[27]. Thus, in table 6, I report the results of the regressions

[23] The Pooled OLS estimation suffers also from Cross-Sectional dependence (contemporaneous correlation between observations).
[24] Test results for the inclusion of a time fixed effect were inconclusive. While the F test for the inclusion of two-ways fixed effects is rejected, LM test for two-way fixed effect cannot rule out the need to control for time-fixed effect.
[25] See appendix A.2
[26] See for an example Benassy-Quere et. al. (2009) and for a thorough review of the different approaches to define Real Exchange Rate Equilibrium (REER), see Siregar (2011).
[27] Which are also used by Rodrik (2008) in his assessment of the determinants of his Undervaluation Index, which I replicate here.

on the undervaluation index including the abovementioned control variables. The qualitative aspects of the results of the baseline specification remains unchanged. Coefficients of the main effect of Wage Share (*ln.labsh*) remain positive (becoming significant at 5% level in the fixed effect models). They increase in magnitude, but this is also observed in the interaction effect coefficients (*ln.labsh x KAOPEN*). And, thus, the implication that the relationship between Wage Share levels and RER Undervaluation becomes negative at relatively modest levels of Capital Account Openness remains unchanged by the addition of the control variables.

Table 6: Introducing control variables

	Dependent variable: ln Underval			
	Pooled OLS	Individual Fixed Effect	Two-Ways Fixed Effect	First Difference
	(1)	(2)	(3)	(4)
ln.labsh	0.455	0.679	0.734	0.207
	t = 1.343	t = 2.138**	t = 1.975**	t = 1.243
KAOPEN	-0.172	-0.220	-0.206	-0.185
	t = -2.767***	t = -3.833***	t = -3.344***	t = -4.178***
Gov Consumption	0.002	0.008	0.006	-0.0003
	t = 0.280	t = 0.951	t = 0.873	t = -0.047
Savings Ratio	0.002	0.005	0.005	0.002
	t = 0.753	t = 1.983**	t = 1.704*	t = 0.912
ln Terms of Trade	-0.931	-0.361	-1.208	-0.479
	t = -1.728*	t = -1.059	t = -1.588	t = -1.841*
ln.labsh x KAOPEN	-1.068	-1.158	-1.185	-0.707
	t = -1.978**	t = -2.626***	t = -2.674***	t = -2.613***
Constant	4.288			
	t = 1.741*			
Observations	481	481	481	390
Adjusted R^2	0.109	-0.076	-0.111	0.036
F Statistic	10.776*** (df = 6; 474)	10.352*** (df = 6; 384)	9.347*** (df = 6; 376)	3.144*** (df = 6; 384)

Note: *p<0.1; **p<0.05; ***p<0.0, t-stats reported are based on heteroskedasticity and cross-sectional dependence robust standard errors

<u>7.2- Introducing lagged dependent variable as an control</u>

The adjusted-PPP undervaluation index (*ln.Underval*) presents a relative high degree of persistence(or inertia) , meaning that a country that presents an undervalued RER index in a given period is likely to exhibit Undervalued RER index in the following period[28]. Thus, it is appropriate to check for the robustness of the results obtained in a dynamic panel-data setting by including a lag of dependent variable in the right-hand side of our estimated equation (24).

The lagged dependent variable is positive and statically significant in the Pooled OLS specification (column 1) and also when we control for Individual Fixed effect (Column 2)[29] and, also, for time fixed effect (Column 3), but it turns out to be very close to zero and insignificant when considering the relationship in terms of first differences. The inclusion of the lagged dependent variable reduces the coefficients of the main effect of the Wage Share on the Undervaluation Index, rendering it insignificant in most specifications (with the exception of the Individual effect model, which return a coefficient which is significant at 10%). The interaction effect remains statistically significant, with the magnitude of the coefficients vary close to the specification without the autoregressive term (except in the Pooled OLS specification, in which the magnitude of the coefficient is halved).

However, as is well-known since the work Nickell (1981), coefficients of the lagged dependent variable estimated by fixed effect models in dynamic setting are biased downwards[30], especially in the context of large N with relatively small T, such as the panel under inquiry here. This bias arises because the demeaning process[31] creates a correlation between regressor and error. The inclusion of other control variables doesn't tackle this bias and, actually, if the regressors are correlated with the lagged dependent variable to some degree, their coefficients may also be biased. This would be problematic the case if the RER undervaluation of country *i* in period *t-1* is correlated with Wage Share levels of country *i* in period *t*. To tackle the possible bias caused by this possibility, following the literature, I use the General Method of Moments, developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998), to estimate the parameters of the model.

