Article's title: Temporal Dimension and Equilibrium Exchange Rate: a FEER / BEER Comparison

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Abstract: This paper investigates the temporal links between two models of equilibrium exchange rate, namely the behavioral and the fundamental approaches. Our results show that, even though in the long-run they are closely related, important differences are observed for some countries and/or some periods. Contrary to previous contributions, we analyze the factors that explain this disconnection. We outline structural changes in matter of competitiveness, the dynamics of foreign assets and valuation effects as explanations. This novel evidence is important if the two approaches for assessing misalignments are used for policy decisions such as setting tariffs to cope with the "currency war".

JEL Classification: F31, F32, C23.

Keywords: equilibrium exchange rate, cointegration, net foreign assets, current account, exchange rate.

1. Introduction

Since the mid-1990s, an important issue in international macroeconomics has been the important increase in global imbalances implying, on the one side, sustained deficits in the current account of some major economies (particularly the United States) and, on the other, important surplus in emerging economies, such as China. In addition, even though the euro zone as a whole keeps an equilibrated position *vis-à-vis* the rest of the world, important differences are observed among its member countries. These imbalances may be considered as a threat to the global macroeconomic stability because they reflect mainly imbalances in terms of growth, savings and investments and exchange rates misalignments (ERM, from now on) in the main economic areas.

In addition, in recent times, the "currency war" is causing international tensions and bringing the subject of currency misalignments, once again, at the heart of the economic policy discussions. Indeed, several politicians and economists propose to treat undervalued currencies (particularly in some emerging countries) as an illegal export subsidy and, therefore, to set tariffs to counterbalance the gain obtained by keeping an undervalued currency. Then, an important question that arises at this point is how to assess real exchange rate misalignments.

By definition, ERM is defined as the gap, in percentage, between observed exchange rates and equilibrium exchange rates. However, even though the literature that deals with this subject is extensive, there is still no consensus about the reference point at which real exchange rates should be compared to. This implies that there is not a unique or single measure of misalignment. We aim at contributing to the literature by analyzing the factors than explain the temporal divergences between the two main approaches to estimate real exchange rate misalignments. Particularly, we insist on the time horizon of each measure to outline their differences.

Indeed, several methodologies can be used to estimate equilibrium exchange rates[1]. In particular, ERM have been studied in detail in the literature using two main approaches: the Behavioral Equilibrium Exchange Rate (BEER) and the Fundamental Equilibrium Exchange Rate (FEER). Briefly, the FEER is defined as the level of exchange rate that allows the economy to reach simultaneously the internal and external equilibrium in the medium term (Williamson, 1994). On the contrary, the BEER approach explains the exchange rate evolution with some main variables (usually the net foreign assets, the terms of trade, and the productivity) which influence the real exchange rate in the long term (Clark and MacDonald, 1998)[2]. In the NATREX approach (Stein and Allen, 1997), an interesting theoretical distinction is made between short, medium and long run. However, the empirical estimation strategy employed in this approach can be considered as a more complex BEER approach.

Given its importance in policy analysis, the literature that aims at estimating equilibrium exchange rate is very extensive. Yet, there is still an extensive debate on which approach is the most convenient to make judgments about exchange rates being over or under-valued[3].

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[1] See Driver and Westaway (2004) for a survey and, for example, Uz and Ketenci (2008) for an empirical implementation of the monetary approach to exchange rate for Turkey and new EU members.

[2] In order to assess misalignments, some central banks rely basically in the 3 methods favored by the IMF, which are close to the FEER and the BEER methodologies.

[3] Cheung et al. (2009) and Dunaway et al. (2009) study the robustness of estimates of equilibrium exchange rates across different methodologies in the case of the Chinese real exchange rate.

The FEER approach is questioned due to its sensitivity to import and export exchange rate elasticities as well as issues related to deriving benchmarks for the current account. On the contrary, the BEER approach is criticized for its lack of theoretical arguments as well as the scarce robustness of the reduced form equations[4].

In this sense, the aim of this study is to contribute to the literature on equilibrium exchange rates by analyzing the temporal dimension. In particular, contrary to previous research on the topic, we aim at understanding the economic reasons behind the divergence between the BEER and the FEER estimations for real exchange rate misalignment for a large panel of countries. To this end, we analyze, in a unified theoretical framework, the BEER and the FEER methodologies. In order to understand the links between these two approaches, we study carefully the temporal links between the two kinds of equilibrium exchange rate.

The contribution of the paper compared to previous studies on the equilibrium exchange rate lies in the fact that often, comparisons are made without taking into account sufficiently the time horizon of each measure, which may lead to serious misinterpretations of the nature and / or the magnitude of misalignments. We outline that we are dealing with *two concepts of equilibrium exchange rate* (FEER / BEER), which correspond to two different time horizons (the medium term / the long term) and two goals of macroeconomic policy (the stabilization of the current account balance / the stabilization of the net external position) that can *temporarily diverge*, as shown, for instance, by the case of the United States during the second half of the 2000s (see below). In addition, we go further than the previous literature by identifying a number of reasons that lie behind the divergence of the two approaches, a fact previously neglected.

This paper is organized as follow. Section 2 summarizes the theoretical and methodological background. Section 3 tests empirically the temporal links between FEERs and BEERs. Section 4 studies the differences between these two approaches and theirs implications in terms of economic policies. Section 5 concludes.

