Research Article

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How Equilibrium Exchange Rate Misalignments Influence on Economic Growth? Evidence for European Countries

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Abstract: The determination of the equilibrium real exchange rate is one of the most important issues in open economy since the policymakers are concerned about predicting and monitoring misalignments and they are usually associated with current account problems and currency crises. To the best of my knowledge, this is the first time a study provides empirical evidence on the impact of deviations from the long-run sustainable real exchange rate equilibrium on real economic growth rate applying panel ARDL model (pooled mean group, mean group and dynamic fixed effect estimators) for the 27 European countries during the 2000–2016 period. This study applies the EQCHANGE database developed by Couharde et al. (2017) to obtain the real effective exchange rate (REER) misalignments according to the behavioral equilibrium exchange rate approach for each country. One of the main objectives is to determine the relationship between REER misalignments and economic growth trying to differentiate between short- and long-run effects. To this purpose, a neoclassical growth model is considered controlling for several economic variables such as gross capital formation, degree of openness, human capital, inflation rate, and population rate.

Keywords: equilibrium real exchange rate, misalignments, economic growth, panel ARDL

JEL Classification Codes: F43, F30, C23, O47

1 Introduction

The exchange rate misalignment is a crucial topic for policymakers due to the fact that persistent deviations can erode current account and usually provoke currency crisis (Holtemöller & Mallick, 2013). According to Edwards (2018), given the growing interconnectedness of economic activity across borders in this era of financial globalization, the real effective exchange rate (REER) behavior is essential to macroeconomic policy formulation. There is a vast literature on real exchange rate (RER) misalignments and their economic implications (see, for instance, Burstein & Gopinath, 2014; MacDonald & Taylor, 1992, for excellent surveys). For this reason, avoiding RER misalignments is understood as a matter of macroeconomic stabilization to generate optimal output and employment (see for instance, Acemoglu, Johnson, Robinson, & Thaicharoen, 2003; Easterly & Levine, 2003; Frankel & Saravelos, 2012; Obstfeld & Rogoff, 1996). Researchers such as Aguirre and Calderón (2005) or Schröder (2013) highlight the crucial negative impact of REER misalignments on economic growth regardless it takes the form of overvaluation or undervaluation.

Conceptually, a REER is misaligned when it deviates from the underlying REER that would have been in the absence of price rigidities, frictions, and other short run factors. It is usually associated with internal and external balance. Specifically, when the economy is under full employment and at full capacity output (internal balance) and when simultaneously is characterized by a sustainable current account position.

According to Comunale (2017, 2019), the EU28 misalignments are detected extremely wide and persistent, which concern to the policymakers. The REER behavior is crucial for Economic and Monetary Union countries to understand the competitive differentials across economies having the same currency or also for new members, which are planning to adopt the euro with an appropriate entry rate. In particular, the persistence of different wage and productivity dynamics on the European Union (EU)

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have ended into divergent dynamics in the REER since the impossibility of the adjustment of nominal rates to avoid competitiveness gaps not only in the euro area but also in the whole EU (Comunale, 2019; Salto & Turrini, 2010). In the same line, Duwicquet, Mazier, and Saadaoui (2018) claim that relative wage and price flexibility are mechanisms that partially act as exchange rate adjustment; nevertheless, it hurts economic growth making more differences among EU economies since the return to the equilibrium is slower.

According to Dufrenot and Yehoue (2005), Razin and Collins (1997), among others, there is neither a consensus indicator of misalignment nor an agreed upon methodology for constructing such indicator. Driver and Westaway (2005) specify that there is not a single definition of the equilibrium real exchange rate (ERER),[1] in which they distinguish 14 different approaches. Specifically, this equilibrium can be treated as a long-run, medium-run or short-run concept, which can be considered as a stock or flow equilibrium. This measure is sensitive to the variables and model implemented (Cheung, Chinn, & Fujii, 2009) and the data source used (Cheung, Chinn, & Fujii, 2010; Cheung & Fujii, 2014). Part of the literature is based on deviations from purchasing parity power (PPP), while other studies focus on distortions of the ERER.

To the best of my knowledge, this is the first time a study provides empirical evidence on the impact of deviations from the long-run sustainable RER equilibrium on real economic growth rate applying panel ARDL for the 27 EU countries during the 2000–2016 period including the financial crisis and sovereign debt crisis in the EU. This study applies the EQCHANGE database developed by Couharde, Delatte, Grekou, Mignon, and Morvillier (2017) to obtain the REER misalignments according to the behavioral equilibrium exchange rate (BEER) approach for each country. One of the main objectives is to determine the relationship between REER misalignments and economic growth trying to differentiate between short- and long-run effects. This recent methodology is seen as an alternative perspective to analyze this relationship that is crucial for researchers and policymakers, since it is able to distinguish the effects between the short- and long-run.

The rest of this study is structured as follows. Section 2 provides a literature review. Section 3 presents the data and variables used in this study. Section 4 provides the panel ARDL. Section 5 reports the empirical results for the 27 European countries during the 2000–2016 period. Finally, in Section 6, the main conclusions are provided.

2 Literature Review

There have been a huge literature analyzing the impact of RER misalignment on economic growth (to name a few, see, for instance, Bhalla, 2012; Couharde & Sallenave, 2013; Dubas, 2009; Gala, 2008; Gala & Lucinda, 2006; MacDonald & Vieira, 2010; Prasad, Rajan, & Subramanian, 2007; Sekkat & Varoudakis, 2000; Zhang & Chen, 2014). Misalignments could arise due to inadequate macroeconomic, trade or exchange rate policies.

The RER misalignment is defined as the deviations of the exchange rate from its long-run sustainable equilibrium level. Nevertheless, there is no consensus in the way to determine its equilibrium (see for instance, Cheung et al., 2010; Cheung, Chinn, Pascual, & Zhang, 2017; Gandolfo, Padoan, & de Arcangelis, 1993; Meese & Rogoff, 1983, among others). There are two main procedures: the structural and the direct approach. The former is relying on a macroeconomic model, and the equilibrium is determined based on internal and external balance. On the contrary, the direct approach uses ad-hoc fundamentals. Through literature, we can find four main approaches: the PPP introduced by Cassel (1918), the natural rate of exchange rate (NATREX) proposed by Stein and Allen (1998), the Fundamental Equilibrium Exchange Rate (FEER) introduced by Williamson (1994) and the BEER proposed by Clark and MacDonald (1998).

The most traditional theoretical method is the PPP which is based on the prediction that the RER does not vary over time and it is equal to one since the price levels are equal when measured in the same currency (Froot & Rogoff, 1995; MacDonald, 1995). According to Cavallo, Cottani, and Khan (1990), and Ghura and Grennes (1993), higher misalignments can generate lower economic growth rate. Given that many authors such as MacDonald (2000), Rogoff (1996), and Taylor and Taylor (2004) have proved that the PPP hypothesis does not hold, it cannot be a proxy for the long-run equilibrium.

The NATREX model was created by Nurkse (1945) and developed by Stein (1990, 1996), and it is considered as a moving equilibrium that varies over time in response to shocks in the current real macroeconomic factors. It guarantees the equilibrium of the balance of payments in the absence of changes in international reserves, speculative capital movements and cyclical factors. This procedure examines the transition between the medium-run to

1 See Lee, Milesi-Ferretti, Ostry, Prati, and Ricci (2008) and Siregar (2011) for recent surveys on this topic.

long-run equilibrium (see for instance, Detken & Martinez, 2001; Federici & Gandolfo, 2002; Gandolfo & Felettigh, 1998; Siregar & Rajan, 2006; van Eden, Bin, Romyn, & Xiaguang, 2001; among others).

