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Abstract

The Washington Consensus emphasizes the economic costs of real exchange rate distortions. However, a sizable recent empirical literature finds that undervalued real exchange rates help countries to achieve faster economic growth. This paper shows that recent findings are driven by inappropriate homogeneity assumptions on cross-country long-run real exchange rate behavior and/or growth regression misspecification. When these problems are redressed, the empirical results for a sample of 63 developing countries suggest that deviations of the real exchange rate in either direction from the value that is consistent with external and internal equilibrium reduces economic growth. Deviations from Balassa-Samuelson adjusted purchasing power parity on the other hand do not seem to matter for growth performance. The real exchange rate should thus be consistent with external and internal balance irrespective of implied purchasing power parity benchmarks.

Keywords: Real exchange rate misalignment, Undervaluation, Economic growth
JEL classifications: F31, F41, F43, O11

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1 Introduction

The real exchange rate (RER) does not play a central role in traditional growth theory. Both the canonical Solow-Swan growth model and endogenous growth models feature closed economies. However, Ricardo's and Lewis's theories of economic growth suggest a more important role for the RER. As nations develop, the "modern" manufacturing sector absorbs "surplus labor", which directly translates into higher national output. The RER, which creates an incentive to allocate resources to the modern manufacturing sector, is therefore of first-order importance to economic growth. The question of what is the optimal relative price of traded goods arises. There are two opposing views on the answer to that question. The aim of this paper is to shed more light on this debate.

The "Washington Consensus", articulated by Williamson (1990), acknowledges a crucial role of the RER in the growth process. According to this view, an appropriate real exchange rate should be consistent with macroeconomic objectives in the medium run and "sufficiently competitive" such that exports grow at a rate consistent with external balance. However, an overly competitive RER is not appropriate because it would fuel inflation and curb resources available for investment. Underlying this view is the notion that there exists an equilibrium real exchange rate (ERER) that satisfies external and internal balance (Nurkse, 1945). Seen in this light, any deviation from the ERER will hamper economic growth.

The opposing view, with Rodrik (2008) at the forefront, maintains that RER overvaluation harms growth and undervaluation promotes it. This stance is in part due to the success story of export-led growth in conjunction with apparently undervalued currencies in East-Asian countries. But there are also other plausible explanations for why real undervaluation is good for growth. In the export-oriented growth literature it is often argued that the manufacturing sector is special because positive externalities (learning-by-doing effects, technology spillovers) are more pronounced for export-linked activities than other sectors of the economy. Another explanation is that an undervalued RER encourages higher savings and investment (Dooley et al., 2004; Levy-Yeyati and Sturzenegger, 2007). Finally, Rodrik (2008) conjectures the manufacturing sector in developing countries is disproportionately subject to distortions and hence below its optimal size in equilibrium. Because removing those distortions proves difficult in practice, an undervalued RER serves as a "more practical" second-best mechanism to optimally reallocate resources toward the manufacturing sector (Rodrik, 2008).

However, there is little systematic evidence supporting any of these views. The nature and prevalence of those positive externalities associated with exporting remain obscured (Eichengreen, 2008; Harrison and Rodríguez-Clare, 2009). Rodrik (2008) was unable to empirically verify that the manufacturing sector is disproportionately subjected to distortions in developing countries. In addition, all of these propositions seem to ignore the distortion cost associated with real undervaluation in the form of reduced aggregate demand (Corden, 1981). It is therefore not clear if the gain in exports outweighs the loss in absorption, especially over longer time horizons. Finally, according to Edwards (1989), RER distortions can lead to resource misallocation across sectors as economic agents base their investment decisions on a relative price in disequilibrium. Because the RER tends to adjust to equilibrium over time, real undervaluation may induce investments in short-lived projects.

The early empirical literature identifies a negative impact of RER overvaluation on growth but does not address RER undervaluation (Cottani et al., 1990; Ghura and Grennes, 1993).[1] However, recent empirical studies unanimously reject the Washington Consensus view in the sense that they find a positive effect of RER undervaluation on economic growth.[2] The most prominent example is Rodrik (2008), whose empirical findings suggest that higher medium-term growth is systematically associated with undervalued exchange rates in developing countries. While Rodrik (2008) defines purchasing power parity (PPP) adjusted for the Balassa-Samuelson effect as the ERER, there is also a sizable number of empirical studies estimating ERERs consistent with internal and external balance that broadly reach the same conclusion (Aguirre and Calderón, 2005; Béreau et al., 2009; Berg and Miao, 2010; MacDonald and Vieira, 2010; Razin and Collins, 1997).[3] Since these two concepts vastly differ from one another and are not directly comparable, this paper considers both ERER definitions but with the prime focus being on RER misalignment in the sense of Nurkse (1945).

[1] The term undervaluation only appears once in a footnote in Cottani et al. (1990) and not at all in Ghura and Grennes (1993).

[2] The only exception is Nouira and Sekkat (2012) whose empirical results are inconclusive regarding the impact of real undervaluation on growth.

[3] See Table B.1 in the Online Appendix for a list of previous empirical studies.

There are two important sources of inconsistencies driving previous results and the bulk of the literature suffers from at least one of these. First, relying on conventional panel data techniques to estimate ERERs imposes strong homogeneity assumptions on cross-country long-run RER behavior. This approach does not conform to the economic theory underlying the ERER and therefore generates misleading results. Second, the objective to infer the effect on growth of two variables (real over- and undervaluation) from a single continuous variable (RER misalignment) introduces a number of pitfalls, which can lead to growth regression misspecification.

This paper explicitly takes into account heterogeneity in long-run RER behavior across countries by individually estimating RER misalignments for 63 developing countries over the period 1970-2007. It then empirically analyzes how RER over- and undervaluation affect economic growth. To this end, the study employs system generalized method of moments (SGMM) developed by Arellano and Bover (1995) and Blundell and Bond (1998). To ensure robust inference, various measures of RER misalignment are used.

The empirical results provide evidence in favor of the Washington Consensus view and reject the notion that RER undervaluation is an expedient development policy tool. This means that the optimal growth promoting relative price of traded goods is the value of the equilibrium real exchange rate. The study also shows that the identified inconsistencies drive previous results, rather than differences in estimation methods or data sets.

As for deviations from adjusted PPP, using the same data set and estimation methods as Rodrik (2008) but redressing the above problems generates results which suggest that adjusted PPP misalignment does not matter for the growth performance of developing countries.

The rest of the paper is organized as follows. Section 2 defines the Nurksian ERER and estimates RER misalignments. Section 3 empirically analyzes the effects of RER distortions and adjusted PPP deviations on growth. Section 4 concludes.

2 Estimation of real exchange rate misalignment

Before the relationship between RER distortions and economic growth can be analyzed, deviations of the actual RER from its equilibrium value need to be estimated. The problem any empirical study on this subject faces is that the ERER is not directly observable. The starting point to resolve this issue is to define the RER and the ERER.

2.1 The equilibrium real exchange rate

The real exchange rate is defined as the domestic relative price of traded to nontraded goods. That is, $RER = EP_T/P_N$, where E denotes the nominal exchange rate (measured as domestic currency per foreign currency). P_T and P_N refer to the price of tradables and nontradables, respectively. Note that an increase in RER indicates depreciation.

The equilibrium real exchange rate (ERER) in the sense of Nurkse (1945) is defined as that value of the RER that results in the simultaneous attainment of both internal and external equilibrium, given sustainable values of relevant variables achieving this objective.[4]

Nurkse's definition directly implies that the ERER is determined by a set of macroeconomic fundamentals. Based on Edwards (1989), Montiel (1999b), and Faruqee (1995), the ERER is a function of the following variables:

$$ERER = ERER(\underset{(+/-)}{TOT}, \underset{(+)}{\phi}, \underset{(-)}{\zeta}, \underset{(-)}{G_N}, \underset{(+)}{G_T}, \underset{(+/-)}{I}, \underset{(+/-)}{NFA}), \tag{1}$$

where TOT refers to the terms of trade, ϕ is a measure of trade policy, ζ captures productivity differentials (Balassa-Samuelson effect), G_N and G_T are government consumption on nontradables and tradables, I refers to investment, and NFA to the net foreign asset position. Importantly, theoretical priors point to an ambiguous effect of some fundamentals on the ERER, as shown by the signs of the partial derivatives below.[5,6] In case a country faces a binding credit constraint, the trade surplus will depend on exogenous foreign aid flows (Baffes et al., 1999). Therefore,

[4] Internal equilibrium implies that the nontraded goods market clears with the unemployment rate being at its "natural" level. External equilibrium means that the current account deficit can be financed through "sustainable" levels of capital inflows.

[5] For details on the relationship between the ERER and its fundamentals, see the Online Appendix.

[6] In theory, international real interest rate differentials and the extent of capital controls also form part of the ERER fundamentals as permanent changes in both variables affect foreign borrowing decisions and therefore the path of the ERER (Edwards, 1989). Unfortunately, severe

Eq. 1 takes a modified form:

$$ERER = ERER(\underset{(+/-)}{TOT}, \underset{(+)}{\phi}, \underset{(-)}{\zeta}, \underset{(-)}{G_N}, \underset{(+)}{G_T}, \underset{(+/-)}{I}, \underset{(+)}{TS}), \tag{1a}$$

where the net foreign asset position has been replaced with the trade surplus, TS.[7]

These two specifications differ fundamentally with regard to the underlying assumption of how the stock of net international indebtedness feeds back on net capital inflows and the ERER. The former conditions the ERER on given (sustainable) values of the stock of net international indebtedness, which also affects the non-exogenous component of net capital inflows (Montiel, 1999a). The latter on the other hand specifies the ERER as a function of exogenous (sustainable) net capital inflows only, with no feedback from the accumulated stock of net foreign assets. Therefore, the concept of external balance is a "stock-flow" approach in Eq. 1 (Faruqee, 1995), and a "flow" approach in Eq. 1a (Montiel, 1999a).[8] Which of the two specifications is relevant for a given country will depend on its economic structure. Intuitively, the flow approach is suitable in foreign aid-receiving low income countries, whereas the stock-flow approach fits better for middle income countries. However, rather than imposing possibly restrictive assumptions, in what follows, the approach will be to let the data "choose" the appropriate specification.

The approach adopted to empirically estimate ERERs in this paper is the single-equation approach developed by Edwards (1989), Elbadawi (1994), and Baffes et al. (1999). It comprises three steps. The first involves estimating the long-run equilibrium relationship between the ERER and its fundamentals. The second is to derive sustainable values of those fundamentals that explain long-run RER behavior. The ERER and the degree of misalignment are calculated in the final step.

According to this approach, the empirical equivalent of Eq. 1 or 1a under the assumption of linearity in the theorized long-run relationship takes the following form:

$$ln\ ERER_{it} = \beta_i' F_{it}^S, \tag{2}$$

where subscript i refers to the country in question, F^S is the vector of the set of fundamentals at sustainable values, and vector β contains the to-be-estimated long-run parameters. Uncovering β thus involves estimating some form of the empirical model in Eq. 2, except that $ERER$ and F^S have to be replaced with their observable counterparts, that is the actual RER and actual values of the fundamentals:

$$ln\ RER_{it} = \beta_i' F_{it} + \nu_{it}. \tag{3}$$

The error term ν_{it} is assumed to be stationary with zero mean.[9]

Once β and F^S are derived, the degree of misalignment (mis_{it}) can be calculated with the following formula:

$$mis_{it} = \frac{ERER_{it} - RER_{it}}{RER_{it}}, \tag{4}$$

where positive (negative) values of mis_{it} indicate overvaluation (undervaluation).

2.2 Data

The absence of readily available indices for the actual RER and some of the fundamentals imposes a considerable obstacle to the empirical estimation of ERERs. The fundamentals for which reliable time series are available are

data limitations prevent including these variables in the ERER equation. This caveat should not worry us, however, since the stock of international indebtedness will capture any adjustment in foreign borrowing and lending that is brought about by capital account liberalizations or changes in real interest rates. Additionally, as pointed out below, misalignment estimates are similar across alternative specifications. Finally, note that the ERER depends on real variables only (Edwards, 1989).

[7] Notice that this ERER specification may be among the sources that introduce endogeneity in the estimation of the growth model since the level of development may affect credit constraints. As it will turn out, however, the data favor the inclusion of binding credit ceilings for only four countries.

[8] Another possibility would be a pure "stock" approach. The net foreign asset position would then be required to have fully adjusted to steady state such that net capital inflows equal the amount needed to sustain the steady state value of the net creditor position. NFA and TS would then not be part of the ERER function. However, the stock approach is unlikely to be appropriate in the context of developing countries where the adjustment process of the net foreign asset position may be a matter of several decades – a horizon too long to be of exchange rate policy relevance. See Montiel (1999a) for more details.

[9] Eq. 2 follows from 3 under the assumption that the ERER and sustainable fundamentals are the long-run conditional expected values of their actual counterparts (Baffes et al., 1997).

investment, the terms of trade, the net foreign asset position, and the trade balance. Proxies have to be used for the actual RER and the other fundamentals.