2. The temporal dimension in the BEER and the FEER approaches

Some authors have compared the BEER and FEER approaches in the same theoretical framework (see e.g. Driver and Westaway, 2005; Rubaszek and Rawdanowicz, 2009; Bénassy-Quéré et al., 2009a). One important conclusion of these previous studies is that, despite of conceptual differences, the two approaches can be seen as complements rather than substitutes. This kind of comparison seems to be misleading because it neglects the temporal dimension. As we shall see, the FEER is a medium run concept in which the current account reaches a sustainable level at medium term. Therefore, it can be seen as a flow equilibrium which is relevant precisely at medium term. Instead, the BEER is a long run concept associated with a stock-flow equilibrium in which the net foreign asset position is stabilized as percent of GDP and so the current account is equal to zero (Driver and Westaway, 2005).

More in detail, the procedure to derive BEER series is quite standard (see, for instance Béreau et al. (2010)). It consists on the estimation of a reduced form panel cointegration relationship between the real exchange rate and a set of economic fundamentals as follows:

[4] Bussière et al. (2010) provide a good discussion on the solutions in dealing with the large uncertainties surrounding equilibrium exchange rate estimates.

$$q_{i,t} = \mu_i + \beta_1 NFA_{i,t} + \beta_2 prod_{i,t} + \beta_3 tot_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where q is the logarithm of the real effective exchange rate of country i, μ stands for the fixed effects, *NFA* is the net foreign asset-to-GDP ratio, *prod* is the logarithm of the relative productivity differential, *tot* is the logarithm of the terms of trade and ε is a white noise process. According to the panel Fully Modified OLS (FMOLS) methodology, all the estimated coefficients in equation (1) have the theoretical expected signs: an improvement in the net foreign asset position as well as gains in relative productivity and better terms of trade they all appreciate the real exchange rate[5]. The previous equation corresponds then to the equilibrium exchange rate from which we can derive real exchange rate misalignments (z). These correspond to the difference between the observed and the equilibrium exchange rates. Therefore, the BEER misalignments are computed as:

$$z_{i,t} = q_{i,t} - \hat{\mu}_i + \hat{\beta}_1 NFA_{i,t} + \hat{\beta}_2 prod_{i,t} + \hat{\beta}_3 tot_{i,t} \quad (2)$$

Note that the BEER methodology suffers from some drawbacks, such as the lack of theoretical foundations and the sensitivity of the results to the fundamental variables retained in equation (1). Yet, it is important to mention that it has been shown (Bénassy-Quéré et al. (2009b)) that BEER estimations are quite robust to alternative specifications.

On the other side, the FEER is defined as the exchange rate prevailing when the economy simultaneously reaches the external equilibrium and the internal equilibriums for all the trading partners. As it is fully described in Jeong et al. (2010) and Aflouk et al. (2010), a two step analysis is used. Firstly, for the main currencies (dollar, euro, yuan, yen, pound sterling) the FEER misalignments are computed with a standard world trade model in which all the variables are endogenous, except the external equilibrium (sustainable current account determined by structural parameters) and the internal equilibrium (full utilization of the productive potential). The external equilibrium is estimated with panel regression techniques. The internal equilibrium is linked to the output gap[6]. Notice that the FEER estimates are not obtained country-by-country but in a consistent framework by relying on a world trade model for the main economic areas. For smaller countries the estimates are link to the multinational model.

Secondly, for smaller economies at the world scale, we simply use national models of foreign trade, in which the world demand and world price are exogeneous. In that case the FEER misalignments, written in differential logarithmic ($r_i = dLog\ R_i = (R_i - R_i^e) / R_i^e$), are computed as:

$$r_i = 1/sx_i \left[b_i / mx_i + \eta m_i di_i - \eta x_i d_i^* \right] \quad (3)$$

where b is the difference between the observed current account and the equilibrium one, as percentage of GDP, d and d^* stand for internal and world demand in volume, also written in

[5] Indeed, the estimated coefficients for the NFA, the relative productivity and the terms of trade were 0.174, 0.181 and 0.155, respectively and significant at the 1% significant level. Note that similar results were obtained by employing the panel PMG estimation (these results are available upon request).

[6] See Jeong et al. (2010). The methodology used is a synthesis of previous works on the FEER (see Borowski and Couharde, (2003) and Jeong and Mazier, (2003)) and of the Symmetric Matrix Inversion Method (SMIM) proposed by Cline (2008).

differential logarithmic, ηm and ηx are import and export volume elasticities, sx and mx are coefficients derived from the foreign trade model in which mark-up behaviors are allowed.

More precisely, to understand theoretically the temporal links between the BEER and the FEER a simple current account model, based on Clark and MacDonald (1998), can be expressed as follows:

$$CA = -KA \tag{4}$$

$$CA = ntb + nfar \tag{5}$$

$$ntb = b_0 + b_1 q + b_2 ydpot + b_3 yfpot \tag{6}$$

With $b_1 > 0$; $b_2 < 0$ and $b_3 > 0$ (we observe a real effective depreciation when q increases).

$$nfar = f(q) \tag{7}$$

The balance of payments identity indicates that the current account balance (*CA*) is equal to the opposite of the capital account balance (*KA*). The current account balance is a sum of the net trade balance (*ntb*) and returns of net foreign assets (*nfar*). The net trade balance is a positive function of the real effective exchange rate (*q*) and full employments output of foreign economies (*yfpot*). The net trade balance is a negative function of domestic full employment output (*ydpot*). Equation (7) captures the effects of exchange rate variations on the returns of the net external position (*nfar*).