Another relevant technique was developed by Williamson (1994). The FEER approach is based on the fact that the REER fluctuates around a time-varying equilibrium which is defined depending on the relationship with the long-run real factors or the so-called fundamentals. This procedure was widely implemented by several authors along the empirical literature (see for instance, Barisone, Driver, & Wren-Lewis, 2006; Carton & Hervé, 2012; Cline & Williamson, 2010, 2011; Cline, 2008; Duwicquet, Mazier, & Saadaoui, 2013; Jeong, Mazier, & Saadoui, 2010; Lee et al., 2008; Saadaoui, 2017a,b; You & Sarantis, 2011; Zhou, 1993). According to Faruqee, Isard, and Masson (1999), Edwards (1989), and Wren-Lewis (1992, 2003), the equilibrium is achieved when both internal and external equilibriums are achieved. In particular, one of the main advantages is that it is a single-equation reduced-form model to measure the equilibrium exchange rate, and it considers low growth levels or unsustainable current account trajectories as possible signs of misalignments (Montiel, 1999). This model is based on a small open economy in which exogenous shocks and policy-induced conditionate the equilibrium. This methodology is considered as a medium-term approach (or structural approach) given that the equilibrium exchange rate is consistent with the medium-run equilibrium of the macroeconomic factors.

The BEER approach is introduced by MacDonald (1997) and developed by Clark and MacDonald (1998). In this case, the RER is estimated against its determinants, and then, it considers the estimated coefficients from the previous regression and the permanent components of RER factors to compute the corresponding equilibrium. Thereafter, the misalignment is computed as the difference between the actual and the equilibrium RER. This method is understood as a direct approach. Several studies have been applied this approach (see for instance, Alberola, 2003; Bénassy-Quéré, Breau, & Mignon, 2009, 2010; Berg & Miao, 2010; Conrad & Jagessar, 2018; Naseem & Hamizah, 2013; among others). One of the main advantages is that it captures not only real exchange movements in the medium or long-term equilibrium level but also movements over time.

Not only there is no consensus in the way to compute the ERER and therefore its misalignment but also there is no consensus on the impact of REER misalignments on economic growth. On the one hand, some monetary authorities argue that the RER below its equilibrium can trigger more inflation, which leads to overheating the economy (Calvo, Reinhart, & Vegh, 1995; Goo, 2006; Haddad & Pancaro, 2010; Krugman & Taylor, 1978). On the contrary, authors such as Aflouk and Mazier (2013), Bhalla (2012), Couharde and Sallenave (2013), Bleaney and Greenaway (2001), Gala (2008), Hausmann, Pritchett, and Rodrik (2005), Razmi, Rapetti, and Skott (2012), and Vieira and MacDonald (2012) maintain that an undervalued RER can promote exports and employment and consequently higher economic growth, since increasing capacity utilization can translate into more profitability of traded goods sectors leading to a stimulus of private investment. In fact, the theoretical understanding of this implication is based on the role of undervaluation in supporting tradable sector (Prasad et al., 2007 or Rodrik, 2008a,b); meanwhile, authors such as Gala (2008), Gluzmann, Levy-Yeyati, and Sturzenegger (2012) or Ibarra (2011) claim the role in stimulating capital accumulation. In the case of Porcile and Lima (2010), they establish that undervaluation can promote exports and investment and through both channels contribute to the balance of payment.

On the other hand, the real overvaluation can erode exports because of the lower competitiveness of home products which supposes current account deficits and therefore currency crises (Couharde & Sallenave, 2013; Easterly, 2005; Elbadawi & Soto, 2008; Gala, 2008; Gala & Lucinda, 2006; Sallenave, 2009; Toulaboe, 2006). Rodrik (2008a,b) claims that an overvalued exchange rate restricts economic activity leading to a balance of payment emergencies and conducting black market practices. Other studies such as Aguirre and Calderón (2005), MacDonald and Vieira (2010), Schröder (2013), and Sekkat and Varoudakis (2000) support that undervaluation and overvaluation both are harmful for economic performance.

Considering a wider sample, in a panel data analysis of around 200 countries, Rodrik (2008a) ensures that undervaluation provides growth rather than overvaluation which can hurt the economic growth. Applying a system GMM model for 58 economies, Gala and Lucinda (2006) highlight that real appreciation can erode growth rates controlling for some macroeconomic factors. Bussière, Lopez, and Tille (2015) obtain that RER appreciations can boost economic growth in developing countries only if they are accompanied by productivity increases implementing the propensity score matching method to address the endogeneity problem. Ramos-Herrera and Sosvilla-Rivero (2021) analyze whether the nexus between per capita economic growth and deviations from its equilibrium exchange rate might differ across different groups of countries applying the group fixed effects method proposed by Bonhomme and Manresa (2015), identifying

heterogeneous relationships. Gala and Lucinda (2006) offer evidence that supports that a real appreciation induces lower economic growth and the opposite result is detected for a real depreciation considering a dynamic panel data model with difference and system GMM for 58 countries.

Attending to emerging markets, there is an extended empirical literature which detects a direct nexus between a more competitive currency and growth (see for instance, Cottani, Cavallo, & Khan, 1990; Dollar, 1992; Gala & Libanio, 2010; Levy-Yeyati, Sturzenegger, & Gluzmann, 2013; Loayza, Fajnzylber, & Calderón, 2005; Vaz & Baer, 2014; among others). Among the theoretical arguments of this outcome is found the fact that bad institutions and market failures affect disproportionately more the tradable sector than the non-tradable sector; therefore, an undervaluation could promote growth (Rodrik, 2008a,b). Another strand is emphasized by Gala and Libanio (2010) or Guzman, Ocampo, and Stiglitz (2018) because undervaluation is able to boost economic growth through incentives to technological capabilities, capital accumulation and information spillovers. Besides, taking into account the distributional effects, an undervalued currency could foster inflation and therefore reducing real wages, and then, there is a redistribution income from workers to capitalists which spurs capital accumulation and economic growth (Ribeiro, McCombie, & Tadeu Lima, 2018).

Concretely, Berg and Miao (2010), Habib, Mileva, and Stracca (2017), and MacDonald and Vieira (2010) detect little evidence of asymmetry analyzing the impact of overvaluation and undervaluation. On the other hand, authors such as Aguirre and Calderón (2005), Bajo-Rubio and Díaz-Roldán (2009), and Schröder (2013) suggest that both positive and negative misalignments can harm the economy.

According to Krekó and Oblath (2020), the results depend on the way of calculating the RER misalignments. For instance, Balassa (1964) applies a simple linear functional form, Rodrik (2008a,b) a log–log form, Bhalla (2012) a S-shaped exponential model, using cross-sectional data for each year (Johnson et al. 2007) or using panel data techniques (MacDonald & Vieira, 2010 or Prasad et al., 2007).