The RER is an incentive measure for both producing and consuming tradable and nontradable goods. Constructing corresponding indexes is infeasible due to conceptual problems and data constraints in low income countries (Hinkle and Nsengiyumva, 1999). Therefore, the RER is measured as the ratio of trade-weighted foreign consumer price indexes (CPI) converted at official exchange rates relative to the domestic CPI.[10]

There is also no direct measure for trade policy. The bulk of the empirical literature proxies this variable through the ratio of total exports plus imports to GDP under the assumption that countries with more liberal trade regimes have higher trade volumes, *ceteris paribus*. Three proxies are considered: the ratio of total exports plus imports to GDP at current (OPEN) and constant (OPEN1) prices as well as the ratio of current imports relative to current GDP (OPEN2). To capture the Balassa-Samuelson-effect, the variable PROD is constructed, which equals the ratio of the home country's GDP per capita to the OECD average GDP per capita. This proxy directly incorporates Balassa's (1964) assumption that productivity gains are associated with higher growth rates.

Finally, there are no data on the composition of government consumption. Data are, however, available on total government consumption as a share of GDP (GEXP). Empirically, government consumption tends to disproportionately fall on nontraded goods (Edwards, 1989). Therefore, GEXP serves as a proxy for G_N. However, this need not be true for all countries (Elbadawi and Soto, 1997). Thus, to avoid imposing more restrictions than necessary, the approach will be to let the data decide whether GEXP proxies G_N or G_T.[11]

Under the criterion of at least 20 consecutive yearly observations within the time span 1970-2007, the final sample consists of 63 developing countries, excluding outliers. Table A.1 provides a description and the sources of the data.

2.3 Method

Previous studies that estimate RER misalignment for a large set of countries commonly employ panel data techniques to estimate a single cointegrating vector, which is then used to calculate RER misalignment for the countries in question. There are four major problems with imposing such strong homogeneity assumptions on cross-country long-run RER behavior.

First, assuming homogenous β is inconsistent with the theoretical models used to derive the empirical equation of the ERER. On theoretical grounds it is not possible to determine a priori the effect of changes in the terms of trade, the investment rate, or the net foreign asset position on the ERER. This implies non-trivial cross-country heterogeneity, which panel estimators that derive a single cointegrating vector do not account for because they impose the same long-run relationship across groups.[12] Second, even if one is willing to assume that the relationship between the ERER and its fundamentals is the same across countries in the (ultra) long run, the question then becomes what time horizon this constitutes.[13] Results of empirical studies that estimate ERER long-run relationships over several decades for many countries individually suggest considerable parameter heterogeneity across countries over many decades.[14] However, this adjustment process is too long for these ERERs to be of interest for policymakers or analysts (Montiel, 1999a). Third, another (more serious) problem associated with such long time-horizons over multiple decades is that the ERER should then be conditioned on steady state values of the predetermined variables such as sectoral capital stocks. But this would represent a violation of the Nurksian definition of the ERER as it rules out this scenario (Montiel, 2007). Finally, while theoretical models of the ERER provide a guideline as to which variables determine long-run RER behavior, empirical regularity tells us that, when estimated individually, not all of these fundamentals turn out to be statistically significant drivers of long-run RER movements but they usually are for the pooled sample. Thus, using the homogeneity assumption may inappropriately condition the ERER on one or more fundamentals that are not part of the true data generating process (DGP) for individual countries.

[10] An alternative proxy for tradable goods would be the wholesale price index (WPI). However, for many countries' main trading partners, WPIs are either unavailable or only cover a few years.

[11] While this is the least restrictive approach, the downside is an implicit equality restriction on the parameters of G_T and G_N.

[12] In their concluding remarks Baffes et al. (1999) also appear to be skeptical about β homogeneity.

[13] This is the common assumption in empirical studies employing the panel approach as outlined.

[14] For example, see the estimation results in Aguirre and Calderón (2005).

The risk of ignoring these concerns can be illustrated using some of the estimation results in Mongardini and Rayner (2009). They use the pooled mean group (PMG) estimator to derive RER misalignments for Sub-Saharan African countries. Their results show considerably undervalued RERs in Senegal and Togo, both members of the CFA-franc zone, before the devaluation in 1994. However, during that period, the RER was in fact overvalued in these countries according to almost any observer or empirical study.[15] Another illuminating example is the study of Roudet et al. (2007) who estimate RER misalignments for a number of African countries both individually and through panel data. Their panel estimates often suggest real undervaluation, whereas their country-by-country estimates indicate overvaluation. In addition, their panel RER misalignment measures tend to be significantly greater in magnitude which is consistent with the view that panel data techniques estimate ultra-long-run ERERs at best. Roudet et al. (2007) conclude that panel data estimators often do not yield accurate ERER estimates and should therefore be supplemented with single-country estimates.

Estimation The approach in this study is to estimate ERERs for each country individually but panel data imposing the homogeneity assumption will also be employed for comparison purposes.

The first step is to determine the order of integration of the variables using Augmented Dickey-Fuller (ADF) as well as Phillips-Perron (PP) tests. In case the unit root null is rejected, the RER follows a stationary process providing evidence for relative PPP to hold. The ERER can then be set at the sample mean.[16]

The second step is to estimate the long-run parameters (β_i). Estimating the full joint distribution of the RER and its fundamentals would be desirable but small samples with at most 38 observations and 6 possible fundamentals render system estimation practically infeasible (Baffes et al., 1999). This motivates a single-equation setting. In principal, the static OLS estimator (SOLS) can be used to estimate β in Eq. 3. While SOLS is superconsistent (the rate of convergence is proportional to the sample size) and there is no asymptotic bias from simultaneous equations or measurement error (Phillips and Durlauf, 1986), SOLS performs poorly for small samples (Banerjee et al., 1993) and the non-standard distribution of the t-statistics prevents valid inference. Phillips and Loretan (1991), Saikkonen (1991), and Stock and Watson (1993) independently propose a dynamic OLS (DOLS) estimator which can handle these issues.[17] The DOLS estimator is asymptotically equivalent to the Johansen (1988) vector error-correction method (Saikkonen, 1991), performs well in small samples (Stock and Watson, 1993; Montalvo, 1995), and Newey and West (1987) standard errors allow for statistical inference. The DOLS method adds first differenced leads and lags of the I(1) regressors to the static cointegrating regression. Lead and lag lengths can be selected such that information criteria (IC) are minimized (Kejriwal and Perron, 2008).[18]

The augmented version of Eq. 3 with m_1 leads and m_2 lags takes the following form:

$$ln\ RER_{it} = \beta'_{i1} F_{it} + \beta'_{i2} Z_{it} + \sum_{s=-m_2}^{s=m_1} \gamma'_{is} \Delta F_{it+s} + \nu_{it}, \tag{5}$$

where the vectors F and Z contain the fundamentals that are I(1) and I(0) respectively.[19]

To test for cointegration, I employ the ADF-cointegration test and the Johansen (1988, 1992) method.[20] Since shocks such as trade or capital account liberalizations may shift the equilibrium relationship between the ERER

[15] See Devarajan (1997) and Coleman (2008) for instance.

[16] RERs for all countries turn out to be I(1) at the five percent level except for Mozambique. The tests for Korea, Malawi, and South Africa are somewhat inconclusive but point towards nonstationarity. Argentina's RER is marginally stationary but treated as nonstationary since RER misalignment estimates are not plausible if the ERER is set at the sample mean. The results are not reported for brevity.

[17] Other options would be the fully modified OLS estimator (FMOLS) proposed by Phillips and Hansen (1990) or a single-equation error correction model approach (SEECM). The issue with SEECM is that weakly exogenous regressors for the parameters of interest are essential for valid inference on the long-run parameters. If this condition is satisfied, SEECM is superior to FMOLS (Phillips and Loretan, 1991). However, the assumption that all of the fundamentals are weakly exogenous for the ERER parameters in all 63 countries is unlikely to hold. Furthermore, testing for weak exogeneity requires system estimation. Finally, the Monte Carlo experiments in Stock and Watson (1993) suggest that DOLS tends to outperform FMOLS.

[18] This encompasses the inclusion of a constant and a trend if it is statistically significant and reduces the ICs.

[19] In a panel setting, the following variant of Eq. 3 is estimated: $ln\ RER_{it} = \mu_i + \beta' F_{it} + \sum_{s=-m_2}^{s=m_1} \gamma'_{is} \Delta F_{it+s} + \nu_{it}$, where μ_i is a country-specific constant. This is the (fixed effects) panel DOLS estimator due to Mark and Sul (2003).

[20] The latter allows testing for uniqueness of the estimated cointegrating vector. I restrict the lag length of the underlying VAR system to two. Due to the small sample problem, however, the Johansen (1988, 1992) method is perhaps best viewed as complementary.

and its fundamentals I also test for parameter stability relying on Hansen's(1992) L_c and Andrews's (1993) parameter stability tests.[21]

It is sometimes possible to find multiple subsets of the fundamentals that form a long-run relationship with the RER. There is no well-established approach to deal with this issue (Montiel, 2007).

Since one of the possibilities has to be chosen, I use the following selection algorithm, which is similar to Montiel (2007). Strict preference is given to the most inclusive specification provided there is evidence for cointegration, the estimated parameters are stable, statistically significant, *and* bear signs consistent with economic theory (see Eqs. 1 and 1a); otherwise it is disregarded. If there are multiple long-run relationships fulfilling these requirements, choice is given to the one that minimizes the information criteria.[22]

The results of the estimated long-run equilibrium relationships are encouraging: there are cointegrating relationships consistent with economic theory for 63 countries.[23] This outcome is not predetermined by the described selection process.[24] In some cases, the coefficient attached to government consumption turned out to be positive, corroborating the previously stated concern that total government consumption is not necessarily tilted towards nontraded goods in all countries. In addition, somewhat surprisingly, the empirical specification incorporating binding credit ceilings performed poorly in that it is not the appropriate model specification to explain long-run RER behavior in all but four countries.

Sustainable fundamentals The next step in estimating ERERs involves deriving sustainable values of the fundamentals that form a long-run equilibrium relationship with the RER. The conventional approach is to decompose the relevant time series into cyclical and trend components using the Hodrick-Prescott (HP) filter (Hodrick and Prescott, 1997).[25] Movements in the trend component are permanent and therefore interpreted as sustainable in the Nurksian sense. [26]

Results The RER misalignment estimates in this study are similar to previous ones (Ades et al., 1999; Montiel, 2007; Kinkyo, 2008; MacDonald and Ricci, 2003; Coleman, 2008; Roudet et al., 2007).[27] Fig. 1 shows country-by-country and panel RER misalignment estimates for China, Korea, and Indonesia. It underlines how the homogeneity assumption can lead to very misleading results. In the case of Korea and Indonesia, the panel estimates suggest significant undervaluation on the eve of the Asian Financial Crisis when any other previous study identifies significant overvaluation. Moreover, China's RER was apparently overvalued by about 10 percent in 2007. This is not consistent with the general consensus that the renminbi has become undervalued in recent years. My econometric results will use the country-by-country estimates.

[Fig. 1 about here]

[21] Test results are available upon request. L_c can also be viewed as testing for cointegration over the sample period under the null that the variables are cointegrated (Hansen, 1992).

[22] This selection process does not affect the main results as the RER misalignment estimates tend to be similar across possible cointegrating equations.

[23] Table B.2 in the Online Appendix reports the results.

[24] The cases of Egypt and the Democratic Republic of the Congo underline this notion as it is not possible to obtain plausible estimates for these countries. They are thus dropped from the sample.

[25] I follow previous studies and set the smoothing parameter at the conventional value of $\lambda = 100$.

[26] Such decomposition techniques are not without caveats. In many developing countries, particularly in Sub-Saharan-Africa and Latin America, fundamentals such as government consumption or the net foreign asset position are likely to have been persistent but unsustainable (Baffes et al., 1999). In these cases, unsustainable changes would be passed through to the trend component. Unfortunately, there are no better alternatives. Baffes et al. (1999) advocate using counterfactual simulations but point out that this requires the unlikely condition that the ERER fundamentals are super-exogeneous for the ERER parameters. In addition, counterfactual simulations are not feasible in this study as detailed knowledge about all 63 countries would be needed. I also considered five-year moving averages but this resulted in some implausible estimates. In sum, the trend component is best thought of as an imperfect approximation for the sustainable values of underlying ERER fundamentals.

[27] They are available in Fig. B.1 in the Online Appendix.