Combining equation (4) to (7) gives:

$$CA^* = f(q^{reer}, ydpot, yfpot) = -KA^* \tag{8}$$

With CA^*, the level of equilibrium current account at medium term.

To determine the FEER, we solve the following equation:

$$q^{feer} = f\left(KA^*, ydpot, yfpot\right) \tag{9}$$

We obtain the fundamental equilibrium exchange rate (q^{feer}), which realizes simultaneously the external and internal equilibrium for all trading partners.

As it is often the case, the BEER is obtained in two steps. Firstly, we estimate a long run relationship between real effective exchange rate and net foreign asset position (*nfa*), relative productivity differential (*prod*) and terms of trade (*tot*). Then, in a second step, we multiply the observed values by the coefficients of the cointegrating vector to obtain the BEER.

$$q^{beer} = f\left(\bar{nfa}, \bar{prod}, \bar{tot}\right) \tag{10}$$

These two measures of equilibrium exchange rate are implicitly linked since the flow equilibrium (equations (9) and (11)) *is not independent* of the stock-flow equilibrium (equations (10) and (12)).

Medium run (flow equilibrium)

$$CUR/GDP \neq 0 \tag{11}$$

Long run (stock-flow equilibrium)

$$\begin{aligned} &CUR/GDP = 0 \\ &\Delta\left(NFA/GDP\right) = 0 \end{aligned} \tag{12}$$

The FEER is a medium run concept. This exchange rate allows the economy to reach internal and external equilibrium at the same period. The essential point is "how to define the equilibrium". We can distinguish three time horizons (short run, medium run and long run) with an equilibrium exchange rate associated with each time horizon. These different measures of equilibrium may be not equal. The FEER concept can be seen as a medium term (flow) equilibrium, defined as in equation (11), in which the equilibrium current account is at a level compatible with an eventual convergence to the stock-flow equilibrium (Driver and Westaway, 2005).

Conversely, since the BEER approach is based on a cointegration relationship between the real exchange rate and the so-called fundamental variables, it is considered to be a long run concept. In this sense, one of the key variables that explain the real exchange rate is the net foreign asset (NFA) position of a country such that, when a country accumulates a surplus in its current account, its net external position increases in percentage of GDP. To stabilize its net external position, its currency must appreciate in real terms above its equilibrium value and, thus, appears overvalued. In the long run, the net foreign asset position as percentage of GDP is stabilized so the current account is equal to zero. This long term equilibrium corresponds to the stock-flow equilibrium for all the agents of the economy, as shown in equation (12). This equilibrium may be reached, but it might take years or decades (Driver and Westaway, 2005). Note that this definition (of the long run equilibrium) has the merit of precluding Ponzi strategies (Cline and Williamson, 2010).

3. Temporal links between FEER and BEER

As it was mentioned before, the aim of this paper is three folded. First, we compare real exchange rate misalignments obtained from the FEER and the BEER approaches[7]. In order to do so, we study a group of seventeen economies among which four industrialized and thirteen emerging countries on the period 1982-2007 (the United States (USA), the United-Kingdom (UK), the Euro area (EU), Japan (JPN), Korea (KOR), China (CHN), Brazil (BRA), India (IND), Mexico (MEX), Argentina (ARG), Chile (CHL), Colombia (COL), Indonesia (INS), Malaysia (MYS), Philippines (PHL), Thailand (THA) and Uruguay (URU)). Second, we detect periods of divergence between the two of them. Finally, we identify the reasons that lie behind the divergence of the two approaches.

Some studies have compared the FEER and the BEER approaches by using a current account balance that would stabilize the NFAs as a proportion of GDP at an appropriate level (see e.g. Bénassy-Quéré et al., 2009a). This kind of comparison seems to be confusing because it neglects the temporal dimension. Indeed, as mentioned before, the FEER is a medium run

[7] Notice that the real effective exchange rate corresponds to a CPI effective rate.

concept in which the current account reaches a sustainable level at medium term. Therefore, it can be seen as a flow equilibrium which is relevant precisely at medium term. Instead, the BEER is a long run concept associated with a stock-flow equilibrium in which the NFA position is stabilized as percentage of GDP and so the current account is in equal to zero (Driver and Westaway, 2005). In other words, by construction, just as the flow and the stock, the two measures should be related in the long-run, even though temporal divergences can appear between them.

In order to illustrate this point, once the two series for each country in the panel has been estimated, we proceed to the comparison between them. In addition to the correlation between the current account and the real effective exchange rate (see next section), another relevant comparison consists into testing the existence of a long run relationship between these two measures of equilibrium exchange rate. In other words, if there is a long run relationship (or a stationary linear combination) consistent with an eventual convergence from flow equilibrium (FEER) to stock-flow equilibrium (BEER).

In a previous study (Barisone et al., 2006), it has been shown that FEERs are cointegrated with real exchange rates (REERs). The implication of this is that the FEER approach represents an improvement over the purchasing power parity (PPP) in explaining medium to long term trends in the real exchange rate of the major industrialized countries. The FEER is a non-stationary process and it is cointegrated with real exchange rate; it represents an improvement over PPP insofar as it explains the long run trends followed by the real exchange rate. In addition, BEERs are cointegrated with REERs since the BEER aims to explain long run behavior of the REERs (Clark and MacDonald, 1998).

[Insert Table 1 about here]

Based on similar principles, we found that FEERs and BEERs are both unit root processes (table 1). The next step consists in using panel data techniques to test if a cointegration relationship between them. According to panel cointegration tests' results (Pedroni's cointegration tests), we strongly reject the null hypothesis of no cointegration at the 1% level (see Appendix A).