3 Data

Based on the neoclassical growth model, this study analyzes the real economic growth for the 27 European countries during the period 2000–2016 with the purpose of understanding the relationship between RER misalignments and the real economic growth rate controlling for the usual macroeconomic variables (Barro & Sala-i-Martin, 2004; Checherita-Westphal & Rother, 2012; Eberhardt & Presbitero, 2015; Pattillo, Poirson, & Ricci, 2011). The REER misalignments have been extracted form Couharde et al. (2017). Besides, the real economic growth as well as the gross capital formation, degree of openness, inflation rate, human capital and population growth rate are acquired from the World Development Indicators Database (see Table A1 for more details).

4 Econometric Methodology

According to Loayza and Rancière (2006), the static panel estimations are not able to estimate the short- and the long-term relationships, since they do not capture the dynamic nature of data. Additionally, the standard panel models only deal with the structural heterogeneity considering fixed or random effects; however, they impose homogeneous slope across countries. The dynamic panel models such as the GMM-difference estimator proposed by Arellano and Bond (1991) or the GMM-system estimator proposed by Arellano and Bover (1995) overcome some weaknesses; nevertheless, the GMM only reflects the short-run dynamics. In order to overcome these shortcomings, this study applies the panel ARDL considering three different estimators: Mean Group (MG), Dynamic Fixed Effect (DFE) and the Pooled Mean Group (PMG) estimators. One of the main advantages of this procedure is that this methodology is capable of estimating simultaneously the short- and long-term effects. Besides, another strong point is that PMG and MG estimators are consistent even in the presence of endogeneity (Pesaran, Shin, & Smith, 1999). Additionally, according to Pesaran and Smith (1995) or Pesaran et al. (1999) or Roodman (2006), one of the main advantages of panel ARDL model over other dynamic panel methodologies, such as fixed effects, GMM estimators or instrumental variables, is that it is superior since these methods are able to offer inconsistent estimates about the average value of parameters unless the coefficients are identical across countries.

In this study, I consider the same generalized empirical ARDL (1, 1, 1, 1, 1, 1) equation proposed by Ramos-Herrera and Sosvilla-Rivero (2021) based on a Solow model[2] augmented with exchange rate misalignments:

2 This study is based on the neoclassical growth model including the usual explanatory factors (see for instance, Barro & Sala-i-Martin, 2004; Becker, 1962; Checherita-Westphal & Rother, 2012; Eberhardt & Presbitero, 2015; Mankiw, Romer, & Weil, 1992; or Pattillo et al., 2011; among others).

$$\begin{aligned}\Delta \text{growth}_{it} = {} & \beta_{0i} + \beta_{1t}\text{growth}_{it-1} + \beta_{2t}\text{Mis}_{it-1} \\ & + \beta_{3t}\text{Pop}_{it-1} + \beta_{4t}\text{HK}_{it-1} + \beta_{5t}\text{INF}_{it-1} \\ & + \beta_{6t}\text{OPEN}_{it-1} + \beta_{7t}\text{GKF}_{it-1} \\ & + \sum_{J=0}^{M-1}\gamma_{ij}\Delta g_{it-J} + \sum_{J=0}^{N-1}\gamma_{ij}\Delta\text{Mis}_{it-J} \\ & + \sum_{J=0}^{O-1}\gamma_{ij}\Delta\text{Pop}_{it-J} + \sum_{J=0}^{P-1}\gamma_{ij}\Delta\text{HK}_{\text{it-J}} \\ & + \sum_{J=0}^{Q-1}\gamma_{ij}\Delta\text{INF}_{it-J} + \sum_{J=0}^{R-1}\gamma_{ij}\Delta\text{OPEN}_{it-J} \\ & + \sum_{J=0}^{S-1}\gamma_{ij}\Delta\text{GKF}_{it-J} + \mu_i + \varepsilon_{it},\end{aligned} \tag{1}$$

where growth_{it} refers to the real economic growth rate, Mis_{it} are the exchange rate misalignments, Pop_{it} is the population growth rate, HK_{it} represents the human capital, INF_{it} is the inflation rate measured by the consumer price index, OPEN_{it} captures the degree of openness, GKF_{it} is the physical capital (gross capital formation), $i = 1, 2, \ldots N$ and time by $t = 1, 2, \ldots T$, μ_i represents the fixed effects and ε_{it} denotes the error term. The ARDL lag structure is determined by the Schwartz Bayesian criterion, and the same optimal lags are detected using the Akaike Information criterion.

One of the main strengths of this recent methodology is that not all variables need to show the same order of integration to guarantee a long-run relationship. For this reason, the panel ARDL does not require unit roots testing (see for instance, Fang, Miller, & Yeh, 2015; Kim, Lin, & Suen, 2010). This econometric technique allows to consider stationary variables or explanatory factors of order 1; however, it is not possible to work with the variables of order 2. For this reason, this study applies *first-* and *second-generation* panel unit root tests to check this requirement. Concretely, the Breitung (2000), Harris and Tzavalis (HT) (1999), Im, Pesaran, and Shin (IPS) (2003), Levin, Lin, and Chu (LLC) (2002), and Fisher-type (Choi, 2000) tests are considered as the *first-generation* panel unit root tests in this analysis. However, one of the main criticisms of the *first-generation* panel unit root tests is that they tend to reject the null hypothesis of unit root more often. For this reason, to analyze whether the results are robust, the cross-sectionally augmented Dickey-Fuller (CADF) test suggested by Pesaran (2007) is also applied in this study. In particular, the CADF test allows to test for unit root in the presence of cross-sectional dependence. This test based on the existence of one single common factor existing among all countries.

The panel ARDL methodology proposes three different estimators. I will focus on the main differences between them. The MG estimator was developed by Pesaran and Smith (1995) and it does not impose any restrictions. In particular, all coefficients are allowed to be country-specific (i.e. heterogeneous) and time-varying in both short- and long-run. One of the requirements to implement this approach is that time-series need to be large. The PMG estimator assumes homogeneity for the long-term slope coefficients across economies; however, it allows heterogeneity across countries for short-term coefficients, the speed of adjustment, error variances and the intercepts. The coefficient on the error-correction term (ECT) must be negative and not lower than –2 in order to corroborate consistency and efficiency. Eberhardt and Teal (2011) argue that the treatment of heterogeneity is crucial to understand the growth process. One of the basic assumptions is that the ECT is not correlated with regressors and is normally distributed meaning that the explanatory factors can be treated as exogenous variables. The DFE estimator was developed by Pesaran et al. (1999), which is similar to PMG estimator; nonetheless, the DFE assumes that the slope coefficient and the error variances are the same across countries in the long run. The speed of adjustment and the short-run coefficient are also homogeneous while the intercepts are country-specific.

The Hausman test is applied in order to identify which is the best estimator. When the null hypothesis is rejected (i.e. the difference between PMG and DFE or between PMG and MG is not significant), the best option is to estimate applying the PMG estimator given that it is more efficient than others.

5 Empirical Results

Attending to Table 1, it can be seen that they are some variables which are integrated of order 1 ($I(1)$) and others are stationary ($I(0)$), but they are not integrated of order 2. This guarantees that this methodology is very appropriate to analyze the relationship between exchange rate misalignments and economic growth. Additionally, this outcome is reinforced by the CADF Pesaran (2007) test controlling for the presence of cross-sectional dependence. Concretely, the variables at level for both without and with trend underline that the degree of openness and the gross capital formation are non-stationary. Nevertheless, the first difference of these variables both without and with trend shows stationarity meaning that they are $I(1)$. The other variables are clearly statistically stationary (i.e. they are integrated of order zero).