[28] A fact that might be viewed as a consequence of high degree of persistence of Real Exchange Rates, as is highlighted by Min et.al (2015).
[29] However only when 10% p-value is considered.
[30] While in the pooled-OLS specification it would be biased upwards.
[31] Subtraction of the overall (time or individual) mean of the variable from each observation.

Table 7: Dynamic Panel-data specifications

	Dependent variable: ln Underval			
	Pooled OLS (1)	Individual Fixed Effect (2)	Two-Ways Fixed Effect (3)	First Difference (4)
lag (ln Underval)	0.633	0.189	0.179	-0.049
	t = 13.497***	t = 2.016**	t = 1.910*	t = -0.841
ln labsh	0.258	0.415	0.357	0.099
	t = 1.565	t = 1.903*	t = 1.412	t = 0.722
KAOPEN	-0.082	-0.215	-0.176	-0.191
	t = -2.089**	t = -3.307***	t = -2.727***	t = -4.153**
ln labsh x KAOPEN	-0.595	-0.926	-0.902	-0.638
	t = -2.400**	t = -3.005***	t = -2.819***	t = -2.632***
Constant	-0.054			
	t = -1.853*			
Observations	504	504	504	412
Adjusted R^2	0.481	-0.043	-0.106	0.037
F Statistic	117.355*** (df = 4; 499)	18.594*** (df = 4; 408)	13.676*** (df = 4; 400)	3.442*** (df = 4; 408)
Note:	*p<0.1; **p<0.05; ***p<0.01			

In this framework one sets up a generalized method of moments (GMM) problem in which the model is specified as a system of equations, where in the Difference-GMM estimator one uses lagged levels of the endogenous variables as instruments for the first-differences instruments. However, lagged levels of the endogenous variables can often be very weakly correlated with lagged first-differences, they tend to be quite poor instruments for first differenced variables, especially if variables are close to a random walk (Wooldridge, 2007). Thus, Arellano and Bover (1995) and Blundell and Bond (1998) developed an extension, known in the literature as system-GMM, which explores further moment conditions. In this estimator, lagged differences of the endogenous variables are also included as instruments, beyond the suitable lags of the levels of the endogenous variables (which enter the equation in differenced form). Table 8 present the result of the difference and system GMM estimators both in their two-step versions, with different number of instruments to assess the robustness of the results to the issue of instrument proliferation as indicated by Roodman (2009)[32].

Results for the difference and System-GMM are presented on table 8. Column (1) and (3) report the Difference-GMM and System-GMM results with the lagged undervalued index observations instrumented by its 3rd lag only, following the results of the autocorrelation tests (which reveal an autocorrelation up until the 2nd lag), and the Wage Share and KAOPEN variables are also considered endogenous and, thus, their observations are instrumented with their 2nd lag. Columns (2) and (4) present results with collapsed instruments[33]. As the Wald-Test for time dummies indicate them as insignificant, only individual-fixed effects are taken into consideration. Results (table 8) for the coefficients mainly corroborate the results reported in table 7. In the case of the difference GMM, the interaction coefficient of Wage Share and Capital Account openness is again negative and statistically significant at a 5% level. The magnitude of the coefficient (-0.85) is very similar to the ones obtained through the fixed-effect models (column (2) and (3) in table 7) and it is at least two time higher in magnitude to the Wage Share main effect coefficient (-0.42, in column (1), and -0.38, in column (2)).

The results for the System-GMM provide rather similar results, indicating that the estimated coefficients are not too sensitive to the problem of instrument proliferation. However, column (8) reports coefficients for the autoregressive term (lag(ln.underval)) in between the results reported in the OLS estimation and the Fixed-effect models, which are considered in the literature to be upper and lower-bounds for the estimated coefficient. Thus, it is the System-GMM specification I place more confidence.