Therefore, given that the BEER and the FEER are integrated and cointegrated, we estimated the following long run equation:

$$feer_{i,t} = \alpha_i + \beta beer_{i,t} + \mu_{i,t} \qquad (13)$$

where variables in minuscule represents natural logarithms[8]. In order to estimate the long-run equation in a cointegrated panel, we implement the Fully Modified Ordinary Least square (FMOLS), a Dynamic Ordinary Least Square (DOLS) estimators (Pedroni, 2001) and the Pooled Mean Group (PMG) estimator (Pesaran et al., 1999).

[Insert Table 2 about here]

The results, presented in table 1, confirm that there is a long run relationship consistent with

[8] Even though our benchmark measure of BEER was obtained by the FMOLS estimation, the comparison was also performed using the alternative results obtained by the PMG methodology to ensure the robustness of our results.

an eventual convergence from the flow equilibrium (FEER) towards the stock-flow equilibrium (BEER). Indeed, as seen by the value the long-term coefficient, when the BEER increases (depreciates) by 1%, the FEER increases (depreciates) by around 0.8%. Yet, it is important to notice that the cointegration relationship between the FEER and the BEER do not imply convergence between them but rather the existence of a stable relationship among them. Indeed, the stationarity of the residuals imply that even though the two measures can diverge in the short run, in the long-run the two series are characterized by a constant, stable relationship. In Appendix B, we present the results of the long run relationship between FEERs and BEERs for emerging economies only. The results seem to be robust to different sub-periods and different groups of countries.

4. Comparison between FEER and BEER estimations

In terms of international monetary cooperation, the most relevant approach seems to be the FEER because it focuses on current account imbalances at medium term. In this context, the BEER seems to be less relevant because of its time horizon. Actually, the evidence suggests that assets stocks are not stabilized at medium term in percent of GDP, as the evolution of net foreign assets in industrialized and developing countries confirms it[9]. However a comparison between the BEER and the FEER estimations gives some interesting lighting.

This first diagnosis can be given by two indicators: a) the absolute average deviation between the FEER and the BEER and, b) the correlation coefficient between misalignments given by both approaches. According to our results, presented in table 2, the absolute average deviation is around 16% for all the countries, but it is smaller for two thirds of them. Similarly, the correlation coefficient is above 0.5 for two third of countries. An interesting feature is that the FEER and BEER give more divergent estimations, both in terms of correlation and deviation, for the three main emerging countries, namely, China, Brazil and India, but also during some periods for industrialized countries (USA in the middle of the 2000s, Japan at the beginning of 1980s). On the whole, they are more convergent for industrialized countries as well as for Mexico, Chile, Malaysia and Indonesia.

[Insert Table 3 about here]

A better understanding of the FEER and BEER divergence would be useful to enlighten economic policy debates on exchange rate policy and on more structural issues. For a simple analysis of their divergence (figure 1), it can be recalled that the BEER is obtained as the deviations of the observed exchange rate and the fundamentals, which are rather stable compared with the large fluctuations of the actual real exchange rates. Usually, a real appreciation above this mean value leads to an overvaluation and, inversely, a real depreciation leads to undervaluation. On the opposite, the FEER is associated to a rather stable current account balance. As a result, FEERs' misalignments reflect mainly deviations between the observed and the equilibrium current balance. Generally, a rising current account above the equilibrium value leads to an undervaluation and, inversely, a decreasing current account leads to an overvaluation.

Therefore, from the way they are defined, it follows that the FEER and BEER misalignments are consistent when the real effective exchange rate and the current account are closely connected (figures 1 and 2). As an illustration, we calculate the linear correlation coefficient

[9] This statement remains true even in the case where the medium term is defined as a period of five or ten years.

between the current account and real effective exchange rate for each of the countries in our sample. When the correlation is strong, the misalignments computed by the FEERs and BEERs follow the same path. On the contrary FEER and BEER diverge when real exchange rates and current account are more disconnected. Indeed, as seen in figure 3, which plots the average correlation between the current account and the exchange rate versus the correlation for the two series of misalignment, there is clearly a positive relationship between both. Indeed, whereas for some countries (as the USA) the evolution of the current account is closely related to its real exchange rate and, at the same time, the FEER and the BEER measures do not differ significantly, in Brazil, India and other countries there are very low correlations between current account and exchange rate, on the one hand, and between FEER and BEER, on the other.

[Insert Figure 1 about here]

[Insert Figure 2 about here]

[Insert Figure 3 about here]

FEER and BEER divergence can be better understood by taking into account two structural factors, the international prices' formation and its effects on current account on one hand, the valuation effect and its impact on net foreign assets on the other hand. These points will be illustrated successively by case studies.

First, for Japan, the most striking period of disconnection between FEERs' misalignments and BEERs' misalignments occurs during the first half of the 1980's. The current account increased from 1 to 4 percent of GDP in spite of a real effective appreciation of 40 percent between 1982 and 1986. In consequence, the FEER measure records an increasing undervaluation and the BEER measure a decreasing undervaluation (figure 1). This can be related to the strong disconnection which exists in Japan between real effective exchange rate measured with CPI index and export price competitiveness due to the nature of the Japanese international specialization. Japanese firms can preserve their export competitiveness for a rather long period in spite of the real revaluation of the yen (figure 4). This has been especially the case during the first part of the 1980s. The same observation can be made for the middle of the 1990s during which the overvaluation of the yen is more marked according to the BEER.