3 Growth regressions

This section examines the impact of RER over- and undervaluation on economic growth. To control for cyclical variations, I split the sample period 1970-2007 into non-overlapping five-year periods.[28]

The empirical growth equation is derived from the Solow-Swan growth model:

$$g_{it} = y_{it} - y_{i,t-1} = \alpha + \beta y_{i,t-1} + \gamma' x_{it} + \psi m^{\dagger}_{it} + \mu_i + \lambda_t + \epsilon_{it}. \quad (6)$$

In this equation, g_{it} reflects the real GDP per capita growth rate for the 5-year period and $y_{i,t-1}$ refers to the logarithm of real GDP per capita at beginning of the period. Vector x_{it} contains the logarithm of the investment ratio and other growth determinants, each averaged over the 5-year period. It also includes $\ln(n_{it} + g + \delta)$, where n_{it} is the average 5-year population growth rate, g technological progress, and δ the depreciation rate. The latter two are assumed to be constant across countries.[29] The term $m^{\dagger}_{it}$ represents the variable used to investigate the relationship between RER under- and overvaluation on growth. The last three components on the right-hand side represent unobserved country fixed effects (μ_i), time specific effects (λ_t), and the idiosyncratic error term (ϵ_{it}), respectively.[30]

It is worth pausing here to discuss model specification in more detail as there are hidden pitfalls. At first, it seems straightforward to include mis_{it} (Eq. 4) in the model. This is the approach the bulk of the literature follows. However, this makes it difficult to infer the respective impact of over- and undervaluation on growth. Given that mis_{it} is negative (positive) when the RER is undervalued (overvalued), a negative sign of the coefficient attached to mis_{it} commonly leads to the inference that undervaluation (overvaluation) is associated with higher (lower) growth. But this is only valid under the condition that RER undervaluation and overvaluation have equal and opposing effects on growth. In the absence of this restrictive assumption, another interpretation is that growth is maximized if RER misalignment is as low as possible ($mis_{it} = 0$).[31]

A further issue arises when it comes to regression specification over five-year periods. It is tempting to average the variables across years. However, averaging mis_{it} with the intent to obtain the five-year average degree of misalignment generates a misleading time series. For illustration, consider the following example. Say the RER was overvalued by 50 percent in the first year and undervalued by 25, 10, 10, and 5 percent in subsequent years. Averaging would produce $mis_{it} = 0$, or perfect alignment when, in accordance with the definition of RER misalignment, average RER misalignment is 20 percent in this case. Averaging is valid only if either, there are no fluctuations between undervaluation and overvaluation during the time interval of interest, or if their effects on growth are equal but of opposite sign.

To deal with these problems, the approach is to split mis_{it} into two variables: one taking negative values when the RER is undervalued, zero otherwise, and another taking positive values when the RER is overvalued, and zero otherwise. I then average these two variables over the 5-year periods. A negative signed coefficient on both variables supports the hypothesis that RER undervaluation (RER overvaluation) fosters (harms) economic growth. In an additional analysis, I also identify RER over- and undervaluation episodes to test their impact on growth.

The last consideration relates to the inclusion of other variables in the model. Importantly, since each ERER fundamental may directly or indirectly affect growth, the model includes each of the ERER fundamentals to properly channel out the impact of RER distortions on growth. I also consider human capital (average years of schooling) and the "rule of law", which proxies institutional quality. Unfortunately, these variables are not available for all countries in the sample. In addition, the rule of law index only starts in 1984. In order to avoid loss of too many observations, a number of regression specifications will be reported.[32]

[28] This results in 8 non-overlapping five-year periods except for the last one which comprises only three years.

[29] I follow Mankiw et al. (1992) and assume that g equals two percent. As for the depreciation rate, Whelan and McQuinn (2006) convincingly argue that δ should be set to six percent. The reason is that capital comprises structures and equipment, each depreciating at a different rate. They base the six percent figure on the empirical weight of each type of capital in the production function. See their paper for more details.

[30] See Table A.1 for details on data sources.

[31] This interpretation follows directly from applying the definition of RER misalignment which is defined as *any* deviation of the RER from its equilibrium level).

[32] Admittedly, there is a whole host of other variables that may be included. So far the empirical growth literature has identified more than 145 growth determinants, but there is no consensus on which of these variables should be included in growth models (Durlauf et al., 2005). Given the humble objective of this paper, which is to investigate the hypothesis that RER undervaluation promotes growth, attempting the latest state of the art model averaging techniques to account for model uncertainty would be out of the scope of this study.

3.1 Estimation

While the model is initially estimated by ordinary least squares (OLS), this procedure does not address the issue of endogeneity. Nickell (1981) shows that the standard fixed-effects estimator of a dynamic panel data model is inconsistent when T (the number of time-series observations) is fixed even as $N \to \infty$ (the number of cross-sectional units). In addition, growth is likely to affect the independent variables, which gives rise to inconsistent estimates. To address these problems, I resort to SGMM.[33]

3.2 Results

Table 1 reports OLS and SGMM results of the impact of RER under- and overvaluation on growth.[34] While OLS and SGMM estimates differ in magnitude, they are qualitatively the same, regardless of model specification. They suggest that the effect of RER undervaluation on growth is negative and statistically significant at least at the 10 percent level. For instance, according to the SGMM results for the baseline growth model (column 1b), a RER that is on average undervalued by 5 percentage points (about one standard deviation) would lead to a lower average annual growth rate of 1.3 percentage points. An augmentation with human capital and/or institutional quality leads to virtually the same result (columns 2b, 3, and 4). Variation in the size of coefficients and standard errors appears to be mainly driven by changes in the sample. The results also corroborate the notion of an adverse impact of RER overvaluation on growth.[35,36] However, the negative relationship between RER undervaluation and growth is in contrast to Rodrik (2008) and other recent studies such as Abida (2011) and MacDonald and Vieira (2010).[37]

[Table 1 about here]

[33] See Arellano and Bover (1995), Blundell and Bond (1998), and Roodman (2009a) for details.

[34] The baseline SGMM results use all available lags as "collapsed" instruments to contain "instrument proliferation" (Roodman, 2009b). Standard errors incorporate Windmeijer's (2005) finite-sample correction for two-step SGMM. The second order test for autocorrelation and the Hansen test for overidentifying restrictions suggest that the validity of the SGMM moment conditions cannot be rejected at conventional levels. Furthermore, SGMM assumes that the idiosyncratic disturbances are independent across countries. The cross-sectional independence test of Pesaran (2004) reveals that the null of cross section independence cannot be rejected at the 10 percent level.

[35] Aguirre and Calderón (2005) and Razin and Collins (1997) find that RER distortions impact on growth in a nonlinear fashion. I have also included squared terms of RER under-and overvaluation in the model but there is no evidence of a nonlinear relationship, implying that the optimal level of misalignment is zero. The result for this regression is available in Table B.3 in the Online Appendix. For comparison purposes, the table also reports results for the baseline model (Table 1, column 1) but using the same samples as in columns 2-4 (Table 1) and for models that only include either the ERER fundamentals or RER distortions. Overall, these do not add much except the result for the latter specification where the coefficient on RER undervaluation shrinks to half of its previous size which underlines the importance of controlling for all ERER fundamentals to properly channel out the growth effect of RER distortions.

[36] I have also tried using crude RER over- and undervaluation 5-year dummies which are the sum of their yearly values. However, this approach does not yield plausible results.

[37] There may be concerns relating to consistency. In particular, RER misalignment estimates may be subject to measurement error thus introducing attenuation bias. Notice that while first-stage estimates of the long-run RER parameters are superconsistent, the problem is that each method to derive the sustainable values of the ERER fundamentals has its caveats (cf. Eq. 2) and that the actual RER is a proxy. It is thus likely that RER misalignment estimates are measured with error. Even so, SGMM estimates are consistent provided there is no correlation between the instruments and the measurement errors, for instance if the latter are serially uncorrelated (Bond et al., 2001; Hauk and Wacziarg, 2009). Where this is not the case, consistent estimates can be obtained by excluding recent lags from the instrument set (Bond et al., 2001). Doing so, however, does not significantly change the results. Furthermore, basing RER misalignment estimates on alternative values of "sustainable" variables derived with the Butterworth-filter (Pollock, 2000) does not make a marked difference. The estimation results are available in Table B.4 in the Online Appendix.

Another issue is that statistical inference might be misleading due to a "generated regressor problem" (Pagan, 1984). While RER over- and undervaluation are not classical generated regressors in the sense of Pagan (1984) (they are neither the first stage prediction nor the error term) the possibility that standard errors are downward biased here cannot be ruled out due to the lack of a theoretical treatment of the present case. Therefore, to adjust for the potential extra variation stemming from RER over- and undervaluation I re-estimate the OLS results with bootstrapped standard errors. As it turns out, the latter remain virtually unchanged thus alleviating the concern that inference based on the main results is misleading (bootstrapped standard errors are at most 2 percent higher for the variables of interest, see Table B.5 in the Online Appendix). Bootstrapping for SGMM on the other hand is problematic since the population moment conditions do not hold in the bootstrap samples (Bond and Windmeijer, 2005). Hall and Horowitz (1996) and Brown and Newey (2002) develop methods to deal with this issue but Bond and Windmeijer (2005) show that bootstrapped two-step standard errors are similar to asymptotic two-step standard errors in terms of unreliability and that (bootstrapped) Wald tests based on the inefficient one-step GMM estimator have less power relative to the Windmeijer (2005) corrected two-step test. In light of this and the fact that bootstrapped OLS standard errors provide no evidence for misleading inference, I abstain from attempting the Hall and Horowitz (1996) or Brown and Newey (2002) bootstrapping procedure for SGMM.

In view of this discussion, the remainder of the paper leaves both issues untreated.

3.3 Episodes

This section identifies over- and undervaluation episodes to better understand the impact of RER misalignment on growth. To this end, I define two types of episodes. The first occurs if the RER is over-/undervalued during the majority of years over the five-year period. The resulting measure takes the value of the average degree of RER over- or undervaluation during the five-year interval, and zero otherwise. The second type is defined as taking place if there is real over-or undervaluation in each of the five years. As before, the value of these variables equals the 5-year average degree of misalignment, and zero otherwise. A third variable measures non-episodic RER distortions as the average degree of absolute misalignment. Given this procedure, a coefficient with positive (negative) sign on RER undervaluation (overvaluation) episodes would corroborate the main results.

Fig. 2 plots the full sample average growth rate together with the maximum value of RER over- and undervaluation episodes. There is an unambiguous negative relationship between growth and episodes of RER distortions. Regardless of episode type, the plots suggest that growth is on average higher the closer the RER is to equilibrium.

[Fig. 2 about here]

Table 2 presents growth regression results. Irrespective of the type of RER undervaluation episode and model specification, there is strong evidence against the hypothesis that RER undervaluation promotes growth. The point estimates of real undervaluation episodes are unanimously positive. They are also statistically significant at conventional levels in all but one model specification (column 4). However, this result should not be overemphasized. The best RER undervaluation may achieve is having a zero effect on growth if and only if real undervaluation persists sufficiently long. Also notice that the coefficient in that regression is still positive and statistically significant at the 20 percent level. In addition, merging RER overvaluation episodes and absolute misalignment to one regressor generates estimates suggesting that undervaluation episodes do have a statistically negative impact on growth (column 3). However, the estimated detrimental effect of 5-year undervaluation episodes on growth seems to be smaller compared to the other estimates. Finally, the coefficients attached to RER overvaluation episodes enter the regressions negatively and with statistical significance. Therefore, it is sensible to conclude that RER distortions of any kind do have a negative effect on growth. In addition, the results of this and the last section suggest that absolute ERER deviations are the best measure to analyze the growth effect of RER distortions (column 6).[38]

[Table 2 about here]

To conclude this section, it is illustrative to provide the narrative behind the experiences of some countries during undervaluation episodes. Fig. 3 shows the evolution of RER distortions and growth over 5-year periods for South Africa and Chile. There is a negative relationship between real undervaluation and growth for South Africa where economic difficulties began to emerge in the 1970s following the oil price crisis and the Soweto uprising. The continued deterioration of South Africa's net international creditor position essentially put in place a credit ceiling in the early 1980s (Hirsch, 1989). The required current account surplus to service the debt stifled economic expansion, a common situation for developing countries dependent on capital good imports. Because of the adoption of a floating exchange rate system, further loss in confidence in the economy, falling gold prices, and high inflation in industrialized countries coming to an end, the rand depreciated continuously (Hirsch, 1989). This resulted in an RER undervaluation episode ending only in 1991. Due to excessive short-term debt, the Rand's depreciation required higher repayments (in domestic currency terms), which exacerbated South Africa's economic woes. [39]

[Fig. 3 about here]

An interesting counterexample seems to be the case of Chile. Following the debt crisis in 1982, Chile underwent trade liberalization reforms between 1985 and 1992, which included an average tariff reduction from 36 to 12

[38] For all specifications in Tables 1 and 2, the hypothesis that under- and overvaluation affect growth equally cannot be rejected at the 10 percent level.