Regarding the interaction term, our main variable of interest here, the System-GMM estimations report an estimated coefficient of -0.56 (column 3) and -0.66 (column 4), significant (at least) at a 5% level. A result very much in line with ones obtained by First-difference estimator. The coefficients of the main effect of the Wage Share are again positive, but statistically insignificant. Moreover, the magnitude of interaction effect relative to the Wage Share main effect is between 2.5 to 3 times higher than the main effect indicating, again, that in

[32] The number of instruments in GMM grows quadratically with the T dimension. And as in our case T=9 and n=92, thus, it can become an issue as the number of instruments can end-up overfitting the number of endogenous variables and distorting the results of the Sargan Test. For more details see Roodman (2009) and Milos and Croissant (2018).

[33] This is a method devised to make the instrument count linear in T. Instead of generating separate instruments for each period but capping the number of instruments generated per period by limiting the lag-depth, in this method only one instrument is made for each lag distance, with 0 substituted for any missing values.

countries that the relationship between Wage Share levels and Real Exchange Rate Undervaluation becomes negative even at modest levels capital account openness.

To illustrate the economic significance, taking the estimates of the System-GMM with Collapsed instruments (column 4), a country with fully open capital account[34] (e.g. the United Kingdom since 1983) a 10% change in their Real Exchange Rate Undervaluation Index is associated with a 4.3%[35] (not percentage points[36]) change in its Wage Share. As such, a country with a wage Share level of 55% of the GDP (for example), would need, *ceteris paribus*, to compress its Wage Share by approximately 2.3 p.p. to be able to achieve a 10% undervaluation of its Real Exchange Rate.

Table 8: GMM estimations

	Dependent variable: ln Underval			
	Two-Step Diff GMM	Two-Step Diff GMM Collapsed Instruments	Two-Step System GMM	Two-Step System GMM Collapsed Instruments
	(1)	(2)	(3)	(4)
lag(ln Underval)	0.557	0.499	0.745	0.556
	t = 4.530***	t = 4.186***	t = 10.641***	t = 5.672***
ln.labsh c	0.421	0.381	0.216	0.235
	t = 1.851*	t = 1.400	t = 1.625	t = 1.200
KAOPEN	-0.187	-0.137	-0.012	-0.025
	t = -2.284**	t = -1.295	t = -0.892	t = -1.451
ln.labsh x KAOPEN	-0.871	-0.832	-0.564	-0.663
	t = -2.356**	t = -2.089**	t = -2.694***	t = -2.414**
Nº of Observations Used	391	391	879	879
Nº of Instruments	53	29	62	36
Sargan Test (p-value)	0.115	0.059	0.109	0.103
AR (3) test (p-value)	0.752	0.735	0.726	0.712

*Note:*1. *p<0.1; **p<0.05; ***p<0.01
2. t-stats reported are robust to o the Windmeijer (2005) heteroscedasticity correction.
3. Results to the AR (2) failed to reject the null hypothesis no serial correlation. Thus, instruments for the lagged dependent variable starts from the 3rd lag.
4. Wald Test for time coefficients strongly rejected the presence of time-fixed effect, thus the results presented are for regressions with individual fixed effect only.

[34] According to Chinn and Ito's (2006) KAOPEN index.

[35] $\beta_1 + \beta_3 = 0.235 + (-0.663 \text{ x } 1) = 0.428$

[36] The overall change in terms of percentage points depends evidently from the level of Wage Share in each country.

7.3- Introducing Wage Share and Capital Account Openness index directly in the regression of the Real Exchange Rate

So far, I have restricted the discussion to relationship between Wage Share and the (adjusted-PPP) Real Exchange Rate Undervaluation index, used by Rodrik (2008) and subsequent literature, instead of directly introducing the Wage Share and Capital Account Openness indexes in a regression of the Real Exchange Rate. This is approach was chosen because the coverage of the PWT 9.0 for the Wage Share variable is much smaller than the coverage of the Real GDP per capita variable. This has implications for the estimated coefficient of the Real GDP per capita in the Real Exchange Rate regression, (as can be seen by comparing columns (1) and (2) in table 9). And the literature derives implications of Real Exchange Rate Undervaluation to economic growth, from a Undervaluation index which is derived from regression results close to the one observed in Column (1). Thus, to dialogue with the literature, the idea is to assess the distributional implications of the Real Exchange Rate Undervaluation estimates, which are in fact used by the literature. Nevertheless, as a last robustness check, I present results of regressing the Real Exchange Rate directly on the Wage Share, Capital Account Openness and an interaction term (beyond the already included Real GDP per capita).