This divergence between export price competitiveness and CPI based real effective exchange rate is also strong in China during the 1980s and at the end of the 2000s. In the early 1980s the yuan strongly depreciated according to a CPI based real effective index, but without any improvement of export price competitiveness (figure 4). This could be explained by the poor quality of the Chinese international specialization at that time. With the beginning of trade openness, current surplus was replaced by deficit, which explains the evolution of FEERs' misalignments in sharp contrast with the BEERs' one. In a different economic context a disconnection can also be noticed at the end of the 2000s. The CPI real effective exchange rate appreciates moderately while export price competitiveness improves. Furthermore, Chinese non price competitiveness improves also a lot due to changes in the nature and the quality of export products, which explains the growing undervaluation of the yuan in the FEER approach.

[Insert Figure 4 about here]

Second, if the BEER is stable, it is influenced in the long run by structural factors, among which the NFA and also the relative productivity trends play a central role. In this sense, even though the NFAs are mainly determined by the cumulated current accounts they are also strongly influenced by valuation effects. These mechanisms (valuation effects, productivity gains) could be taken into account in complementing the previous analysis which was only focused on the real effective exchange rate and the current account. This could improve the understanding of divergences.

[Insert Figure 5 about here]

To illustrate the previous point, we analyze the divergence of the ERM measured by these two approaches for the U.S dollar in real effective terms between 2002 and 2006 (figure 1). Even though for the US the BEER and the FEER are closely related for the whole period, an important divergence is observed during these years. At the same time, it is precisely between 2002 and 2006 when the evolutions of the current account and of the net foreign asset are clearly disconnected. Indeed, whereas with a real depreciation of about 20% of the dollar, the deficit in the current account in the USA increased considerably, the net foreign assets position did not deteriorate in the same magnitude (figures 2 and 5) [10]. This disconnection between exchange rate, current account and the net foreign asset position during these years is at the heart of the disconnection between the two measures of equilibrium exchange rate: whereas the FEER indicates a growing overvaluation which corresponds to a growing U.S. current deficit until 2006, the BEER indicates a decreasing overvaluation which corresponds to a progressive stabilization of the NFAs due to the valuation effects.

Of course, some discrepancy can be due to the methodological differences between these two measures of equilibrium exchange rates. Yet, we center our attention in *short-run* deviations. Indeed, as a cointegration exists between the BEER and the FEER, short-run deviations may exist also due to discrepancies between the real effective exchange rate and the current account. The case of the United States is a clear example of a *short-run* deviation between the BEER and the FEER that cannot be due to the estimation technique.

Another interesting episode is the case of the Chinese yuan after the Asian crisis of 1997-98. Between 1997 and 1999, we observe a halving of the Chinese current surplus due to regional economic slowdown and currency devaluations in its major trading partners. The FEER measure indicates a sharp decrease of the yuan real undervaluation which corresponds to the current account decrease. On the contrary, the BEER indicates a rather stable undervaluation on this period (around 25 %) which corresponds to a net external position above its structural value and to a rather stable real effective exchange rate (figures 2 and 5).

[Insert Figure 6 about here]

Indeed, the effects of the NFA being in discordance to the current account are another explanation for the temporal divergence between the flow equilibrium and the stock-flow equilibrium (i.e. the FEER and the BEER). As before, this can be better illustrated by plotting average correlations between the NFA and the current account, and the misalignments (figure 6).

[10] It has been proposed (Blanchard et al., 2005) that this situation reflects the effects of exchange revaluation of assets denominated in foreign currencies owned by U.S. residents

In sum, BEER and FEER misalignments are closely related when the current account reacts to movements in the real exchange rate. However the dynamic of foreign asset positions, valuation effects and structural changes in matter of competitiveness could alter the relation between FEER and BEER.

5. Conclusion

The objective of this study was to understand the temporal links between the two main measures of equilibrium exchange rate, namely the BEER and the FEER approaches. In order to do so, we analyzed carefully the temporal dimension and we test empirically a unified theoretical framework, inspired from Driver and Westaway (2005), which posits a positive and significant long run relationship between the flow equilibrium (the FEER) and the stock-flow equilibrium (the BEER).

To avoid serious misinterpretations, it is important to underline that we are dealing with *two concepts of equilibrium exchange rate* (FEER / BEER), which correspond to two different time horizons (the medium term / the long term) and two goals of macroeconomic policy (the stabilization of the current account balance / the stabilization of the net external position) that can *temporarily diverge*.

Our results show that, in average, the two measures are closely related. Yet, important differences can be observed for some countries and/or some periods of time. Therefore, we identified several factors which are able to alter the relation between the FEER and the BEER, This factors are mainly temporal disconnections between the current account and the real effective exchange rate, which are probably the result of structural changes in matter of competitiveness, as it is the case in Japan in the first half of the 80s, the dynamic of foreign asset positions, and valuation effects, as in the USA between 2002-2006.

It is important to mention that we based our analysis on the links between current account and NFA position in order to explain the temporal divergence between the BEER and the FEER. Yet, the internal balance can also play a role through the link between potential output and relative productivity as explained in equations (9) and (10). This is an interesting topic which deserves further attention.

Finally, as mentioned before, our conclusions point to the fact that there are, sometimes, temporary divergences between the BEER and the FEER measures of misalignment. Yet, the fact that they may diverge reflects structural factors such as the international prices' formation and its effects on current account or/and the valuation effect and its impact on net foreign assets. This is important if the two approaches for assessing misalignments are used for policy decisions as, for example, setting tariffs in order to cope with the "currency war".