Table 1: Panel unit roots results (first and second panel unit root tests)

Levels							
Test Statistic	**RGDP growth**	**Mis186**	**POP**	**HK**	**INF**	**OPEN**	**GKF**
First-generation panel unit root tests							
LLC							
Level	−7.9870	−5.8466	−5.172	−0.9454	−6.7325	−2.7404	−2.7433
	(0.0000)	(0.0000)	7(0.0000)	(0.1722)	(0.0000)	(0.0031)	(0.0030)
Trend	−7.0905	−3.3740	−6.5797	−2.7595	−8.4172	−6.3764	−2.7011
	(0.0000)	(0.0004)	(0.0000)	(0.0029)	(0.0000)	(0.0000)	(0.0035)
HT							
Level	0.3846	0.7643	0.6211	0.8025	0.6315	0.8893	0.7363
	(0.0000)	(0.0138)	(0.0000)	(0.1631)	(0.0000)	(0.9629)	(0.0010)
Trend	0.3016	0.6128	0.4316	0.4450	0.5235	0.6543	0.5868
	(0.0000)	(0.5679)	(0.0000)	(0.0001)	(0.0314)	(0.8675)	(0.3371)
Breitung							
Level	−7.4385	−0.8330	0.6526	9.9719	−1.9343	0.1138	−2.7555
	(0.0000)	(0.2024)	(0.7430)	(1.0000)	(0.0265)	(0.5453)	(0.0029)
Trend	−6.1689	3.4318	2.0865	2.6591	−5.3599	−2.1216	−0.4581
	(0.0000)	(0.9997)	(0.9815)	(0.9961)	(0.0000)	(0.0169)	(0.3234)
IPS							
Level	−5.5349	−2.1558	−0.9028	0.2126	−5.3548	2.0043	−0.7563
	(0.0000)	(0.0155)	(0.1833)	(0.5842)	(0.0000)	(0.9775)	(0.2247)
Trend	−6.1834	−1.5297	−2.9172	−4.1198	−6.6347	−2.4883	−3.0375
	(0.0000)	(0.0630)	(0.0018)	(0.0000)	(0.0000)	(0.0074)	(0.0012)
Fisher							
Level	1.2282	5.7944	1.3403	−0.5901	−0.6617	−0.0461	0.1760
	(0.1097)	(0.0000)	(0.0901)	(0.7224)	(0.7459)	(0.5184)	(0.4302)
Trend	−0.8131	2.8362	0.5827	0.2358	−1.1214	−0.0897	−1.4168
	(0.7919)	(0.0023)	(0.2800)	(0.4068)	(0.8689)	(0.5358)	(0.9217)
Second-generation panel unit root test							
CADF							
Level	−3.173	−2.314	−1.860	−2.279	−4.284	0.512	2.760
	(0.001)	(0.010)	(0.031)	(0.011)	(0.000)	(0.696)	(0.997)
Trend	0.421	−0.349	−2.488	−0.762	−2.096	2.745	4.418
	(0.049)	(0.064)	(0.006)	(0.223)	(0.018)	(0.997)	(1.000)
First differences							
Test Statistic	**RGDP growth**	**Mis186**	**POP**	**HK**	**INF**	**OPEN**	**GKF**
First-generation panel unit root tests							
LLC							
Level	−14.3033	−6.5281	−8.5084	−6.9755	−15.5616	−9.6661	−8.5226
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Trend	−11.6388	−6.5952	−8.8237	−6.2519	−13.9443	−8.1088	−7.4115
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
HT							
Level	−0.1648	−0.0384	0.0493	−0.1652	0.0121	0.1595	−0.1135
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Trend	−0.1623	0.0077	0.0553	−0.0897	0.0882	0.2445	−0.0884
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Breitung							
Level	−11.8886	−9.3155	−5.3457	−6.9330	−9.5563	−11.8332	−11.6170
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Trend	−11.1847	−6.5366	−2.0629	−7.2917	−11.2759	−10.4759	−9.7519
	(0.0000)	(0.0000)	(0.0196)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
IPS							

(*Continued*)

Table 1: *Continued*

First differences							
Test Statistic	**RGDP growth**	**Mis186**	**POP**	**HK**	**INF**	**OPEN**	**GKF**
First-generation panel unit root tests							
Level	−10.3696	−8.4490	−7.2024	−10.7903	−10.0578	−7.9048	−9.9734
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Trend	−10.4378	−9.2670	−7.1776	−11.0602	−10.0089	−8.4991	−10.3557
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Fisher							
Level	10.5783	4.9491	6.0956	8.5969	13.0639	6.0494	2.4680
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0068)
Trend	4.4543	1.0059	1.2012	5.3260	7.2443	3.8970	5.6914
	(0.0000)	(0.1572)	(0.1148)	(0.0000)	(0.0000)	(0.0000)	(0.0014)
Second-generation panel unit root test							
CADF							
Level	−4.725	−3.643	−6.760	−5.773	−7.890	−3.765	−2.845
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.039)	(0.026)
Trend	−1.483	−1.185	−5.215	−3.731	−4.835	−1.751	−1.114
	(0.069)	(0.018)	(0.000)	(0.000)	(0.000)	(0.000)	(0.086)

Numbers in parenthesis are *p*-values.

Table 2 shows the estimation results of PMG, MG and DFE for the 27 European countries during the period 2000–2016. According to the Hausman test, the PMG estimator is identified as the best estimator since the null hypothesis of homogeneity assumption on regressors is rejected meaning that it is the most efficient estimator compared with MG and DFE. Therefore, I focus my interpretations on these estimations. A negative and highly significant relationship is detected between the RER misalignments and the real economic growth; nevertheless, a positive and significant impact is shown in the short run. These results are in line with Tipoy, Breitenbach, and Zerihun (2017) in which they conclude for a sample of emerging countries that an increase in misalignment significantly spurs output in the short run when exchange rates are closer to their equilibriums. This outcome emphasizes the relevance of keeping the RER closer to its equilibrium level to avoid hamper the economic growth in the long run. This output is consistent with the argument that a significant and persistent deviation from its ERER may have relevant consequences on economic balance since authors such as Aguirre and Calderón (2005), Bajo-Rubio and Díaz-Roldán (2009) or Schröder (2013) point out that both overvaluation and undervaluation could have a detrimental effect on economic growth.

Analyzing the usual macroeconomic control variables, the gross capital formation ratio and the human capital are the most important explanatory factors. The results highlight that these variables clearly contribute to a higher economic growth rate in the long run. These results are in line with Becker (1962) or Savvide and Stengos (2009) in which they emphasize how investment in human capital highly contributes to higher economic growth through education and health. Moreover, the stock of physical capital is one of the main drivers of economic growth highlighted by Solow's classic model (1956). Besides, population growth rate provides higher economic growth. On the contrary, inflation erodes the economic growth in the long term (in accordance with Barro, 1995; Bittencourt, 2012; among others). Paying attention to the short term, a positive and highly significant effect on real economic growth is achieved by the degree of openness and the gross capital formation ratio in the short run. Additionally, one can be seen that any shock in the short run could reach the long-run equilibrium at a speed of 68% per year, given that the ECT is negative and statistically significant at the 1% significance level.