The results reveal again the importance of the degree of Capital Account Openness index to uncover the relationship between Real Exchange Rate and Wage Share Levels. When the Real Exchange Rate is regressed against, only, the Real GDP per capita and the Wage Share (column 3), the Wage Share coefficient is zero and statistically insignificant. When we introduce the Capital Account Openness index, KAOPEN, (column 4), the Wage Share coefficient remain very close to zero and statistically insignificant. It is when we include the interaction effect that the relationship becomes apparent. As it occurred with the regression of the Undervaluation Index, when the Capital Account is closed (KAOPEN = 0) a 1% increase in the Wage Share is associated, on average, with a 0.5% devaluation of the Real Exchange Rate (column 5)[37]. However, the coefficient of the interaction term is negative (-1.254), statistically significant at a 5% level and 2.5 times higher in magnitude. Indicating that for countries with Capital Account Openness higher than 0.4[38] [39], an increase in the Wage Share is associated with an appreciation of the Real Exchange Rate. For a country with fully Open Capital Account (KAOPEN =1) a 1%

[37] Although, the effect is statistically insignificant.

[38] In this paper, Chinn and Ito's (2006) KAOPEN index has been normalized with values ranging from 0 (closed capital account) to 1 (open capital account).

[39] This is a level observed in 2017 (last available year of the database) in countries like Colombia, Indonesia, Malasya, Vietnam, Albania, among others. And it was levels observed in countries like France between 1973 and 1989, Denmark between 1970 and 1989, Norway between 1973 and 1992, Spain between 1977 and 1992, Ireland between 1978 and 1991, among others.

increase in the Wage Share is associated with an appreciation of 0.75% in the Real Exchange Rate[40].

Table 9: Regressing the Real Exchange Rate and Functional Income Distribution under different degrees of Capital Account Openness

	Dependent variable: ln RER				
	(1)	(2)	(3)	(4)	(5)
ln.RGDP per capita	-0.186	-0.369	-0.361	-0.302	-0.280
	t = -7.538***	t = -10.057***	t = -10.304***	t = -7.895***	t = -6.438***
ln.labsh			-0.041	0.001	0.509
			t = -0.241	t = 0.004	t = 1.555
KAOPEN				-0.310	-0.322
				t = -4.064***	t = -4.072***
ln.labsh x KAOPEN					-1.254
					t = -2.456**
Observations	1,877	541	541	505	505
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.187	0.579	0.512	0.606	0.638
F Statistic	445.612*** (df = 1; 1863)	700.903*** (df = 1; 495)	288.818*** (df = 2; 530)	262.397*** (df = 3; 493)	225.161*** (df = 4; 492)

Note: *p<0.1; **p<0.05; ***p<0.01

8. Conclusion

The importance of Real Exchange Rates levels to economic development has gained renewed attention in the past decade. Several papers have identified a positive relationship between Real Exchange Rate Undervaluation and Economic Growth. However, the results are more consistent mainly for low income developing countries. In particular, Rodrik (2008) and Rapetti et.al (2012) find that the relationship was statistically significant and more robust for a sample of countries with Real GDP US$ 6000 (in 2000 constant prices[41]). The theoretical justification given, for the fact that the relationship is stronger and more robust for the case of developing economies, is that that the tradable sector of these countries would suffer

[40] $\beta_1 + \beta_3 = 0.509 + (-1.254.\text{x } 1) = 0.748$

[41] Which yields around US$ 7500 in 2011 constant prices, which are the base year used in version 9.0 of Penn-World-Table used in this study.

disproportionately from the government or market failures, which are more prevalent in nation with lower Real GDP per capita.

In this paper we analyse the topic from a different perspective, focusing in particular on the relationship between the Real Exchange Rate Undervaluation and Functional Income Distribution, analysing the political economy consequences of countries pursuing an 'currency undervaluation strategy' to economic development. Albeit preliminary, the findings suggest that the relationship between Real Exchange Rate Undervaluation and Wage Share levels is mediated by the degree of Capital Mobility, as measured by Chinn and Ito's (2006) KAOPEN index. The regression results indicate that to move its' Real Exchange Rate to a value perceived as undervalued (as measured by the adjusted-PPP framework) a country, with even modest levels of capital account openness, will need to compress pursue policies that reduce the share of Wages in the GDP.