[39] South Africa was not the only country with such an experience. A similar situation took place in Algeria in the early 1990s. After a decade of sluggish growth and high international indebtedness, in part due to falling oil prices, the Algerian dinar was significantly overvalued. In 1991, a more than 100 percent depreciation vis-à-vis the U.S. dollar generated a real undervaluation episode that lasted until 1997. Economic performance improved from the mid 1990s onwards after debt restructuring and a series of reforms that aimed for macroeconomic stability and greater trade openness.

percent (Li, 2004). Since tariff removals cause the ERER to depreciate (Edwards, 1989), the actual RER should depreciate as well to restore equilibrium. The trade policy reforms were therefore accompanied by a (large) nominal devaluation which caused the RER to become undervalued in 1985. The RER did not appreciate back to equilibrium for 10 consecutive years (the longest undervaluation episode in the sample). Real undervaluation was sustained for so long because the crawling band exchange rate system leveled off the impact of inflation on the RER (Edwards, 1995). Nonetheless, Chile experienced rapid economic growth during that period. Whether this growth expansion occurred because or despite real undervaluation requires analyzing the counterfactual. Either way, this exchange rate protection came at the cost of fueled inflation (Edwards, 1995).[40]

The econometric results in this section suggest that the average experience of developing countries during undervaluation episodes is much closer to South Africa's than to Chile's.

3.4 PPP misalignment

So far this study has examined the growth effect of deviations of RER from the level consistent with internal and external balance. Thus the results are not comparable with those of studies by Rodrik (2008) and others that have measured RER misalignment following the (Balassa-Samuelson adjusted) PPP approach. It could well be that RER undervaluation from the point of view of internal and external equilibrium retards growth whereas undervaluation relative to PPP is growth promoting. Rather than further discussing the relative merits of the two approaches to measuring RER misalignment, in this sub-section I probe whether the Rodrik (2008) results stand up to scrutiny.

Rodrik (2008) uses Penn World Table 6.2 (PWT) data on the exchange rate ($XRAT$) and PPP conversion factors to compute the RER as $\ln RER_{it} = \ln (XRAT/PPP)_{it}$, with t indexing 5-year averages covering the period 1950-2004.[41,42] To adjust for the Balassa-Samuelson effect, Rodrik (2008) regresses the RER on GDP per capita ($RGDPCH$):

$$\ln RER_{it} = \alpha + \beta \ln RGDPCH_{it} + f_t + u_{it}, \tag{7}$$

where f_t is a time fixed effect and u_{it} the error term. The latter is also the estimate of adjusted PPP misalignment ($MISPPP$).[43] Note that this specification implicitly assesses that the magnitude of the impact of productivity gains on RER (operating via wages) is uniform across countries. Thus it ignores differences in labor market distortions or "surplus labor" situations across countries.

To examine the sensitivity of the Rodrik (2008) results to this restrictive assumption, I first follow his approach to estimate $MISPPP$ and re-estimate Eq. 7 by adding country slope dummies to obtain $MISPPP$ measures that account for parameter heterogeneity.[44] I then compare the growth effects of the two alternative misalignment indicators by estimating Rodrik's (2008) baseline growth specification:

$$g_{it} = \alpha + \beta \ln RGDPCH_{i,t-1} + \delta\, MISPPP_{it} + f_i + f_t + u_{it}, \tag{8}$$

where g_{it} is annual growth and f_i are country specific effects.

Table 3 reports the results. They match Rodrik's (2008) for the full and developing country sample (columns 1 and 2).[45] In particular, the point estimate of $\delta = 0.026$ for the developing country subsample implies that a 10 percent undervaluation spurs growth by 0.26 percentage points in these countries. Splitting $MISPPP$ into positive and negative values still yields estimates that suggest a significantly positive impact of undervaluation on growth (column 3). Including my measure of RER misalignment in the growth model leads at first also to the conclusion that PPP undervaluation promotes growth (column 4). However, distinguishing between undervaluation and overvaluation changes the results. The coefficient of RER undervaluation is close to zero and fails to

[40] The narrative behind the first RER undervaluation episode (1975-1980) is very similar. Tariff removals accompanied by a large nominal devaluation resulted in a significant real undervaluation.

[41] To avoid confusion, I use the same notation as Rodrik (2008) whenever it is suitable.

[42] A ratio greater than one means that the RER is more depreciated relative to the PPP benchmark. It follows that an increase in $\ln RER_{it}$ refers to depreciation.

[43] Under this approach, $MISPPP$ is positive (negative) when the RER is undervalued (overvalued). Rodrik (2008) names this variable $UNDERVAL$.

[44] Indeed, the homogeneity restriction on β is rejected at the 1 percent level.

[45] Only the t-stats are trivially different.

achieve statistical significance. This suggests that countries do not gain from RERs that are undervalued relative to Balassa-Samuelson adjusted PPP. Interestingly, the point estimate of PPP overvaluations is the same across $MISPPP$ measures (0.022) and implies a negative and statistically significant impact on growth. But this negative effect also disappears when employing SGMM to control for endogeneity (column 6).[46] Therefore, in contrast to Nurksian ERER deviations, adjusted PPP misalignment does not seem to matter for growth.[47] This is in fact good news for developing countries. Otherwise a terms of trade boom leading to a long-lasting Nurksian ERER appreciation above the PPP benchmark (assuming the actual RER follows suit) would stifle growth even though the appreciation is an equilibrium phenomenon. In sum, my alternative estimates suggest that Rodrik's (2008) inference that RER undervaluation promotes growth is driven by the questionable parameter homogeneity restriction in the first stage.

[Table 3 about here]

3.5 Reconciliation with previous results

This section demonstrates that the driving force behind the finding in this study that Nurksian undervaluation reduces growth is the combination of estimating RER misalignments on a country-by-country basis and the way the study distinguishes between RER over- and undervaluation in the second stage.

To this end, let's see what happens when I use annual and 5-year panels in the first stage to estimate "panel misalignment" measures (mis_{it}, Eq. 4).[48] Using as regressor mis_{it} that is estimated through the annual panel and then averaged over five years generates a coefficient on this variable which is equal to -0.11 and significant at the 5 percent level (Table 4, column 1). This suggests that a 10 percent undervaluation increases annual growth by 0.22 percentage points. Interestingly, this effect is similar to Rodrik's (2008) baseline result for the developing country subsample. Even when a distinction is made between positive and negative values of mis_{it} using the same approach as in this paper, the coefficient attached to RER undervaluation is insignificant (column 2). The results are virtually the same when I use a 5-year panel in the first stage to estimate mis_{it} (columns 3 and 4). In sum, as opposed to the country-by-country misalignment estimates, panel measures only identify a negative growth impact of RER overvaluation but not undervaluation.

However, it is still possible to obtain results suggesting a positive instead of a negative effect of RER undervaluation on growth using country-by-country RER misalignment measures. This happens when the previously mentioned pitfalls associated with model specification are ignored. For instance, using 5-year averaged mis_{it} as a covariate yields a negative coefficient that is statistically and economically significant (column 5). In addition, splitting 5-year averaged mis_{it} (as opposed to first splitting, then averaging) and then including RER over- and undervaluation as well as their squares in the model generates results that suggest a positive impact of RER undervaluation of up to 21 percent on growth before it turns negative (column 5). This is similar to Aguirre and Calderón's (2005) finding.

[Table 4 about here]

4 Conclusion

The purpose of this paper has been to contribute to debate on the impact of real exchange rate misalignment on economic growth with particular emphasis on the inference of some recent studies that real undervaluation promotes growth. While the traditional position on this issue (the "Washington Consensus") advocates for the RER being close to its equilibrium level, the recent theoretical and empirical literature emphasizes the economic benefits of real undervaluation. This study has estimated RER misalignments for 63 developing countries and analyzed the impact of RER over- and undervaluation on economic growth. In accordance with the Washington

[46] The instrument set contains all available lags resulting in 172 instruments. Initial income is treated as predetermined and under-and overvaluation as endogenous. The AR(2) test is rejected at the 5 percent level suggesting a violation of the SGMM moment conditions but this is not an issue since no causal claim is being made here.

[47] I have also used annual observations in the first stage and then 5-year averages in the second. This procedure yields very similar results.

[48] For simplicity, I continue to use Rodrik's (2008) above specification. Including more regressors does not significantly affect the results.

Consensus, the results suggest that any deviation of the RER from the level that is consistent with external and internal equilibrium lowers economic growth. Previous results seem to be driven by two inconsistencies. First, the strong homogeneity assumption on long-run RER behavior across countries produces misleading results and is inconsistent with economic theory. Second, the objective to infer the effect on growth of two variables (real over- and undervaluation) from a single continuous variable (RER misalignment) can lead to model misspecification. The paper has also revisited the claim that PPP undervaluation promotes growth in developing countries. Again, when the two problems are taken into account, the results suggest that deviations from adjusted PPP do not impact on developing countries' growth performance.

Thus, despite recent criticisms, the Washington Consensus still has valuable policy guidelines to offer. Developing countries should aim to keep the RER close to its equilibrium level in the sense of Nurkse (1945), which reinforces another policy guideline of the Washington Consensus: sound macroeconomic policies. In addition, countries with fixed but adjustable exchange rate regimes should closely review their current pegs if there are movements in anchor currencies. However, while it is true that the fastest-growing countries tend to have avoided excessive RER distortions in either direction, it is not a sufficient condition for growth take-off. For example, the RER rarely diverged from equilibrium in the Central African Republic but the country did not experience fast growth. Therefore, "the real exchange rate is best thought of as a facilitating condition" (Eichengreen, 2008, p. 20).

Tables

Table 1: Growth regressions – Main results
Dependent variable: Real GDP per capita growth

	(1a)	(1b)	(2a)	(2b)	(3)	(4)
Independent variable	OLS	SGMM	OLS	SGMM	SGMM	SGMM
Initial Income	-0.25 (8.4)***	-0.01 (0.1)	-0.24 (7.4)***	-0.02 (0.4)	-0.02 (0.6)	-0.02 (0.6)
Investment	0.22 (3.2)***	0.19 (2.7)***	0.15 (5.7)***	0.13 (2.0)**	0.07 (1.1)	0.08 (1.3)
$\ln(n+g+\delta)$	-0.09 (0.7)	-0.50 (1.4)	-0.11 (0.9)	-0.32 (0.9)	-0.67 (1.7)*	-0.48 (1.8)*
Terms of Trade	0.002 (0.1)	0.01 (0.4)	-0.01 (0.6)	-0.02 (0.7)	0.02 (0.3)	0.08 (1.2)
Trade Openness	0.02 (0.7)	0.1 (1.4)	0.004 (0.1)	0.01 (0.3)	-0.02 (0.5)	-0.06 (1.6)
Government Consumption	-0.14 (2.0)**	-0.09 (0.9)	-0.05 (1.3)	-0.05 (0.7)	-0.03 (0.5)	0.01 (0.1)
Net Foreign Asset Position	0.04 (1.6)	-0.13 (2.4)**	0.04 (1.7)*	-0.03 (0.7)	-0.02 (0.5)	0.01 (0.4)
Human Capital			-0.07 (1.6)	0.06 (0.9)		0.01 (0.2)
Rule of Law					0.12 (2.9)***	0.12 (3.0)***
RER Undervaluation	0.27 (1.8)*	1.29 (3.3)***	0.32 (2.2)**	1.16 (2.6)**	0.82 (1.8)*	1.08 (2.2)**
RER Overvaluation	-0.65 (3.6)***	-2.01 (4.7)***	-0.60 (3.2)***	-1.06 (1.5)	-0.80 (1.8)*	-1.18 (3.0)***
Observations	469	469	430	430	216	210
N	63	63	57	57	55	53
AR(2) (p-value)		0.71		0.21	0.72	0.92
Hansen test (p-value)		0.81		0.83	0.68	0.88
Instruments		69		77	67	74

Notes: ***, **, * denote the level of statistical significance at 1, 5, and 10 percent. t-ratios in parentheses (calculated on the basis of robust clustered standard errors for OLS and the Windmeijer (2005) correction for two-step SGMM standard errors). Each regression includes country and time fixed effects. SGMM results use all available lags as "collapsed" instruments in columns 1b and 2b. In columns 3 and 4, the instrument set is restricted to lag 1. The terms of trade is treated as strictly exogenous; initial income, the rule of law, and human capital as predetermined; and the rest as endogenous. Observations are averages over five-year periods. The value of the variable RER Undervaluation (Overvaluation) is less (greater) than or equal to zero. Initial income, investment, population growth, government consumption, the terms of trade, the rule of law, and human capital (average years of schooling) are measured in natural logarithms.