6 Conclusion

According to Ulasan (2018), a competitive RER is really relevant specially in recent years which has been characterized

Table 2: Panel ARDL results

	Pooled mean group		Mean group		Dynamic fixed effects	
	Coef.	**Std. error**	**Coef.**	**Std. error**	**Coef.**	**Std. error**
Long-run coefficients						
Mis	−0.0665***	0.0117	−0.3656	0.2474	−0.1205***	0.0201
Pop	0.0044*	0.0025	0.0246	0.2719	−0.0077*	0.0043
HK	0.5676***	0.0912	9.6246	8.5725	0.8859***	0.1979
INF	−0.0101***	0.0010	−0.0178***	0.0208	−0.0030*	0.0017
OPEN	0.0110	0.133	0.0495	0.1536	0.0632	0.0292
GKF	0.0480***	0.0071	−0.0154*	0.1482	0.0344**	0.0178
Error-correction coefficient						
ECT (−1)	−0.6844***	0.0484	−1.0560***	0.0871	−0.7077***	0.0413
ΔMis186	0.0569**	0.0301	−0.0339	0.1215	0.0402	0.0353
ΔPop	−0.0035	0.0084	0.0363	0.0301	0.0007	0.0057
ΔHK	−0.5593	0.7417	1.4355*	2.4559	−1.3304***	0.4359
ΔINF	0.0040***	0.0008	0.0001***	0.0052	0.035***	0.0012
ΔOPEN	0.2120***	0.0239	0.0850*	0.1006	0.1840***	0.0265
ΔGKF	0.0513***	0.0189	0.0620	0.0598	0.0228	0.0148
Intercept	1.5876***	0.1112	−8.9121	7.3162	2.4814***	0.5197
BIC	−2947.14		−4031.31		−3056.58	
AIC	−3005.58		−4089.74		−3111.62	
Observations	432		432		432	
Hausman test			0.09[(i)]		0.00[(ii)]	
			(1.0000)		(1.0000)	

Note: *, **, and *** indicate significance at 10, 5, and 1%, respectively. (i) Under the null hypothesis, PMG is a more efficient estimation than MG. (ii) PMG is a more efficient estimation than DFE under the null hypothesis. In brackets are the associated *p*-values.

by long-standing weak economic growth, currency crises and more expanded inward-oriented protectionist trade policies in the aftermath of the global financial crisis. As RER can act as a signal for intersectoral resource transfer and factor movements (labor, physical capital and human capital), the REER misalignments can be costly due to sources relocation or time-consuming process, especially when they occur often, since it can derive into excess capacity, unemployment or lower living conditions for economic agents (Elbadawi, Kaltani, & Soto, 2012). For these reasons, this analysis tries to contribute to the empirical literature applying a more recent methodology on the 27 European countries.

To the best of my knowledge, this is the first time a study provides empirical evidence on the impact of deviations from the long-run sustainable RER equilibrium on real economic growth rate applying panel ARDL model (PMG, MG and DFE estimators) for the 27 European countries during the 2000–2016 period. This study implements the EQCHANGE database developed by Couharde et al. (2017) to obtain the REER misalignments according to the BEER approach for each country. One of the main objectives is to determine the relationship between REER misalignments and economic growth trying to differentiate between short- and long-run effects. Precisely, this technique does not require unit root testing since it allows to consider a different order of integration to guarantee a long-run relationship. Another strength of this novel method is that PMG and MG estimators are consistent even in the presence of endogeneity. Moreover, the traditional panel models impose homogeneous slope across countries; however, the PMG estimator consider heterogeneity not only for the short-term coefficients but also for the speed of adjustment, error variances and intercepts. Moreover, another relevant advantage of this methodology is that is able to estimate simultaneously the short- and long-run impacts, unlike the GMM-difference estimator that only reflects the short-run dynamics. For this reason, this recent method seems a good alternative to review and contribute to the literature about the relationship between exchange rate misalignments and economic growth.

The results of the panel ARDL model detect a negative and highly significant relationship between the RER misalignments and the real economic growth; nevertheless, a positive and significant impact is shown in the short run. These results are in line with Tipoy et al. (2017) in which they conclude for a sample of emerging countries that an increase in misalignment significantly

spurs output in the short run when exchange rates are closer to their equilibriums. This outcome emphasizes the relevance of keeping the RER closer to its equilibrium level to avoid hamper the economic growth in the long run. This output is consistent with the argument that a significant and persistent deviation from its equilibrium RER may have relevant consequences on economic balance since authors such as Aguirre and Calderón (2005), Bajo-Rubio and Díaz-Roldán (2009) or Schröder (2013) point out that both overvaluation and undervaluation could have a detrimental effect on economic growth.

Analyzing the usual macroeconomic control variables, the gross capital formation ratio and the human capital are the most important explanatory factors. The results highlight that these variables clearly contribute to a higher economic growth rate in the long run. Besides, population growth rate provides higher economic growth. On the contrary, inflation erodes the economic growth in the long term. Paying attention to the short term, a positive and highly significant effect on real economic growth is achieved by the degree of openness and the gross capital formation ratio in the short run. Additionally, one can be seen that any shock in the short run could reach the long-run equilibrium at a speed of 68% per year, given that the ECT is negative and statistically significant at the 1% significance level.

According to Comunale (2019), the REER does not reflect only the production structure or development and trade behavior but also its exchange rate policy in case of economies with flexible regimes. For this reason, the results highlight the role of policymakers with the purpose of controlling the economic fundamentals featured throughout the literature to control the long-run movements in the REER in the entire EU since it can deteriorate the long-run economic growth. As Duwicquet et al. (2018) pointed, current account imbalances and public debt dynamics can get out of control whether the European authorities do not deal with the intra-European exchange rate misalignments and the competitiveness loss in southern economies since it could lead to economic stagnation. In other words, sound structural policies should be implemented in order to improve non-price competitiveness in these countries.

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References

Acemoglu, D., Johnson, S., Robinson, J. A., & Thaicharoen, Y. (2003). Institutional causes, macroeconomic symptoms: Volatility, crises and growth. *Journal of Monetary Economics*, *50*, 49–123.

Aflouk, N., & Mazier, J. (2013). Exchange rate misalignment and economic growth: A threshold panel approach. *Economics Bulletin*, *33*, 1333–1347.

Aguirre, A., & Calderón, C. (2005). Real exchange rate misalignments and economic performance. *Central Bank of Chile working papers no. 315*.

Alberola, E. (2003). *Misalignment, liabilities dollarization and exchange rate adjustment in Latin America. Banco de España Documento de Trabajo No. 0309*. Madrid: Banco de España.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, *58*, 277–297.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*, 29–52.

Bajo-Rubio, O., & Díaz-Roldán, C. (2009). Does the balance of payments constrain economic growth? Some evidence for the new EU members. *Post-Communist Economies*, *21*, 41–46.

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

Barisone, G., Driver, R. L., & Wren-Lewis, S. (2006). Are our FEERs justified? *Journal of International Money and Finance*, *25*, 741–759.

Barro, R. J. (1995). Inflation and economic growth. *Quarterly Bulletin-Bank of England, London*, *35*(2), 166.

Barro, R. J., & Sala-i-Martin, X. (2004). *Economic growth*. London and Cambridge: MIT Press.

Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *Journal of Political Economy*, *70*, 9–49.

Bénassy-Quéré, A., Breau, S., & Mignon, V. (2009). Ro of equilibrium exchange rates within the G20: A panel BEER approach. *Scottish Journal of Political Economy*, *56*, 608–633.