These findings, however, need to be further scrutinized. Robustness of the findings need to be evaluated regarding other metrics of Real Exchange Rate Equilibrium and associated over/undervaluation measures, to the addition of further control variables and using alternative measures of Capital mobility and income distribution. However, as they stand, these results indicate a trilemma facing policy makers, as they cannot simultaneously pursue 'currency undervaluation strategy' to spur economic growth, redistribute income towards workers and increase its financial integration to the capital movements.

References

Alberola, E.; Cervero, S. G.; Lopez H., Ubide, A., Bayoumi, T.T., Faruquee, H., Ford, R., Gordo, E., Krueger, T. (1999), 'Global equilibrium exchange rates: euro, dollar, 'ins,' 'outs' and other major currencies in a panel cointegration framework', IMF Working Paper, 1999, No 75.

Amsden, A. (2001) *The Rise of "The Rest": Challenges to the West from Late-Industrializing Economies*, Oxford University Press, 2001.

Antonopoulos, R. (1999) 'A classical approach to real exchange rate determination with an application for the case of Greece', Review of Radical Political Economics vol. 31, no. 3, pp. 53-65.

Bhaduri, A., Marglin, S., 1990. 'Unemployment and the real wage: the economic basis for contesting political ideologies', Cambridge Journal of Economics 14(4), 375-393.

Béreau, S., Lopez-Villavicencio, A., Mignon, V. (2012) 'Currency misalignments and growth: a new looking using nonlinear panel data methods'. Applied Economics vol. 44, no. 27, pp. 3011–3503.

Berg, A., J. Ostry, and J. Zettelmeyer (2008) 'What makes growth sustained?'. IMF Working Paper 08/59.

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

Chinn, M. and Ito. H. (2006). 'What Matters for Financial Development? Capital Controls, Institutions, and Interactions,' Journal of Development Economics, Volume 81, Issue 1, Pages 163-192 (October).

Couharde, C. and Sallenave, A. (2013) 'How do currency misalignments' threshold affect economic growth?' Journal of Macroeconomics vol. 36, no. C, pp.106–120

Edwards, S. Yeyati, E. L. (2005) 'Flexible exchange rates as shock absorbers', European Economic Review, Volume 49, Issue 8, November 2005, Pages 2079-2105.

Eichengreen, B. (2008). 'The Real Exchange Rate and Economic Growth', World Bank PREM Network, Commission on Growth and Development Working Paper No. 4.

Eichengreen, B. and Sachs, J. 'Exchange Rates and Economic Recovery in the 1930s', The Journal of Economic History, Vol. 45, No. 4 (Dec., 1985), pp. 925-946.

Ersoy, E. (2010), 'Investigation Of Long-Run Real Exchange Rates: The Case Of Turkey', Sosyal Bilimler Dergisi 2010, (2), 14-29.

Feenstra, R. C., Inklaar, R. and Timmer, M. P. (2015), 'The Next Generation of the Penn World Table' American Economic Review, 105(10), 3150-3182

Felipe, J. and Kumar, U. (2014) 'Unit labor costs in the eurozone: the competitiveness debate again', Review of Keynesian Economics, Vol. 2 No. 4, Winter 2014, pp. 490–507.

Gala, P. (2008), 'Real exchange Rate Levels and Economic Development: Theoretical Analysis and Empirical Evidence', Cambridge Journal of Economics, vol. 32, pp. 273-288.

Glüzmann, P. A., Levy-Yeyati, E. and F. Sturzenegger (2012) 'Exchange rate undervaluation and economic growth: Díaz Alejandro (1965) revisited', Economics Letters, vol. 117, no. 3, pp. 666-672.

Goncalves, C.E., Rodrigues, M. (2017) 'Exchange Rate Misalignment and Growth: A Myth?' IMF Working Paper 17/283.

Guzman, M., Ocampo, J. A., Joseph E. Stiglitz, J. E. (2018), 'Real exchange rate policies for economic development', World Development, vol. 110 (2018), pp. 51–62.

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

Johnson, S., W. Larson, C. Papageorgiou, and A. Subramanian, 2009, 'Is Newer Better? Penn World Table Revisions and Their Impact on Growth Estimates,' National Bureau of Economic Research Working Paper No. 15455.