Table 2: Growth regressions – Misalignment episodes
Dependent variable: Real GDP per capita growth

	(1)	(2)	(3)	(4)	(5)	(6)
Independent variable	SGMM	SGMM	SGMM	SGMM	SGMM	SGMM
Initial Income	-0.02 (0.5)	-0.03 (0.6)	-0.002 (0.0)	-0.02 (0.4)	-0.03 (0.7)	0.002 (0.1)
Investment	0.22 (3.0)***	0.14 (1.8)*	0.20 (2.9)***	0.20 (3.1)***	0.13 (2.0)**	0.20 (2.7)***
$\ln(n+g+\delta)$	-0.53 (1.5)	-0.24 (0.7)	-0.42 (1.4)	-0.44 (1.5)	-0.45 (1.5)	-0.48 (1.4)
Terms of Trade	0.004 (0.1)	-0.01 (0.4)	-0.01 (0.2)	0.001 (0.1)	-0.01 (0.4)	-0.01 (0.3)
Trade Openness	0.11 (1.1)	0.02 (0.5)	0.08 (1.1)	0.1 (1.2)	0.03 (0.6)	0.09 (1.3)
Government Consumption	-0.12 (1.2)	-0.07 (0.8)	-0.06 (0.7)	-0.11 (1.3)	-0.08 (1.1)	-0.06 (0.8)
Net Foreign Asset Position	-0.09 (1.7)*	-0.02 (0.4)	-0.12 (1.9)*	-0.10 (1.6)	-0.03 (0.6)	-0.13 (1.9)*
Human Capital		0.07 (0.9)			0.05 (0.9)	
Absolute RER Misalignment			-1.80 (2.7)***	-1.52 (2.6)***	-1.37 (2.6)***	-1.68 (3.2)***
RER Undervaluation Episodes	1.35 (2.7)***	1.04 (2.5)**	0.84 (1.9)*	0.58 (1.4)	0.66 (2.0)**	
RER Overvaluation Episodes	-1.75 (2.7)***	-1.04 (1.9)*		-1.97 (3.3)***	-1.44 (2.2)**	
Observations	466	427	469	469	430	469
N	63	57	63	63	57	63
AR(2) (p-value)	0.83	0.15	0.69	0.69	0.21	0.58
Hansen test (p-value)	0.68	0.90	0.79	0.92	0.99	0.44
Instruments	69	77	69	76	84	62

Notes: ***, **, * denote the level of statistical significance at 1, 5, and 10 percent. t-ratios in parentheses (calculated on the basis of the Windmeijer (2005) correction for two-step SGMM standard errors). Each regression includes country and time fixed effects. SGMM results use all available lags as "collapsed" instruments. The terms of trade is treated as strictly exogenous; initial income and human capital as predetermined; and the rest as endogenous. The value of the variable RER Undervaluation (Overvaluation) Episodes is less (greater) than or equal to zero. In columns 3-5, absolute RER misalignment equals zero during RER over- and undervaluation episodes. Initial income, investment, population growth, government consumption, the terms of trade, and human capital (average years of schooling) are measured in natural logarithms.

Table 3: Growth regressions – Adjusted PPP misalignment
Dependent variable: Real GDP per capita growth

	(1)	(2)	(3)	(4)	(5)	(6)
Independent variable	All countries	Developing	Developing	Developing	Developing	Developing (SGMM)
Initial Income	-0.030 (5.4)***	-0.039 (4.8) ***	-0.039 (4.9)***	-0.033 (3.8)***	-0.033***	0.014 (4.6)***
RER Misalignment	0.017 (3.4) ***	0.026 (4.1) ***		0.015 (2.5)**		
RER Undervaluation			0.031 (3.4)***		0.006 (0.6)	0.010 (0.7)
RER Overvaluation			0.022 (2.3) **		0.022 (2.9)***	0.005 (0.4)
Observations	1303	790	790	790	790	790

Notes: ***, **, * denote the level of statistical significance at 1, 5, and 10 percent. t-ratios in parentheses (calculated on the basis of robust clustered standard errors for OLS and the Windmeijer (2005) correction for two-step SGMM standard errors). Each regression includes country and time fixed effects. Developing country observations are those with real GDP per capita below $6,000. Iraq, Laos, and North Korea have been excluded from the sample.

Table 4: Growth regressions – Panel RER misalignment
Dependent variable: Real GDP per capita growth

	(1)	(2)	(3)	(4)	(5)	(6)
Independent variable	Annual	Annual	5-year panel	5-year panel	Country-by-country	Country-by-country
Initial Income	-0.22 (7.5)***	-0.22 (6.7) ***	-0.19 (6.6)***	-0.20 (6.7)***	-0.19 (6.4)***	-0.19 (6.5)***
RER Misalignment	-0.11 (2.5) **		-0.09 (2.2)**		-0.31 (2.5)**	
RER Undervaluation		0.05 (0.3)		-0.01 (0.2)		-0.84 (2.5)**
RER Undervaluation Squared						-4.00 (2.7)***
RER Overvaluation		-0.19 (2.6)**		-0.16 (2.1)**		0.37 (1.5)
RER Overvaluation Squared						-3.16 (4.2)***
Observations	463	463	473	473	471	471
N	63	63	63	63	63	63

Notes: ***, **, * denote the level of statistical significance at 1, 5, and 10 percent. t-ratios in parentheses (calculated on the basis of robust clustered standard errors). Each regression includes country and time fixed effects.

Figures

Figure 1: RER misalignment estimates for China, Indonesia, and South Korea

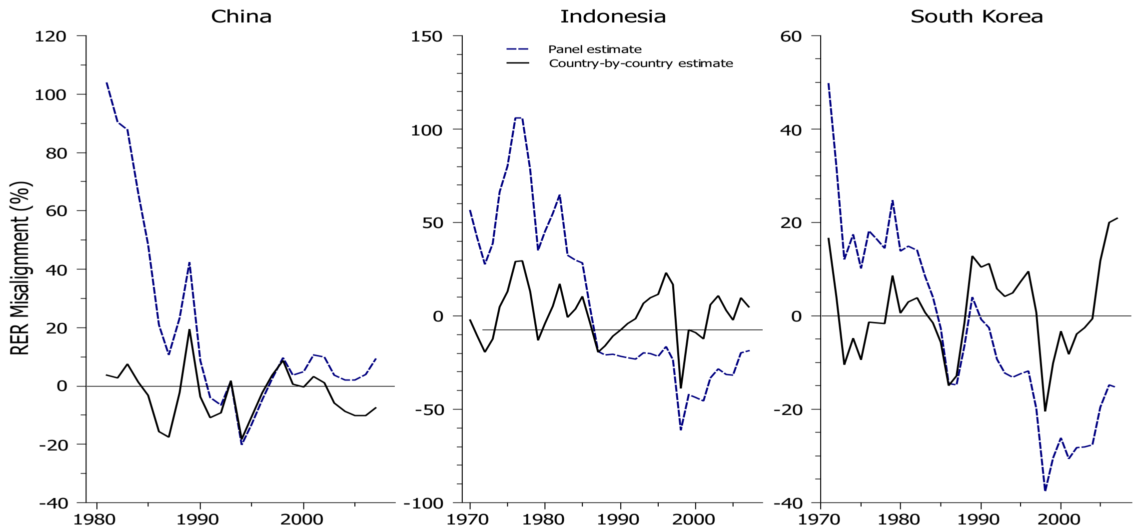
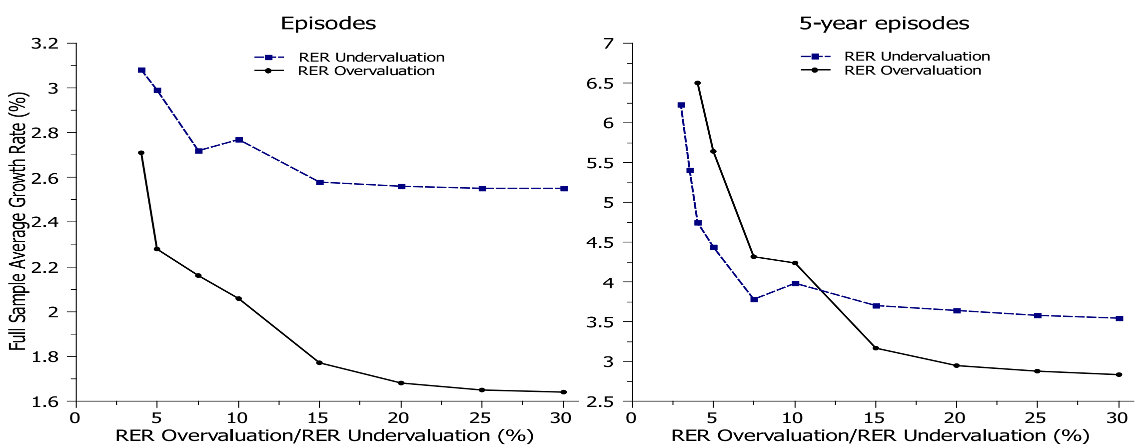
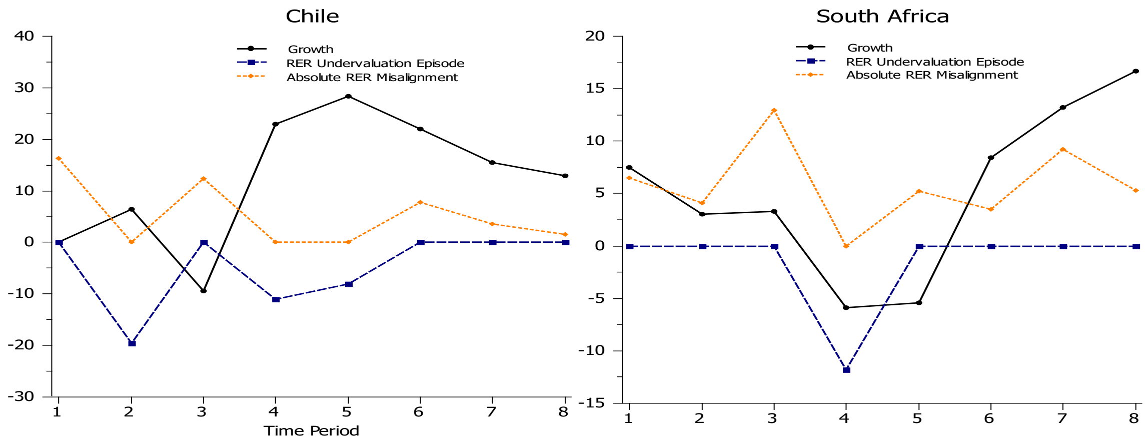


Figure 2: RER distortions-growth nexus



Note:
Each scatter represents the full sample average growth rate for values of RER over- or undervaluation (absolute RER misalignment) less than or equal to the corresponding value on the x-axis in the left panel (right panel).

Figure 3: RER distortions-growth nexus for selected countries



Appendix A

Table A.1: Data Appendix Table
Data sources and definitions.

Variable	Description	Source
RER misalignment estimation		
Real exchange rate (RER)	Constructed with the formula: $RER = (NER \cdot CPI_T)/CPI_D$. NER, CPI_T, and CPI_D are the multilateral official nominal exchange rate, the multilateral foreign consumer price index, and the domestic consumer price index respectively. NER and CPI_T are calculated as geometric averages weighted by total official trade shares of the largest trading partners. The total trade shares are calculated for the time period under consideration.	Compiled from: WDI, UN Comtrade, DOT (IMF), and WDI
Terms of trade (TOT)	The ratio of the export price index to the import price index.	Compiled from: WDI and WT
Trade policy (OPEN)	Constructed as the ratio of the sum of the total value of exports (X) plus the total value of imports (M) relative to GDP at current prices. OPEN1=(X+M)/GDP at constant prices. OPEN2=M/GDP at current prices.	PWT 7.0 (OPEN & OPEN1) WDI (OPEN2)
Balassa-Samuelson-effect (PROD)	Proxied with the ratio of GDP per capita (home country) to the OECD average of GDP per capita income at current (PROD) and constant (PROD1) prices.	WDI
Government consumption (GEXP)	GDP share of total government consumption expenditure at current prices (GEXP). GEXP1: Government consumption share of PPP converted GDP per capita at current prices.	WDI (GEXP) PWT 7.0 (GEXP1)
Net foreign asset position (NFA)	The ratio of net foreign assets relative to GDP at current prices. Net foreign assets are defined as the sum of net holdings of portfolio equity assets, foreign direct investment assets, debt assets, financial derivatives assets, and foreign exchange reserves minus gold.	Lane and Milesi-Ferretti (2007)
Investment (INV)	The investment share of PPP converted GDP per capita at current prices.	PWT 7.0
Trade surplus (TS)	Net exports relative to GDP: TS=(X-M)/GDP.	WDI
General		
Sample size and outliers	The data set for estimating RER misalignment in the sense of Nurkse (1945) is constructed with the objective of maximizing sample size. Any country is included for which the above data is available for at least 20 consecutive years within the period 1970-2007. This study defines each country as "developing" except Japan, European countries, and Western Offshoots. Observations with RER misalignment in excess of 100 percent are excluded as well as their adjacents provided a time-series of at least 20 consecutive observations is retained. Otherwise the country's observations are dropped altogether. In addition, civil war-torn countries are excluded from the sample as well as those countries for which it was not possible to estimate plausible ERERs.	
Growth regressions		
GDP per capita	Real GDP per capita at constant prices (chain series)	PWT 7.0
$\ln(n+g+\delta)$	Average growth of the population (n). Technological progress ($g = 0.02$) and depreciation rate ($\delta = 0.06$).	PWT 7.0
Investment	Log of the investment share of GDP at constant prices.	PWT 7.0
ERER fundamentals	See above.	
Human capital	Average years of schooling of population over age 15.	Barro and Lee (2010)
Rule of law	The strength and impartiality of the legal system. Measured from 0 (lowest) to 6 (highest).	International Country Risk Guide (ICRG)

Appendix B Supplementary material

1. ERER fundamentals

The following list discusses each fundamental's theorized impact on the ERER:

Terms of trade The external terms of trade of a country (the relative price of exportables to importables) is among the key fundamentals explaining long-run RER behavior. The general argument is that an improvement in the terms of trade increases real income resulting in excess demand for nontradables. To restore equilibrium, the price of nontraded goods would have to rise, meaning ERER appreciation. However, Edwards (1989) shows that this income effect can be more than offset by substitution effects such that improved terms of trade would lead to depreciation. It is therefore not possible to determine a priori which of these two effects dominates (Edwards, 1989).