Appendix A

[Insert Table A1 about here]

Appendix B

[Insert Table B1 about here]

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Table 1: Panel unit root tests

Test:	*LLC*	*Breit.*	*F_ADF*	*F_PP*	*LLC*	*Breit.*	*F_ADF*	*F_PP*
Difference:	No	No	No	No	Yes	Yes	Yes	Yes
Exogenous variable:	None	None	None	None	None	None	None	None
Null Hypothesis:	UR	UR	UR	UR	UR	UR	UR	UR
Common UR:	Yes	Yes	No	No	Yes	Yes	No	No
$feer_{i,t}$	1.7	1.9	9.1	9.9	-17.4***	-13.7***	312.8***	363.9***
$beer_{i,t}$	1.4	1.6	15.5	9.1	-18.2***	-15.5***	331.2***	394.9***

Notes: "UR" indicates the null hypothesis of the presence of unit root. The symbol *** indicates statistical stationarity at the 1 percent level. The table shows different panel unit root tests: Levin, Lin, and Chu (2002) (LLC); Breitung (2000); Maddala and Wu (1999) and Choi (2001) Fischer-type panel unit root tests (F_ADF and F_PP).
Source: authors' calculations.

Table 2: Long run relationship between FEERs and BEERs

	Long Run Coefficient (β)	*P-value*
FMOLS[1]	0.88***	0.00
DOLS[2]	0.72***	0.00
PMG[3]	0.92***	0.00
Hausman test	0.55	0.45
Number of cross-sections	17	-
Number of periods	26	-
Number of observations	442	-

Notes: (1) FMOLS is the Fully Modified OLS estimation; (2) DOLS is the Dynamic OLS estimation; (3) PMG is the Pooled Mean Group estimation. The symbol *** indicates statistical significance at the 1 percent level. The null hypothesis in the Hausman test is homogeneity of the long run coefficient in the PMG estimation.
Source: authors' calculations

Table 3: FEER and BEER matrix

		Absolute average deviation[1]	
		Below Average	*Above Average*
Correlation[2]	*Above 50 %*	USA, Euro area, Japan, Mexico, Korea, Indonesia, Malaysia, Chile	Argentina, Colombia, Uruguay
	Below 50 %	UK, Philippines, Thailand	China, Brazil, India

Notes: (1) The absolute average deviation corresponds to the absolute average difference between the FEER and the BEER; (2) The correlation is the correlation between FEER's and BEER's misalignments.
Source: authors' calculations.

Table A.1: Panel cointegration test between the natural logarithm of the FEER and the natural logarithm of the BEER on the 1982-2007 period

Pedroni residual cointegration test (1999)	
Null Hypothesis: No cointegration	
Included observations	442
Cross-sections included	17
Alternative hypothesis: common AR coefficients (within-dimension)	
Panel-v	-2.62
Panel-rho	-2.40***
Panel-PP	-4.14***
Panel-ADF	-5.11***
Alternative hypothesis: individual AR coefficients (between-dimension)	
Group rho-Statistic	0.17
Group PP-Statistic	-2.02**
Group ADF-Statistic	-3.10***

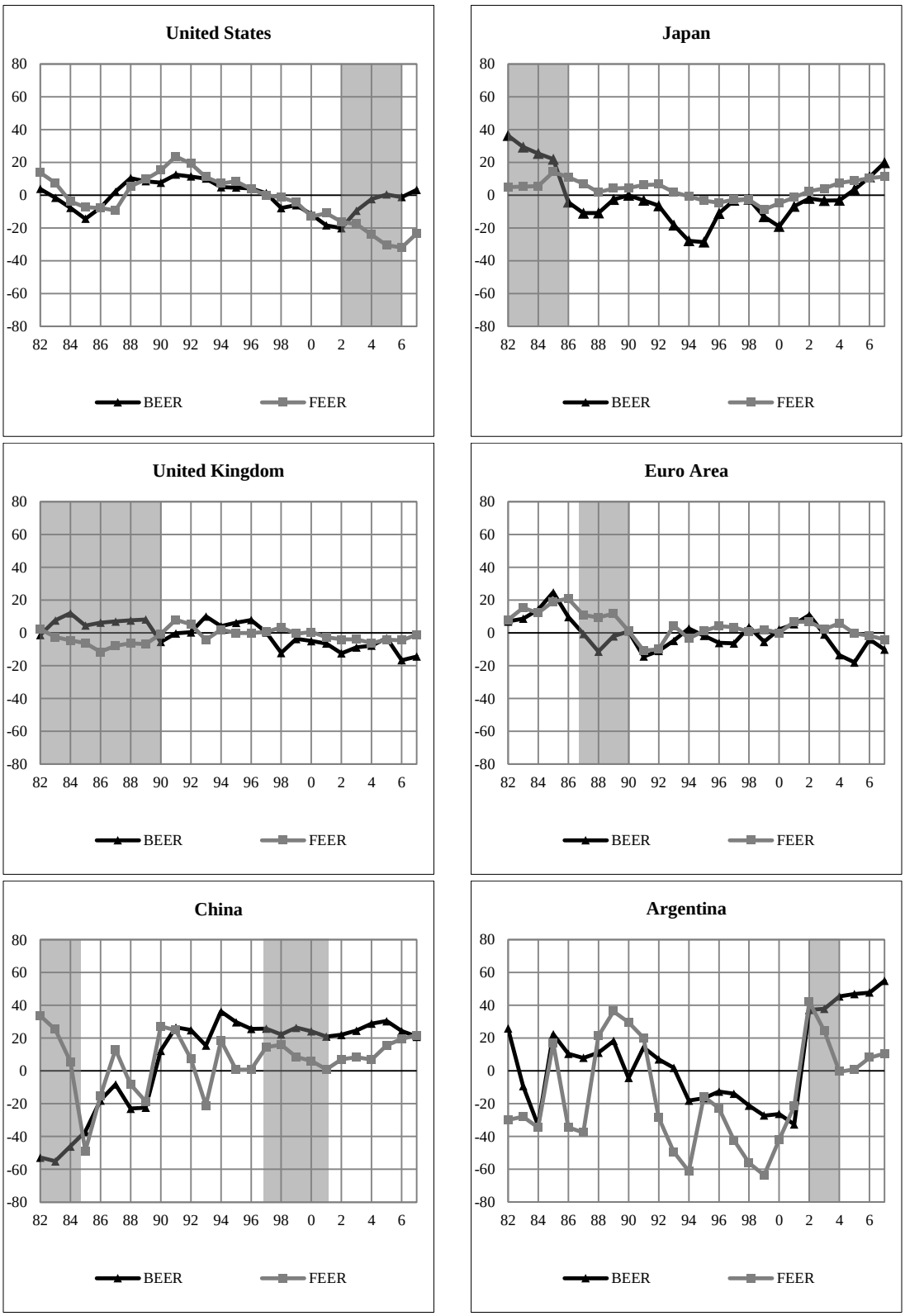
Notes: The symbols *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. ***Reject null of nonstationarity even at the 1% level; **Reject null of nonstationarity at the 5% level.
Source: authors' calculations.