Bénassy-Quéré, A., Breau, S., & Mignon, V. (2010). On the complementarity of equilibrium exchange rate approaches. *Review of International Economics*, *18*, 618–632.

Berg, A., & Miao, Y. (2010). The real exchange rate and growth revisited: The Washington consensus strikes back? *IMF working papers no. 10/58*.

Bhalla, S. S. (2012). *Devaluing to prosperity: Misaligned currencies and their growth consequence*. Peterson Institute.

Bittencourt, M. (2012). Inflation and economic growth in Latin America: Some panel time-series evidence. *Economic Modelling*, *29*, 333–340.

Bleany, M., & Greenaway, D. (2000). The impact of trade and real exchange rate volatility on investment and growth in sub-Saharan Africa. *Journal of Development Economics*, *65*, 491–500.

Bonhomme, S., & Manresa, E. (2015). Grouped patterns of heterogeneity in panel data. *Econometrica*, *83*, 1147–1184.

Breitung, J. (2000). The local power of some unit root tests for panel data. In B. H. Baltagi, T. B. Fomby, & R. C. Hill (Eds.), *Advances in econometrics, volume 15: Nonstationary panels, panel cointegration, and dynamic panels*. Bingley: Emerald Group.

Burstein, A., & Gopinath, G. (2014). International prices and exchange rates. In *Handbook of International Economics* (Vol. 4, pp. 391–451). Elsevier.

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

Calvo, G. A., Reinhart, C. M., & Vegh, C. A. (1995). Targeting the real exchange rate: Theory and evidence. *Journal of Development Economics*, *47*, 97–133.

Carton, B., & Hervé, K. (2012). Estimation of consistent multi-country FEERs. *Economic Modelling*, *29*, 1205–1214.

Cassel, G. (1918). Abnormal deviations in international exchanges. *The Economic Journal*, *112*, 413–415.

Cavallo, D., Cottani, J., & Khan, M. S. (1990). Real exchange rate behavior and economic performance in LDCs. *Economic Development and Cultural Change*, *39*, 61–76.

Checherita-Westphal, C., & Rother, P. (2012). The impact of high government debt on economic growth and its channels: An empirical investigation for the Euro Area. *European Economic Review*, *56*, 1392–1405.

Cheung, Y.-W., & Fujii, E. (2014). Exchange rate misalignment estimates-sources of differences. *International Journal of Finance & Economics*, *19*, 91–121.

Cheung, Y.-W., Chinn, M. D., & Fujii, E. (2009). Pitfalls in measuring exchange rate misalignment: The yuan and other currencies. *Open Economies Review*, *20*, 183–206.

Cheung, Y.-W., Chinn, M. D., & Fujii, E. (2010). Measuring renminbi misalignment: Where do we stand? *Hong Kong Institute for Monetary Reserve Working Paper 24/2010*.

Cheung, Y.-W., Chinn, M. D., Pascual, A. G., & Zhang, Y. (2017). Exchange rate prediction redux: New models, new data, new currencies. *NBER working papers 23267*.

Choi, I. (2000). Unit root tests for panel data. *Journal of International Money and Finance*, *20*, 249–272.

Clark, P., & MacDonald, R. (1998). Exchange rates and economic fundamentals: A methodological comparison of BEERs and FEERs. *IMF working paper no. 67, November*.

Cline, W. R. (2008). *Estimating consistent fundamental equilibrium exchange rates. Working paper 08-6*. Washington, DC: Peterson Institute for International Economics.

Cline, W. R., & Williamson, J. (2010). *Estimates of fundamental equilibrium exchange rates*. Washington, DC: Peterson Institute for International Economics Policy Brief 15.

Cline, W. R., & Williamson, J. (2011). *The current currency situation. Policy Brief No. PB11-18*. Washington, DC: Petersen Institute for International Economics.

Comunale, M. (2019). Long-run determinants and misalignments of the real effective exchange rate in the EU. *Scottish Journal of Political Economy*, *66*(5), 649–672.

Comunale, M. (2017). Dutch disease, real effective exchange rate misalignments and their effect on GDP growth in EU. *Journal of International Money and Finance*, *73*, 350–370.

Conrad, D., & Jagessar, J. (2018). Real exchange rate misalignment and economic growth: The case of Trinidad and Tobago. *Economies*, *6*, 1–23.

Cottani, J., Cavallo, D. F., & Khan, M. S. (1990). Real exchange rate behaviour and economic performance in LDC's. *Economic Development and Cultural Change*, *39*, 61–76.

Couharde, C., & Sallenave, A. (2013). How do currency misalignments threshold affect economic growth? *Journal of Macroeconomics*, *36*, 106–120.

Couharde, C., Delatte, A.-L., Grekou, C., Mignon, V., & Morvillier, F. (2017). Eqchange: A world database on actual and equilibrium effective exchange rates. *CEPR discussion papers 12190*.

Detken, C., & Martinez, C. M. (2001). The effective euro equilibrium exchange rate since the 1970's: A structural NATREX estimation. *European Central Bank* (*ECB*) *Working Paper*.

Dollar, D. (1992). Outward oriented countries do grow more rapidly: Evidence from 95 LDCS, 1976–1985. *Economic Development and Cultural Change*, *40*, 523–544.

Driver, R., & Westaway, P. (2005). Concepts of equilibrium exchange rates. *Bank of England working papers no. 248*. United Kingdom: Bank of England.

Dubas, J. M. (2009). The importance of the exchange rate regime in limiting misalignment. *World Development*, *37*, 1612–1622.

Dufrenot, G., & Yehoue, E. (2005). Real exchange rate misalignment: A panel cointegration and common factor analysis. *International monetary fund. Working paper 05/164*.

Duwicquet, V., Mazier, J., & Saadaoui, J. (2018). Dealing with the consequences of exchange rate misalignments for macroeconomic adjustments in the EMU. *Metroeconomica*, *69*, 737–767.

Duwicquet, V., Mazier, J., & Saadaoui, J. (2013). Désajustements de change, fédéralisme budgétaire et redistribution. *Revue de l'OFCE*, *127*, 57–96.

Easterly, W. (2005). National policies and economic growth: A reappraisal. In P. Aghion & S. Durlauf (Eds). *Handbook of economic growth*. Amsterdam: Elsevier.

Easterly, W., & Levine, R. (2003). Tropics, germs and crops: Endowments influence economic development. *Journal of Monetary Economics*, *50*, 3–39.

Eberhardt, M., & Presbitero, A. F. (2015). Public debt and growth: Heterogeneity and non-linearity. *Journal of International Economics*, *97*, 45–58.

Eberhardt, M., & Teal, F. (2011). Econometrics for grumblers: A new look at the literature on cross-country growth empirics. *Journal of Economic Surveys*, *25*, 109–155.

Edwards, S. (2018). Finding equilibrium: On the relation between exchange rates and monetary policy. *BIS Paper*, *96*, 81–107.

Edwards, S. (1989). Exchange rate misalignment in developing countries. *The World Bank Research Observer*, *4*, 3–21.

Elbadawi, I. A., Kaltani, L., & Soto, R. (2012). Aid, real exchange rate misalignment and economic growth in Sub-Saharan Africa. *World Development*, *40*(4), 681–700.