Trade policy Under the assumption that nontradables and importable goods are substitutes, a reduction in tariffs on imported goods decreases (increases) the demand for nontradables (importables), causing the ERER to depreciate.[49]

Productivity of tradable production According to the Balassa-Samuelson theorem (Balassa, 1964; Samuelson, 1964), productivity gains in traded goods production are positively related to the growth rate and tend to be higher in the tradable sector than in the nontradable sector. Since tradable goods prices tend to be uniform across countries (law of one price), productivity improvements relative to trading partners result ERER appreciation. Under the assumption of full employment and perfect labor mobility, the price adjustment is brought about by higher real wages in both sectors (income effect) and labor absorption in the traded goods sector away from the nontradable sector (supply effect).

Government consumption Altering government spending patterns on traded or nontraded goods will have an immediate impact on the ERER. The rationale behind this intuition is straightforward. Increased or shifted government spending towards traded goods results in an increase of the trade deficit requiring real depreciation such that the external balance continues to hold (Montiel, 1999b). In case government spending increases or tilts towards nontradables, the effect on the ERER is the opposite as it results in excess demand for nontradables. The relative price of nontradables then has to rise to restore internal equilibrium (Montiel, 1999b).

Investment An increase in the investment level has an ambiguous effect on the ERER (Edwards, 1989). Whether the ERER appreciates or depreciates depends on if it takes place in the tradable or nontradable sector and on factor intensities (Edwards, 1989).

Net foreign asset position Intuitively, an increase in a country's net international indebtedness should result in a larger trade surplus in order to service the debt, hence requiring real depreciation (and vice versa). On the other hand, it is possible for the "target level" of the net foreign asset position to rise "permanently" during the adjustment process towards equilibrium, implying current account surpluses and ERER depreciation (Faruqee, 1995). Obversely, it may be desirable for a country to move to a net debtor position leading to current account deficits accompanied by an ERER appreciation (Égert et al., 2005). However, based on previous empirical results, an improvement in the net creditor position tends to be associated with ERER appreciation (Aguirre and Calderón, 2005; MacDonald and Ricci, 2003; Montiel, 2007).

[49] See Edwards (1989) for more details. Montiel (1999b) considers the case of export subsidies. ERER depreciation associated with a decline in export subsidies is then brought about through resource reallocation from the exportable to the nontradable sector resulting in excess supply for nontradable goods.

2. Tables

Table B.1: Empirical studies on the RER undervaluation-growth nexus

Author	Countries & Period	Econometric Methodology[1]	Finding
Razin and Collins (1997)	93 countries 1975-1992	SEA, panel data, FE	(+) (nonlinear)
Aguirre and Calderón (2005)	60 countries 1965-2003	SEA, DOLS and panel DOLS	(+) (nonlinear)
Gala and Lucinda (2006)	58 developing countries 1960-1999	PPP adjusted	(+)
Rodrik (2008)	188 countries 1950-2004	PPP adjusted	(+)
Béreau et al. (2009)	31 countries + EU 1980-2007	SEA, panel data, PMG & FM-OLS	(+)
Berg and Miao (2010)	181 countries 1950-2004	SEA, panel data, FE	(+)
MacDonald and Vieira (2010)	90 countries 1980-2004	SEA, panel data, FE & RE	(+)
Abida (2011)	3 MENA countries 1980-2008	SEA,panel data, FM-OLS	(+)
Nouira and Sekkat (2012)	52 developing countries 1980-2005	SEA, panel DOLS	inconclusive, mostly 0

[1] Notes: Contains information about the ERER definition and the econometric methodology to derive RER misalignment. SEA refers to the single-equation-approach developed by Edwards (1989); Elbadawi (1994),and Baffes et al. (1999), implying an ERER definition consistent with internal and external balance. PPP adjusted means the ERER in these studies is defined as absolute PPP adjusted for the Balassa-Samuelson effect.

Table B.2: Long-run equilibrium relationships

Dependent variable: ln RER

Estimation technique: Dynamic OLS

COUNTRY	ln TOT	OPEN	PROD	GEXP	NFA	INV	TS	[leads,lags]
Algeria	0.55 (33.0)***		-0.08 (45.1)***					[1,0]
Argentina	-1.19 (2.5)**	0.04 (6.5)***						[1,0]
Bangladesh		0.02 (9.6)***			-0.016 (6.3)***			[1,2]
Bolivia	-0.51 (2.5)**	0.01 (3.0)***	-0.05 (3.2)***					[2,2]
Botswana		0.007 (6.5)***		0.006 (2.3)**	0.003 (11.2)**			[1,0]
Brazil	-0.24 (3.5)***		-0.02 (6.4)***		-0.01 (4.8)***			[2,1]
Burkina Faso		0.02 (6.4)***	-0.39 (12.7)***	-0.01 (2.4)**		-0.02 (5.7)***		[2,0]
Cabo Verde			-0.11^{1} (8.6)***			0.004 (4.2)***		[1,0]
Cameroon	-0.32 (3.5)***	0.04^{2} (6.9)***	-0.11 (9.2)***	-0.05 (3.9)***				[3,0]
Central African Republic	-0.12 (3.0)***			-0.03^{1} (5.8)***			0.04 (6.8)***	[2,0]
Chile	-0.46 (8.1)***	0.01 (11.3)***	-0.02 (7.6)***					[1,0]
China		0.02 (8.3)***			-0.03 (7.6)***			[3,1]
Colombia		0.02 (8.5)***	-0.05 (17.1)***	-0.01 (3.1)***	-0.004 (2.3)**			[3,0]
Costa Rica			-0.04 (8.2)***	0.08^{1} (4.9)***		0.01 (3.4)***	0.02 (7.4)***	[1,2]
Côte d'Ivoire		0.02 (7.5)***	-0.02 (3.5)***	-0.07 (16.6)***	-0.005 (6.5)***			[2,0]
Dominican Republic	-0.14 (2.2)**	0.01^{2}(1.8)**	-0.05 (3.8)***					[1,2]
Ecuador		0.007 (4.2)***	-0.03 (4.3)***	-0.02 (2.3)**	-0.003 (3.9)***			[1,0]
El Salvador			-0.07 (2.9)***	-0.12^{1} (5.0)***				[2,2]
Equatorial Guinea	0.42 (4.2)***	0.003 (13.6)***			-0.004 (4.8)***			[1,0]
Gabon			-0.02 (13.5)***			0.03 (10.8)***	0.02 (17.0)***	[2,0]
The Gambia				-0.04^{1} (4.9)***	-0.001 (3.7)***	0.01 (2.6)**		[0,1]
Guatemala	-0.40 (5.4)***	0.009 (4.0)***	-0.26^{1} (15.2)***					[2,2]
Haiti		0.01 (3.9)***			-0.005 (2.9)**	-0.06 (2.5)**		[2,2]
Honduras			-0.06 (6.7)***	-0.03 (4.3)***		0.01 (4.3)***		[1,1]
Hong Kong		0.005 (5.2)***	-0.02^{1} (7.8)***	-0.17 (6.3)***				[1,1]
India		0.01 (9.6)***	-0.30 (29.2)***		-0.003 (2.8)**			[1,0]
Indonesia		0.007 (3.8)***	-0.19 (16.2)***			0.009 (3.2)***		[1,0]
Israel		0.006 (13.5)***	-0.007 (8.0)***	-0.006 (3.7)***				[1,1]
Jordan	0.33(3.3)***	0.003^{2} (2.7)**	-0.02 (13.5)***			0.003 (3.4)***		[1,0]
Kenya			-0.10 (3.2)***		-0.003 (2.8)***			[1,0]
Madagascar		0.02 (8.3)***	-0.27 (4.6)***		-0.003 (1.8)*			[2,2]
Malawi	-0.42 (5.2)***	0.01 (6.8)***		-0.04^{1} (4.1)***		-0.01 (2.5)**		[0,2]
Malaysia	0.28 (4.3)***	0.003 (11.9)***	-0.01 (3.5)***					[3,1]
Mali			-0.98 (21.0)***		0.006 (8.5)***			[2,0]
Mauritania			-0.33 (8.9)***	-0.007 (3.2)***				[1,0]
Mauritius		0.002 (2.3)**	-0.04 (3.1)**		0.004 (3.2)***			[2,2]
Mexico	0.14 (9.6)***		-0.02 (10.3)***	-0.04 (7.5)***	-0.008 (15.3)***			[1,0]
Morocco		0.003 (3.0)***	-0.08 (10.5)***					[1,0]
Niger	-1.0 (5.9)***		-0.11 (3.1)***	-0.06 (4.5)***				[2,0]
Nigeria	-0.47 (7.9)***	0.02 (10.5)***			-0.001 (2.8)**	-0.06 (5.5)***		[0,1]
Pakistan		0.03 (5.3)***		0.06 (5.3)***		-0.10 (8.3)***		[0,2]
Panama			-0.01 (4.4)***		0.001 (4.8)***	0.002 (4.5)***		[3,0]
Paraguay	0.74 (14.6)***		-0.05 (4.9)***	0.06 (3.6)***		0.03 (4.6)***		[1,0]
Peru		0.03 (8.3)***	-0.06 (10.6)***	0.13 (8.5)***			0.02 (4.5)***	[2,2]
Philippines		0.004 (5.8)***	-0.11 (12.7)***	-0.04 (5.0)***		0.01 (4.0)***		[1,1]
Sénégal	-0.88 (5.5)***		-0.12 (2.3)**	-0.04 (3.4)***				[2,2]
Seychelles		0.004^{2} (3.0)***		-0.01^{1} (4.2)***				[2,0]
Singapore	-0.79 (6.1)***	0.001 (10.5)***	-0.003 (7.5)***		-0.002 (7.4)***			[2,0]
South Africa	-0.36 (5.0)***	0.01 (8.7)***	-0.02 (18.0)***					[1,3]
South Korea			-0.003 (1.8)*	0.03 (2.3)**	0.004 (2.1)**			[2,2]
Sri Lanka		0.004 (2.3)**	-0.30 (16.0)***					[2,2]
Swaziland				-0.01 (2.4)**	0.0005 (2.8)***	0.06 (2.2)**		[2,0]
Tanzania	-0.34 (4.0)***	0.03 (9.8)***			0.002 (3.2)***	0.02 (2.2)**		[2,2]
Thailand		0.004 (15.1)***	-0.03 (3.2)***	-0.02 (2.6)**	-0.004 (7.3)***			[1,1]
Togo	0.064 (2.3)**			-0.02(6.2)***	-0.002(6.5)***			[1,1]
Trinidad & Tobago	-0.48 (3.5)***	0.01 (5.5)***		-0.01 (2.3)**	0.002 (2.2)**			[1,0]
Tunisia	0.23 (5.4)***	0.01 (9.0)***	-0.04 (3.5)***			-0.01 (2.7)***		[1,0]
Turkey			-0.04 (7.8)***	-0.04 (2.2)**	0.02 (3.0)***			[2,1]
Uruguay	0.23 (2.3)**				-0.004 (2.0)**			[1,0]
Venezuela		0.01 (4.2)***	-0.008 (6.8)***	-0.07 (4.3)***				[2,0]
Zambia	0.35 (4.1)***		-0.04 (2.5)**		-0.002 (3.6)***			[2,1]
Zimbabwe		0.01 (2.7)**	-0.06 (8.3)***	-0.01 (3.6)***				[0,1]
Panel	-0.13 (2.5)**	0.004 (5.9)***	-0.01 (7.3)***		-0.001 (2.9)***	-0.003 (1.9)*		[1,1]

Notes: ***, **, * denote the level of statistical significance at 1, 5, and 10 percent. Numbers in parentheses are the absolute values of the t-ratio. The last column reports the number of leads and lags that minimized the information criteria. ^{1} or ^{2} on top of the coefficients refer to the alternative proxies (OPEN1, OPEN2, PROD1, GEXP1) as set out in Table A.1.