Lavoie, M. (2014), Post-Keynesian Economics: New Foundations, Cheltenham, Edward Elgar, 2014, 660 pp.

MacDonald, R. and Vieira, F. (2010) 'A Panel Data Investigation of Real Exchange Rate Misalignment and Growth'. CESifo working paper, No. 3061

Martinez-Hernandez, F. (2010) 'An Alternative Theory of Real Exchange Rate Determination: Theory and Empirical Evidence for the Mexican Economy, 1970-2004'. Investigacion Economica, vol. LXIX, 273, julio-septiembre de 2010, pp. 55-84.

Min, H., Shin, S., McDonald, Judith, A. (2015) 'Income Inequality and the Real Exchange Rate: Linkages and Evidence', Annals of Economics And Finance 16-1, pp. 115-141.

Nouira, R. and K. Sekkat (2012) 'Desperately seeking the positive impact of undervaluation on growth', Journal of Macroeconomics, vol. 34, no. 2, pp. 537-552.

Onaran, O., Galanis, G. (2014) 'Income Distribution and Growth: A Global Model', Environment and Planning A: Economy and Space, Volume: 46 issue: 10, page(s): 2489-2513.

Pasinetti, L.L. (1973) 'The Notion of Vertical Integration in Economic Analysis', Metroeconomica, Vol. 25(1).

Quinn, D., Schindler, M. and Toyoda, A. M. (2008) 'Does capital account liberalization lead to economic growth?', The Review of Financial Studies, 21 (3), 1403–1449.

Quinn, D., Schindler, M. and Toyoda, A. M. (2011) 'Assessing Measures of Financial Openness and Integration', IMF Economic Review, Vol. 59, No. 3, 2011 International Monetary Fund.

Rapetti, M., Peter S. and Arslan R. (2012) 'The real exchange rate and economic growth: Are developing countries different', International Review of Applied Economics, vol. 26, no. 6, pp.735-753.

Ribeiro, R. S.M, McCombie, J.S.L, Lima, G.T (2017) 'Does Real Exchange Rate Undervaluation Really Promote Economic Growth?', 45o Meeting of National Association of Graduate Schools of Economics, Natal/RN, Brazil, December 2017.

Rodrik, D. (2008) 'The real exchange rate and economic growth', Brookings Papers on Economic Activity, vol. 39, no. 2, pp. 365-439.

Ruiz-Napoles, P. (2004) 'The Purchasing Power Parity Theory and Ricardo's Theory of Value', Contributions to Political economy, Vol. 23.

Ruiz-Nápoles, P. (2010) 'Vertically integrated unit labour costs by sector: Mexico and USA 1970-2000', Investigación económica, vol. LXIX, 273, julio-septiembre de 2010, pp. 15-54, UNAM.

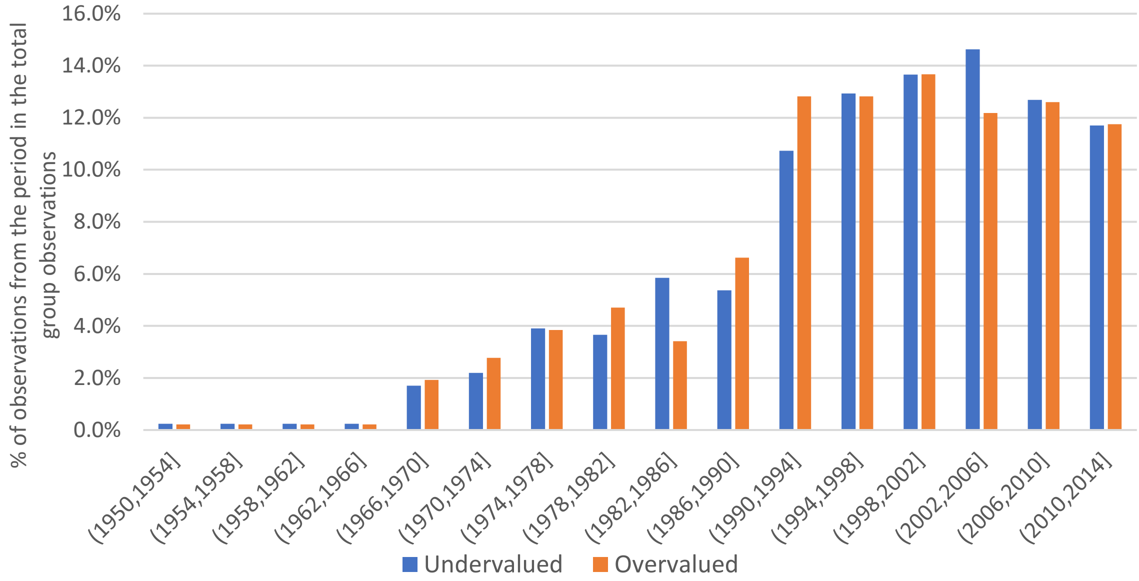
Shaikh, A. (1999) 'Real Exchange Rates and International Mobility of Capital', The Jerome Levy Economics Institute, Working Paper No. 265.