Table B.1: Long run relationship between FEERs and BEERs on the 1982-2007 period (emerging countries only)

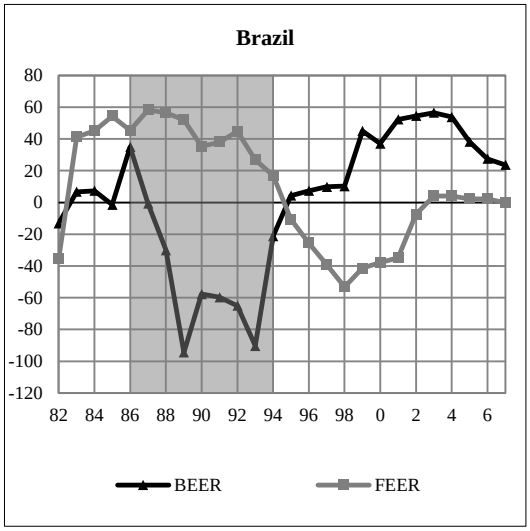
	Long Run Coefficient (β)	*P-value*
FMOLS[1]	1.06***	0.00
DOLS[2]	0.88***	0.00
PMG[3]	0.87***	0.00
Hausman test	0.03	0.86
Number of cross-sections	13	-
Number of periods	26	-
Number of Observations	338	-

Notes: (1) FMOLS is the Fully Modified OLS estimation; (2) DOLS is the Dynamic OLS estimation; (3) PMG is the Pooled Mean Group estimation. The symbol *** indicates statistical significance at the 1 percent level. Under the null hypothesis of the Hausman test, we accept the hypothesis of homogeneity of the long run coefficient for the PMG estimation.
Source: authors' calculations.

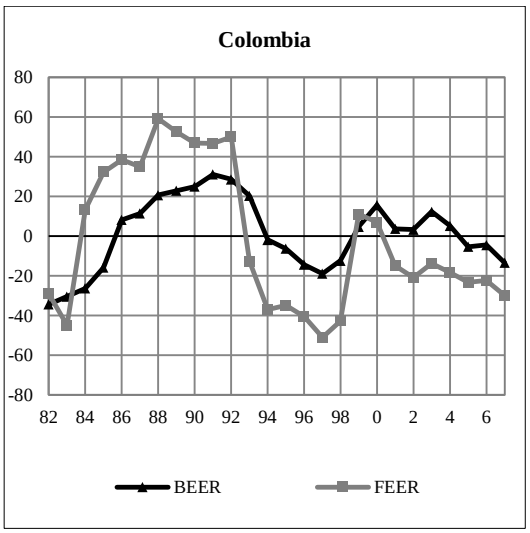
Figure 1: BEERs and FEERs' misalignments (in %)[11]