Table B.3: Growth regressions – Additional results

Dependent variable: Real GDP per capita growth

	(1)	(2)	(3)	(4)	(5)
Independent variable	SGMM	SGMM	SGMM	SGMM	SGMM
Initial Income	-0.05 (1.0)	0.01 (0.2)	0.02 (0.6)	-0.05 (0.9)	-0.02 (0.4)
Investment	0.21 (2.8)***	0.11 (1.8)*	0.12 (2.2)**	0.19 (3.2)***	0.21 (2.4)**
$\ln(n+g+\delta)$	-0.54 (1.9)*	-0.42 (1.2)	-0.53 (1.7)*	-0.83 (2.6)***	-0.50 (1.4)
Terms of Trade	-0.01 (0.1)	-0.02 (0.7)	0.07 (1.7)*		-0.04 (1.1)
Trade Openness	0.11 (1.5)	0.02 (0.6)	-0.06 (1.8)*		0.11 (1.2)
Government Consumption	-0.15 (1.9)*	-0.06 (0.8)	0.00 (0.0)		-0.10 (1.1)
Net Foreign Asset Position	-0.07 (1.2)	-0.04 (0.8)	-0.02 (0.5)		-0.09 (1.5)
RER Undervaluation	1.35 (1.3)	1.00 (1.5)	1.29 (2.2)**	0.76 (1.7)*	
RER Undervaluation Squared	4.25 (0.9)				
RER Overvaluation	-0.86 (0.7)	-1.35 (1.7)*	-1.43 (3.2)***	-2.19 (6.3)***	
RER Overvaluation Squared	-2.46 (1.3)				
Observations	469	430	210	469	469
N	63	57	53	63	63
AR(2) (p-value)	0.97	0.13	0.26	0.74	0.85
Hansen test (p-value)	0.93	0.65	0.87	0.43	0.21
Instruments	83	69	70	45	55

Notes: ***, **, * denote the level of statistical significance at 1, 5, and 10 percent. t-ratios in parentheses (calculated on the basis of the Windmeijer (2005) correction for two-step SGMM standard errors). Each regression includes country and time fixed effects. SGMM results use all available lags as "collapsed" instruments, except in column 3 where the first lag is used. The terms of trade is treated as strictly exogenous; initial income as predetermined; and the rest as endogenous. Observations are averages over five-year periods. The value of the variable RER Undervaluation (Overvaluation) is less (greater) than or equal to zero. Initial income, investment, population growth, government consumption, the terms of trade, are measured in natural logarithms.

Table B.4: Growth regressions – Robustness

Dependent variable: Real GDP per capita growth

	(1a)	(1b)	(2a)	(2b)	(3)	(4)	(5)
Independent variable	OLS	SGMM	OLS	SGMM	SGMM	SGMM	SGMM
Initial Income	-0.25 (8.3)***	-0.001 (0.0)	-0.25 (7.5)***	0.01 (0.1)	0.04 (0.6)	-0.05 (0.5)	-0.02 (0.2)
Investment	0.23 (3.3)***	0.22 (2.4)**	0.16 (5.6)***	0.18 (3.4)***	0.28 (2.6)***	0.26 (2.3)**	0.27 (2.5)**
$\ln(n+g+\delta)$	-0.05 (0.4)	-0.29 (1.0)	-0.08 (0.6)	-0.15 (0.4)	-0.64 (1.6)	-0.46 (1.1)	-0.52 (1.3)
Terms of Trade	0.01 (0.4)	0.01 (0.3)	-0.01 (0.5)	-0.03 (1.0)	0.00 (0.1)	0.02 (0.6)	0.01 (0.1)
Trade Openness	0.03 (0.9)	0.08 (1.0)	0.01 (0.3)	-0.01 (0.2)	0.07 (0.7)	0.15 (1.1)	0.05 (0.6)
Government Consumption	-0.15 (2.0)**	-0.09 (1.1)	-0.06 (1.4)	0.04 (0.4)	-0.02 (0.1)	-0.09 (0.9)	-0.09 (0.5)
Net Foreign Asset Position	0.05 (1.7)*	-0.10 (1.8)*	0.05 (1.9)*	-0.02 (0.5)	-0.23 (2.8)***	-0.19 (2.4)**	-0.15 (1.2)
Human Capital			-0.07 (1.4)	0.04 (0.7)			
RER Undervaluation	0.25 (1.9)*	0.97 (2.9)***	0.29 (2.1)**	0.74 (2.5)**	1.26 (2.2)**	0.91 (1.8)*	1.26 (2.2)**
RER Overvaluation	-0.54 (3.2)***	-1.42 (3.1)***	-0.49 (3.0)***	-0.73 (1.6)	-1.63 (2.6)***	-2.09 (3.8)***	-1.85 (2.8)***
Observations	456	456	422	422	469	469	469
N	61	61	56	56	63	63	63
AR(2) test		0.99		0.11	0.65	0.63	0.69
Hansen test (p-value)		0.72		0.89	0.44	0.43	0.29
Instruments		69		77	61	53	45

Notes: ***, **, * denote the level of statistical significance at 1, 5, and 10 percent. t-ratios in parentheses (calculated on the basis of robust clustered standard errors for OLS and the Windmeijer (2005) correction for two-step SGMM standard errors). Each regression includes country and time fixed effects. In columns 1a-2b RER misalignment estimates are based on alternative values of "sustainable" variables derived with the Butterworth-filter. Tanzania and Nigeria are dropped from the sample as both are classed as outliers. In columns 1a and 2b SGMM results use all available lags as "collapsed" instruments. Columns 3-5 exlude instruments up to lag 1, 2, and 3, respectively. The terms of trade is treated as strictly exogenous; initial income and human capital as predetermined; and the rest as endogenous. The value of the variable RER Undervaluation (Overvaluation) is less (greater) than or equal to zero.

Table B.5: Growth regressions – Robustness: bootstrapped standard errors

Dependent variable: Real GDP per capita growth

	(1a)	(1b)	(2a)	(2b)
Independent variable	OLS	OLS	OLS	OLS
Initial Income	-0.25 (0.03)***	-0.25 (0.031)***	-0.24 (0.033)***	-0.24 (0.035)***
Investment	0.22 (0.068)***	0.22 (0.066)***	0.15 (0.027)***	0.15 (0.03)***
$\ln(n+g+\delta)$	-0.09 (0.128)	-0.09 (0.131)	-0.11 (0.135)	-0.11 (0.136)
Terms of Trade	0.002 (0.028)	0.002 (0.03)	-0.01 (0.026)	-0.01 (0.026)
Trade Openness	0.02 (0.032)	0.02 (0.034)	0.004 (0.031)	0.004 (0.032)
Government Consumption	-0.14 (0.068)**	-0.14 (0.068)**	-0.05 (0.038)	-0.05 (0.041)
Net Foreign Asset Position	0.04 (0.024)	0.04 (0.025)	0.04 (0.024)*	0.04 (0.026)
Human Capital			-0.07 (0.046)	-0.07 (0.053)
RER Undervaluation	0.27 (0.147)*	0.27 (0.150)*	0.32 (0.147)**	0.32 (0.149)**
RER Overvaluation	-0.65 (0.183)***	-0.65 (0.180)***	-0.60 (0.189)***	-0.65 (0.188)***
Observations	469	469	430	430
N	63	63	57	57

Notes: ***, **, * denote the level of statistical significance at 1, 5, and 10 percent. Robust clustered standard errors in parentheses in columns 1a and 2a. Bootstrapped standard errors (1000 replications) in parentheses in columns 1b and 2b.

3. Figures

Figure B.1: Estimated RER misalignments

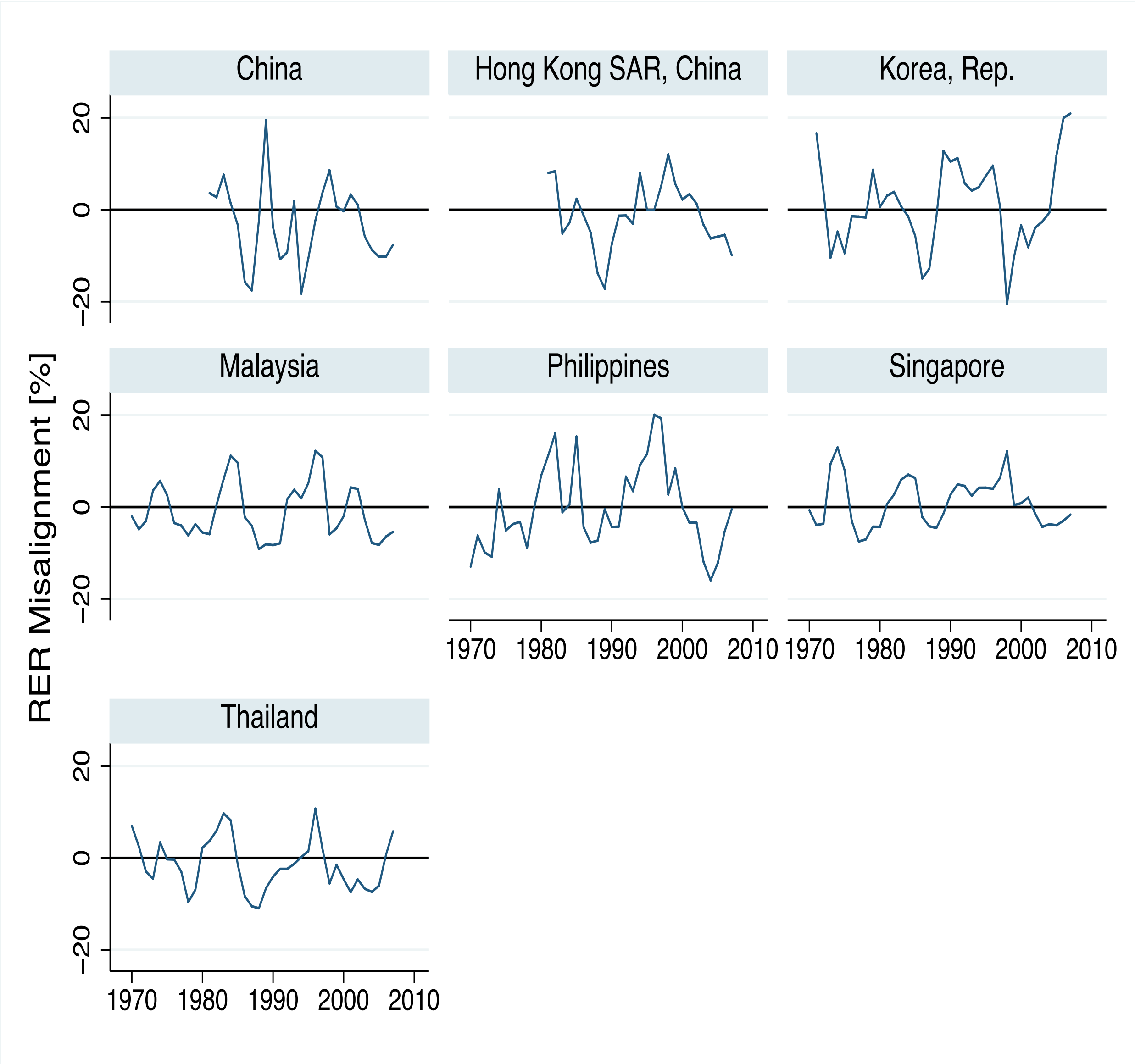


Figure B.1: Estimated RER misalignments (ctd)

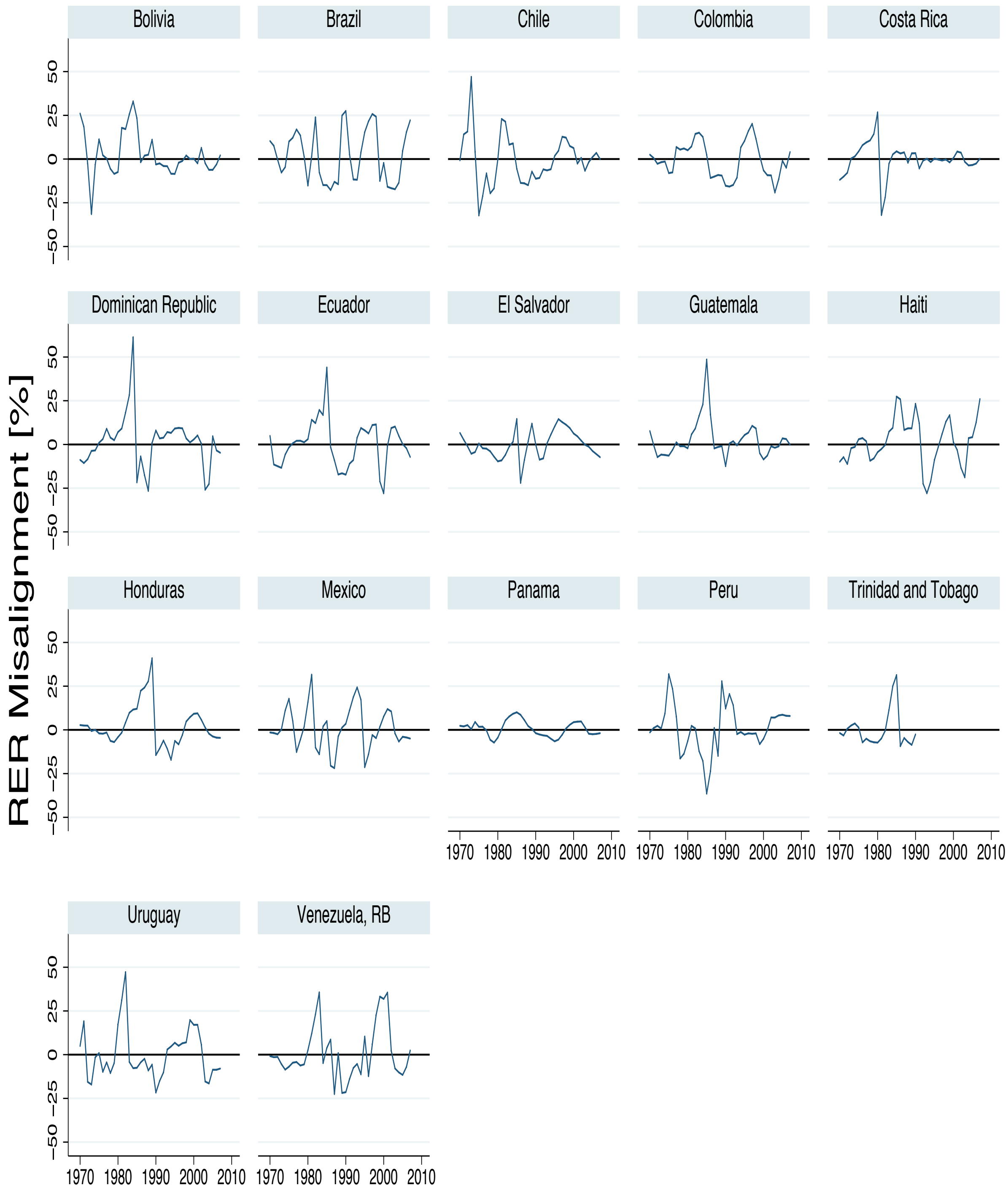


Figure B.1: Estimated RER misalignments (ctd)