Elbadawi, I., & Soto, R. (2008). Theory and empirics of real exchange rates in developing countries. *Documentos de trabajo 324*. Instituto de Económica, Ponfificia Universidad Católica de Chile.

Fang, W., Miller, S. M., & Yeh, C.-C. (2015). The effect of growth volatility on income inequality. *Economic Modelling*, *45*, 212–222.

Faruqee, H., Isard, P., & Masson, P. R. (1999). A macroeconomic balance framework for estimating equilibrium exchange rates. In R. MacDonald & J. L. Stein (Eds.), *Equilibrium exchange rates* (pp. 103–134). Massachusetts: Kluwer Academic Publishers

Federici, D., & Gandolfo, G. (2002). Endogenous growth in an open economy and the NATREX approach to the real exchange rate: The case of Italy. *Australian Economic Papers*, *41*, 499–518.

Frankel, J., & Saravelos, G. (2012). Can leading indicators assess country vulnerability? Evidence from the 2008–09 global financial crisis. *Journal of International Economics*, *87*(2), 216–231.

Froot, K. A., & Rogoff, K. (1995). Chap. 32. Perspectives on PPP and long-run real exchange rates. *Handbook of international economics* (Vol. III, pp. 1647–1688). Elsevier Science.

Gala, P. (2008). Real exchange rate levels and economic development: Theoretical analysis and empirical evidence. *Cambridge Journal of Economics*, *32*, 273–288.

Gala, P., & Libanio, G. (2010). Exchange rate policies, patterns of specialization and economic development: Theory and evidence in developing countries. *Working Paper 211*. Brazil: Sao Paulo Business Administration School, Getulio Vargas Foundation.

Gala, P., & Lucinda, C. R. (2006). Exchange rate misalignment and growth: Old and new econometric evidence. *Revista Economia*, 165–187.

Gandolfo, G., & Felettigh, A. (1998). The NATREX: An alternative approach. *Theory and empirical verifications. University "La Sapienza" working papers 52*.

Gandolfo, G., Padoan, P. C., & de Arcangelis, G. (1993). The theory of exchange rate determination and exchange rate forecasting. In H. Frisch & A. Wörgötter (Eds.), *Open-Economy Macroeconomics, Proceedings of a conference held in Vienna by the International Economic Association*. MacMillan.

Ghura, D., & Grennes, T. J. (1993). The real exchange rate and macroeconomic performance in Sub-Saharan Africa. *Journal of Development Economics*, *42*, 155–174.

Gluzmann, P., Levy-Yeyati, E., & Sturzenegger, F. (2012). Exchange rate undervaluation and economic growth: Díaz Alejandro (1965) revisited. *Economics Letters*, *117*(3), 666–672.

Goo, S. W. (2006). *Inflation and exchange rate policy: The experience of Indonesia*. South Korea and Thailand, Mimeo: School of Economics, University of Adelaide.

Guzman, M., Ocampo, J. A., & Stiglitz, J. (2018). Real exchange rate policies for economic development. *World Development*, *110*, 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*, *73*, 386–398.

Haddad, M., & Pancaro, C. (2010). Can real exchange rate undervaluation boost exports and growth in developing countries? Yes, but not for long. *World Bank Economic Premise*, *20*, 1–5.

Harris, R. D. F., & Tzavalis, E. (1999). Inference for unit roots in dynamic panels where the time dimension is fixed. *Journal of Econometrics*, *91*, 201–226.

Hausmann, R., Pritchett, L., & Rodrik, D. (2005). Growth accelerations. *Journal of Economic Growth*, *10*(4), 303–329.

Holtemöller, O., & Mallick, S. (2013). Exchange rate regime, real misalignment and currency crises. *Economic Modelling*, *34*, 5–14.

Ibarra, C. A. (2011). Capital flows, real exchange rate and growth constraints in Mexico. *International Review of Applied Economics*, *25*(6), 653–668.

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, *115*, 53–74.

Jeong, S., Mazier, J., & Saadoui, J. (2010). Exchange rate misalignments at world and European levels: A FEER approach. *International Economics*, *121*, 25–57.

Johson, S., Ostry, J. D., & Subramanian, A. (2007). The prospects for sustained growth in Africa: Benchmarking the constraints. NBER Working Paper, No. 13120.

Kim, D.-H., Lin, S.-C., & Suen, Y.-B. (2010). Dynamic effects of trade openness on financial development. *Economic Modelling*, *27*, 254–261.

Krugman, P., & Taylor, L. (1978). Contractionary effects of devaluation. *Journal of International Economics*, *8*, 445–456.

Lee, J., Milesi-Ferretti, G. M., Ostry, J., Prati, A., & Ricci, L. A. (2008). Exchange rates assessments: CGER methodologies. *IMF occasional papers 261*.

Levin, A., Lin, C.-F., & Chu, C.-S. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, *108*, 1–24.

Levy-Yeyati, E., Sturzenegger, F., & Gluzmann, P. A. (2013). Fear of appreciation. *Journal of Development Economics*, *101*, 233–247.

Loayza, N. V., & Rancière, R. (2006). Financial development, financial fragility and growth. *Journal of Money, Credit and Banking*, *38*, 1051–1076.

Loayza, N., Fajnzylber, P., & Calderón, C. (2005). *Economic growth in Latin America and the Caribbean: Stylized facts, explanations and forecasts*. Washington, DC: World Bank.

MacDonald, R. (1995). Long-run exchange rate modelling: A survey of the recent evidence. *International Monetary Fund WP/95/14*.

MacDonald, R. (1997). What determine real exchange rate? The long and short of it. *Journal of International Financial Markets, Institutions and Money*, *8*, 117–153.

MacDonald, R. (2000). Concepts to calculate equilibrium exchange rates: An overview. *Economic research group of the Deutsche Bundesbank discussion papers 3/00*.

MacDonald, R., & Vieira, F. (2010). *A panel data investigation of real exchange rate misalignment and growth. Working paper*, 2010–13, Business School-Economics, University of Glasgow.

MacDonald, R., & Taylor, M. P. (1992). Exchange rate economics: A survey. *IMF Staff Paper*, *39*(1), 1–57.

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *Quarterly Journal of Economics*, *107*, 407–437.

Meese, R. A., & Rogoff, K. (1983). Empirical exchange rate models of the Seventies: Do they fit out of sample? *Journal of International Economics*, *14*, 3–24.

Montiel, P. J. (1999). The long-run equilibrium real exchange rate: Conceptual issues and empirical research. In L. E. Hinkle & P. J. Montiel (Eds.), *Exchange rate misalignments: Concepts and measurement for developing countries* (pp. 219–263). New York: Oxford University Press.

Naseem, N. A. M., & Hamizah, M. S. (2013). Exchange rate misalignment and economic growth: Recent evidence in Malaysia. *Pertanikan Journal of Social Sciences and Humanities*, *21*, 47–66.

Nurkse, R. (1945). *Conditions of international monetary equilibrium. Essay in international finance*. Princeton, NJ: International Finance Section, Princeton University.

Obstfeld, M., & Rogoff, K. (1996). *Foundations of international macroeconomics*. Cambridge: MIT Press.

Pattillo, C., Poirson, H., & Ricci, L. (2011). External debt and growth. *Review of Economics and Institutions*, *2*, 1–30.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, *22*, 265–312.

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association*, *94*, 621–634.