Appendix

Table A.1: Estimating a RER Norm- PPP-based adjusted for Harrod-Balassa-Samuelson

Dependent Variable: ln (Real Exchange Rate)				
	Estimate	Robust Std. Error	t value	Pr(>|t|)
ln (Real GDP per capita)	-0.19419	0.02506	-7.777	1.117e-14***
Time fixed effects	Yes			
Country fixed effects	No			
N° of Countries	182	N° of observations	2295	
Multiple R-squared	0.21132	Adjusted R-squared:		0.20557
F-statistic	624.832 on 1 and 2332 DF	p-value:		< 2.22e-16

Figure A.2: Distribution of RER observations classified in each group by period (% of the total observations of each group)



Source: Author's elaboration based on Penn-World Table Version 9.0

Table A.3: Wooldridge's first-difference test for serial correlation in panels

- **Table 5, Column (5): ΔLn (Underval) = Δ Wage Share + Δ KAOPEN**

```
F = 0.84857, df1 = 1, df2 = 425, p-value = 0.3575
alternative hypothesis: serial correlation in differenced errors
```

- **Table 5, Column (6): ΔLn (Underval) = Δ Wage Share + Δ KAOPEN + Δ (Wage Share x KAOPEN)**

```
F = 0.53419, df1 = 1, df2 = 425, p-value = 0.4653
alternative hypothesis: serial correlation in differenced errors
```

- **Table 6, Column (5): ΔLn (Underval) = Δ Wage Share + Δ CAPITAL**

```
F = 3.0073, df1 = 1, df2 = 421, p-value = 0.08362
alternative hypothesis: serial correlation in differenced errors
```

- **Table 6, Column (6): ΔLn (Underval) = Δ Wage Share + Δ CAPITAL + Δ (Wage Share x CAPITAL)**

```
F = 2.977, df1 = 1, df2 = 421, p-value = 0.08519
alternative hypothesis: serial correlation in differenced errors
```

$$(1-\alpha_A^{NT}-\alpha_A^{M})=\alpha_B^{M} \rightarrow 1-\alpha_A^{NT}=\alpha_B^{M}+\alpha_A^{M}$$

$$(1-\alpha_B^{NT}-\alpha_B^{M})=\alpha_A^{M} \rightarrow 1-\alpha_B^{NT}=\alpha_B^{M}+\alpha_A^{M}$$

$$1-\alpha_A^{NT}=1-\alpha_B^{NT}$$

$$\alpha_A^{NT}=\alpha_B^{NT}$$

Table A.2: Data definitions, sources and coverage.

Name	Code	Definition	Source	Coverage
Real Exchange Rate	RER	XRAT/PPP	Author's own calculation	1950-2014
Real GDP per capita	rgdpo	Output-side real GDP at chained PPPs (in mil. 2011US$)	PWT 9.0	1950-2014
Purchasing Power Parity indexes	PPP	Price level of CGDPo relative to price level of USA CGDPo GDPo in 2011=1	PWT 9.0	1950-2014
Nominal Exchange Rate	XRAT	Exchange rate, national currency/USD (market+estimated)	PWT 9.0	1950-2014
Wage Share	labsh	Share of labour compensation in GDP at current national prices	PWT 9.0	1950-2014
Capital Account Openness	KAOPEN	De Jure Indicator of Capital Account Openness	Chinn and Ito (2006)	1950-2012
	CAPITAL	De Jure Indicator of Capital Account Openness	Quinn and Toyoda (2008)	1970-2016
GDP per capita	CGDPo	Output-side real GDP at current PPPs (in mil. 2011US$)	PWT 9.0	1950-2014