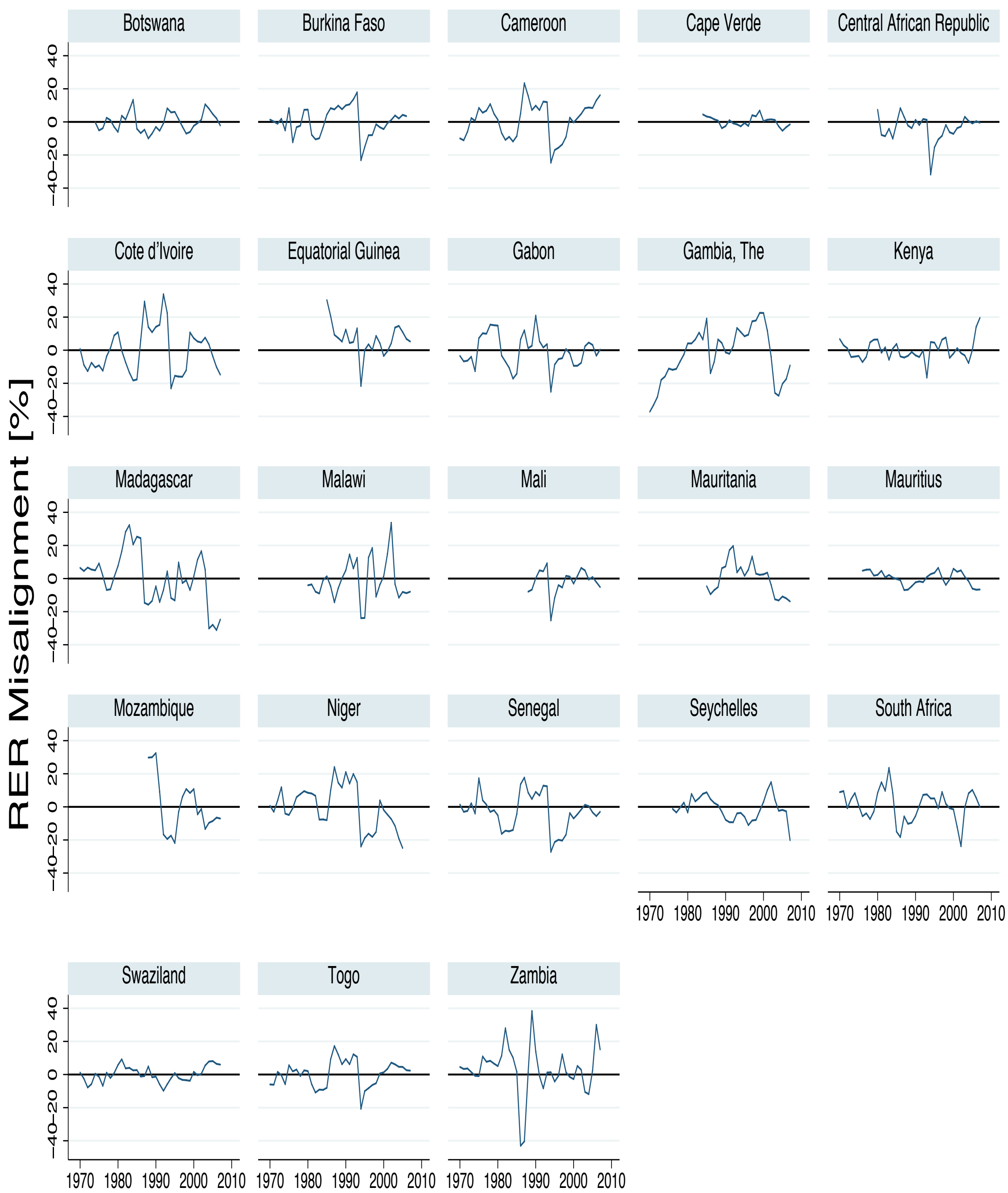


Figure B.1: Estimated RER misalignments (ctd)

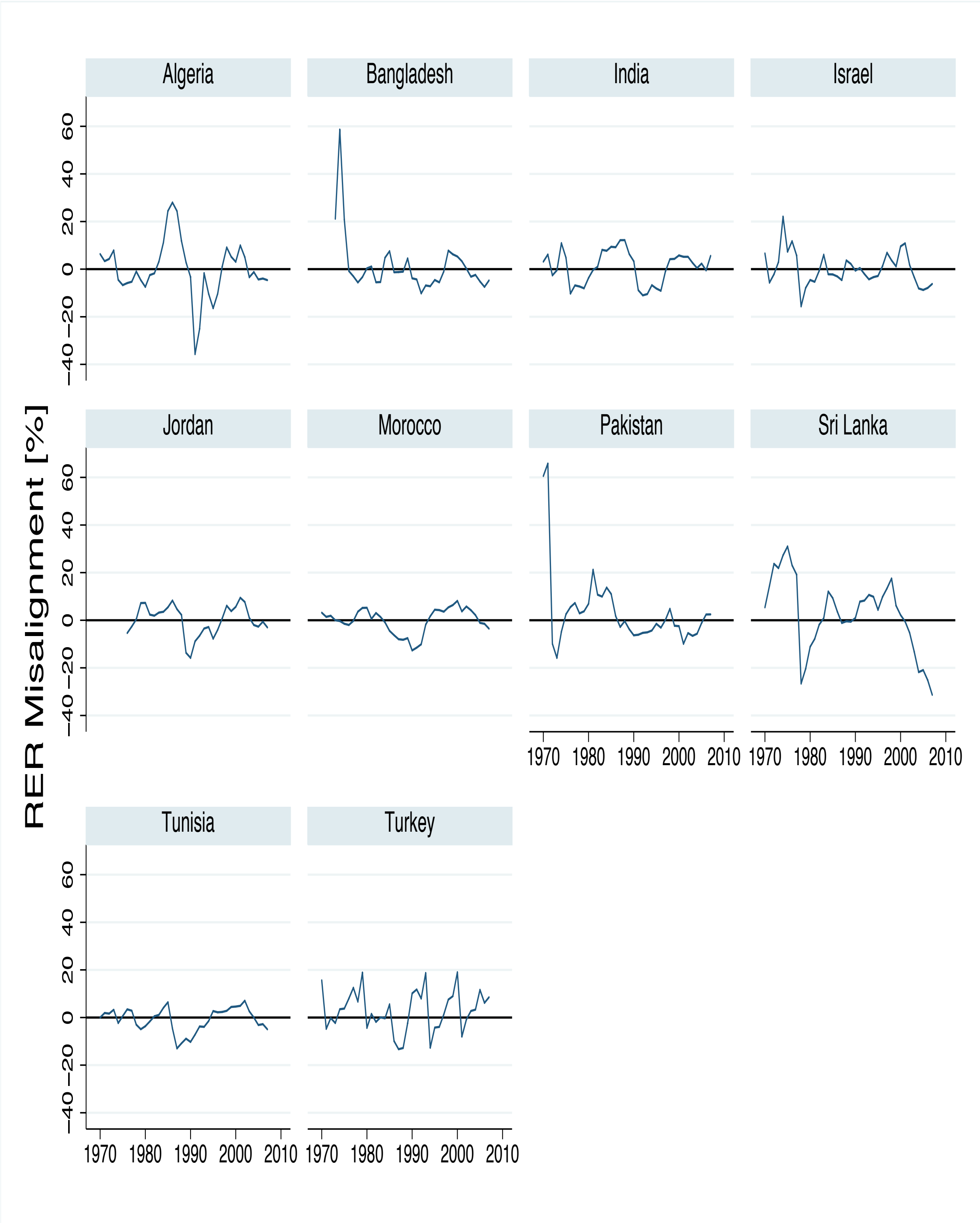
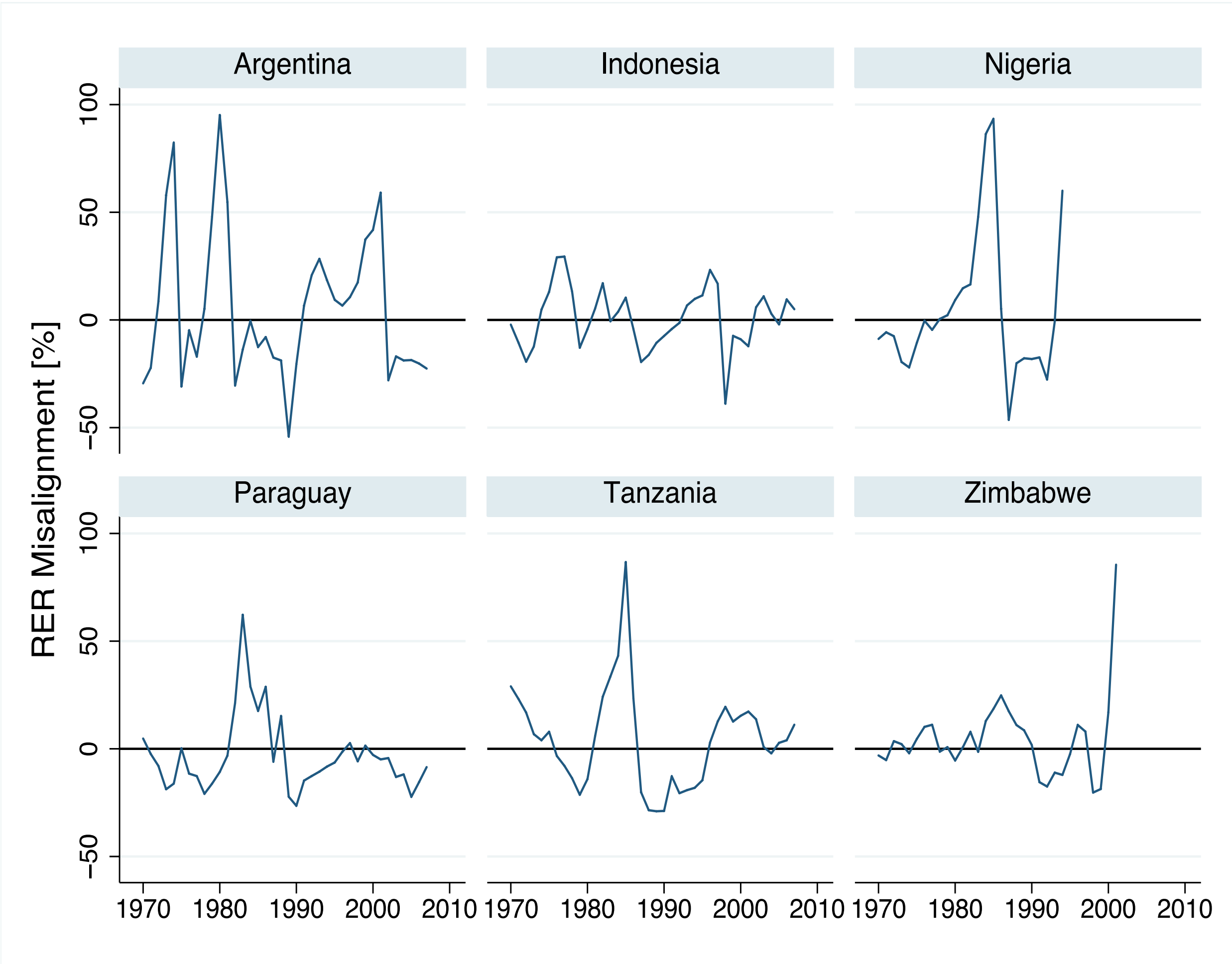


Figure B.1: Estimated RER misalignments (ctd)



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