Pesaran, H., & Smith, R. (1995). Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics*, *68*, 79–113.

Porcile, G., & Lima, G. T. (2010). Real exchange rate and elasticity of labour supply in a balance-of-payments-constrained macrodynamics. *Cambridge Journal of Economics*, *34*(6), 1019–1039.

Prasad, E. S., Rajan, R. G., & Subramanian, A. (2007). Foreign capital and economic growth. *Brookings papers on economic activity, No. 27/1*.

Ramos-Herrera, M. C., & Sosvilla-Rivero, S. (2021). *Economic growth and deviation from the equilibrium exchange rate* (Unpublished manuscript). Madrid, Spain: Department of Economic Analysis, Complutense University of Madrid.

Razin, O., & Collins, S. M. (1997). *Real exchange rate misalignments and growth. International finance*. Germany: University Library of Munich.

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

Ribeiro, R. S. M., McCombie, J. S. L., & Tadeu Lima, G. (2018). Does real exchange rate undervaluation really promote economic growth? *Structural Change and Economic Dynamics*, *52*, 408–417.

Rodrik, D. (2008a). The real exchange and economic growth. *Brookings Papers on Economic Activity, Economic Studies Program, The Brookings Institution*, *39*, 365–412.

Rodrik, D. (2008b). The real exchange rate and economic growth: Theory and evidence. *Working paper union. Topics in middle Eastern and North African Economies, VIII*.

Rogoff, K. (1996). The purchasing power parity puzzle. *Journal of Economic Literature*, *34*, 647–668.

Roodman, D. (2006). How to do xtabond2: An introduction to difference and system GMM in stata. *Center for global development working paper* (*103*).

Saadaoui, J. (2017a). Global imbalances: Should we use fundamental equilibrium exchange rates? *Economic Modelling*, *47*, 383–398.

Saadaoui, J. (2017b). Internal devaluations and equilibrium exchange rates: New evidences and perspectives for the EMU. *Applied Economics*, *50*, 6364–6381.

Sallenave, A. (2009). Real exchange rate misalignments and economic performance for the G20 countries. *International Economics*, *121*, 59–80.

Salto, M., & Turrini, A. (2010). Comparing alternative methodologies for real exchange rate assessment. *Economic Papers*, *427*, 1–54.

Savvide, A., & Stengos, T. (2009). *Human capital and economic growth*. Stanford, C.A: Stanford University Press.

Schröder, M. (2013). Should developing countries undervalue their currencies? *Journal of Development Economics*, *105*, 140–151.

Sekkat, K., & Varoudakis, A. (2000). Exchange rate management and manufactured exports in sub-saharan Africa. *Journal of Development Economics*, *61*, 237–253.

Siregar, R. Y. (2011). The concepts of equilibrium exchange rate: A survey of literature. *The South East Asian Central Banks* (*SEACEN*). *Staff paper no. 81*.

Siregar, R. Y., & Rajan, R. (2006). *Model of equilibrium real exchange rates revisited: A selective review of the literature*. University of Adelaide, Centre for International Economic Studies. Discussion Papers 604.

Solow, R. M. (1956). A contribution to the theory of economic growth. *Quarterly Journal of Economics*, *70*, 65–94.

Stein, J. (1990). The real exchange rate. *Journal of Banking and Finance*, *14*, 1045–1078.

Stein, J. (1996). The natural real exchange rate: Theory and application to the real exchange rate of the US dollar relative to the G8 and to the real effective exchange rate of Germany. *Brown University, Working Paper No. 96-4*.

Stein, J. L., & Allen, P. R. (1998). *Fundamental determinants of exchange rates*. Oxford University Press.

Taylor, A. M., & Taylor, M. P. (2004). The purchasing power parity debate. *Journal of Economic Perspectives*, *18*, 135–158.

Tipoy, C. K., Breitenbach, M. C., & Zerihun, M. F. (2017). Exchange rate misalignment and economic growth: Evidence from non-linear panel cointegration and granger causality tests. *Studies in Nonlinear Dynamics & Econometrics*, *22*, 1–30. doi: 10.1515/snde-2016-0117.

Toulaboe, A. (2006). Real exchange rate misalignments and economic growth in developing countries. *Southwestern Economic Review*, *33*, 57–74.

Ulasan, B. (2018). Real exchange rate misalignment and economic growth: An update. *Working papers 1819*. Research and Monetary Policy Department, Central Bank of the Republic of Turkey.

van Eden, I., Bin, L., Romyn, G., & Xiaguang, Y. (2001). NATREX and determination of real exchange rate of RMB. *Journal of Systems Science and Complexity*, *14*, 356–372.

Vaz, P. H., & Baer, W. (2014). Real exchange rate and manufacturing growth in Latin America. *Latin American Economic Review*, *23*(2). doi: 10.1007/s40503-014-0002-6.

Vieira, F. V., & MacDonald, R. (2012). A panel data investigation of real exchange rate misalignment ang growth. *Estudos Econômicos* (*Sao Paulo*), *42*(3), 433–456.

Williamson, J. (1994). Estimates of FEERs. In J. Williamson (Ed.), *Estimating equilibrium exchange rates* (pp. 177–244). Washington D.C.: Institute for International Economics.

Wren-Lewis, S. (1992). On the analytical foundations of the fundamental equilibrium exchange rate. In C. P. Hargreaves (Ed.), *Macroeconomic modeling of the long run*. London: E. Elgar.

Wren-Lewis, S. (2003). *Estimates of equilibrium exchange rates for sterling against the euro*. London: HM Treasury.

You, K., & Sarantis, N. (2011). Structural breaks and the equilibrium Chinese yuan/us dollar real exchange rate: A FEER approach. *Review of International Economics*, *19*, 791–808.

Zhang, Z., & Chen, L. (2014). A new assessment of the Chinese RMB exchange rate. *China Economic Review*, *30*, 113–122.

Zhou, S. (1993). Fundamental equilibrium exchange rates and exchange rate dynamics. *Open Economies Review*, *4*, 189–209.

Appendix

Table A1: Definition of the explanatory variables in the panel regression and data sources

Variable	Description	Source
Real economic growth rate (g)	Growth rate of real gross domestic product (RGDP) (annual %)	World Development Indicators (World Bank)
Population growth rate (POPGR)	Population growth (annual %). Annual population growth rate for year t is the exponential rate of growth of midyear population from year $t-1$ to t	World Development Indicators (World Bank)
Gross capital formation ratio (GKR)	Gross fixed capital formation (% of gross domestic product (GDP)). It includes equipment purchases, land improvements, schools, hospitals, construction of roads, plant, offices, industrial and commercial buildings, railways, private residential dwellings	World Development Indicators (World Bank)
Inflation rate (INF)	Inflation measured by the consumer price index (annual %)	World Development Indicators (World Bank)
Human capital (HK)	Human capital using life expectancy at birth (years) as a proxy. This variable is considered by World Bank to elaborate the Human Capital Index; however, its data availability is scarce to our database, so for this reason I use life expectancy at birth	World Development Indicators (World Bank)
Degree of openness (OPEN)	It is the sum of exports and imports of goods and services (% of GDP)	World Development Indicators (World Bank)
Misalignment (MIS)	It is the difference between the real effective exchange rates and their equilibrium real effective exchange rates, which is calculated against 186 trading partners based on the behavioral equilibrium exchange rate approach	Couharde et al. (2017)