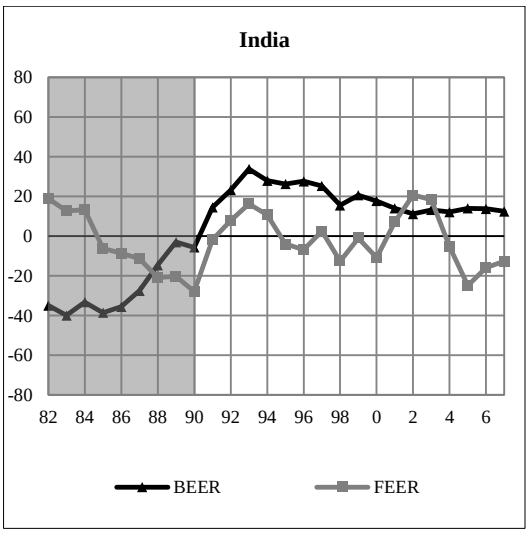


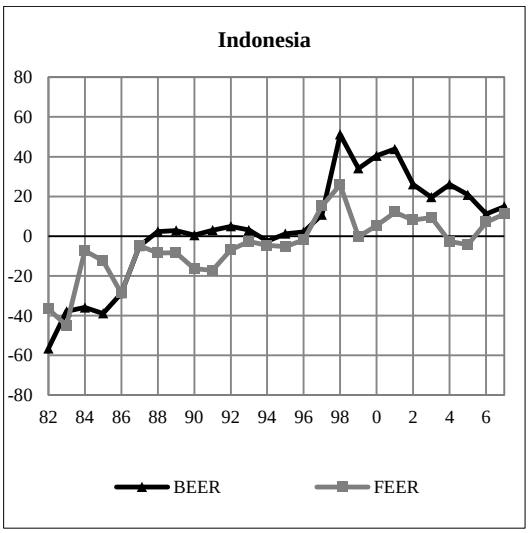
[11] A positive number indicates an undervaluation, and a negative one, an overvaluation.


Brazil
80
60
40
20
0
-20
-40
-60
-80
-100
-120
82 84 86 88 90 92 94 96 98 0 2 4 6
BEER
FEER

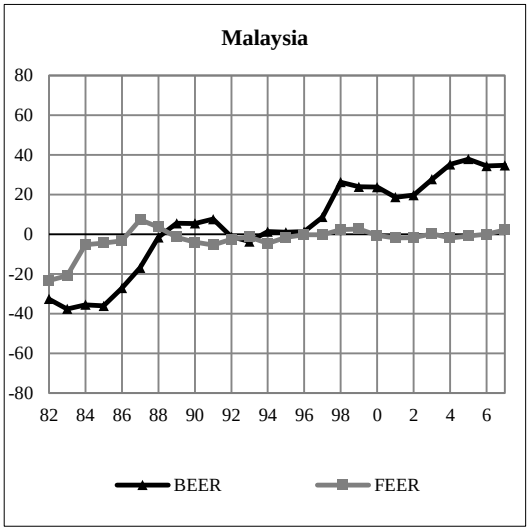

Chile
80
60
40
20
0
-20
-40
-60
-80
82 84 86 88 90 92 94 96 98 0 2 4 6
BEER
FEER

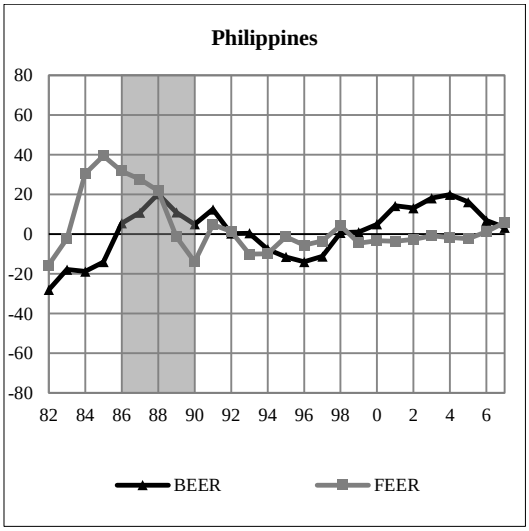

Colombia
80
60
40
20
0
-20
-40
-60
-80
82 84 86 88 90 92 94 96 98 0 2 4 6
BEER
FEER

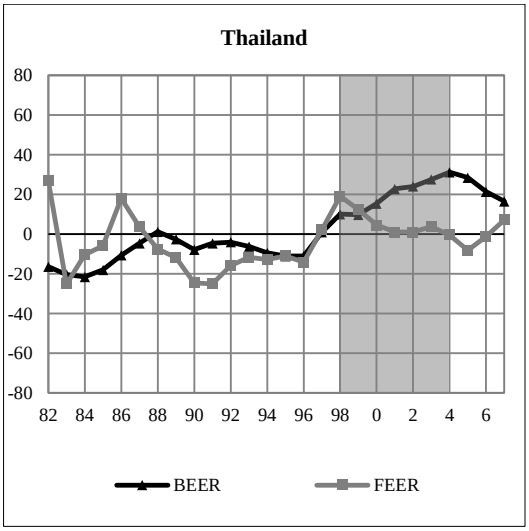

India
80
60
40
20
0
-20
-40
-60
-80
82 84 86 88 90 92 94 96 98 0 2 4 6
BEER
FEER

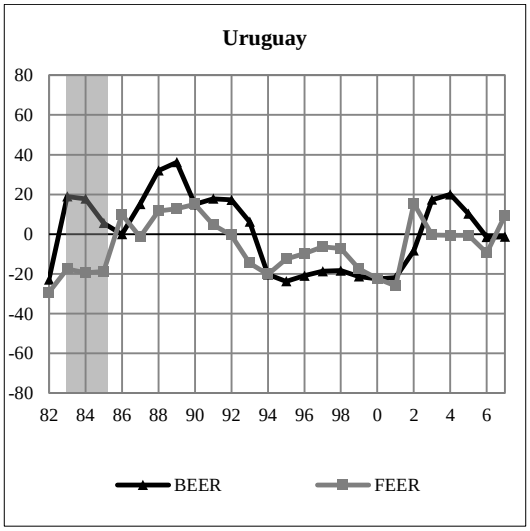

Indonesia
80
60
40
20
0
-20
-40
-60
-80
82 84 86 88 90 92 94 96 98 0 2 4 6
BEER
FEER


Korea
80
60
40
20
0
-20
-40
-60
-80
82 84 86 88 90 92 94 96 98 0 2 4 6
BEER
FEER



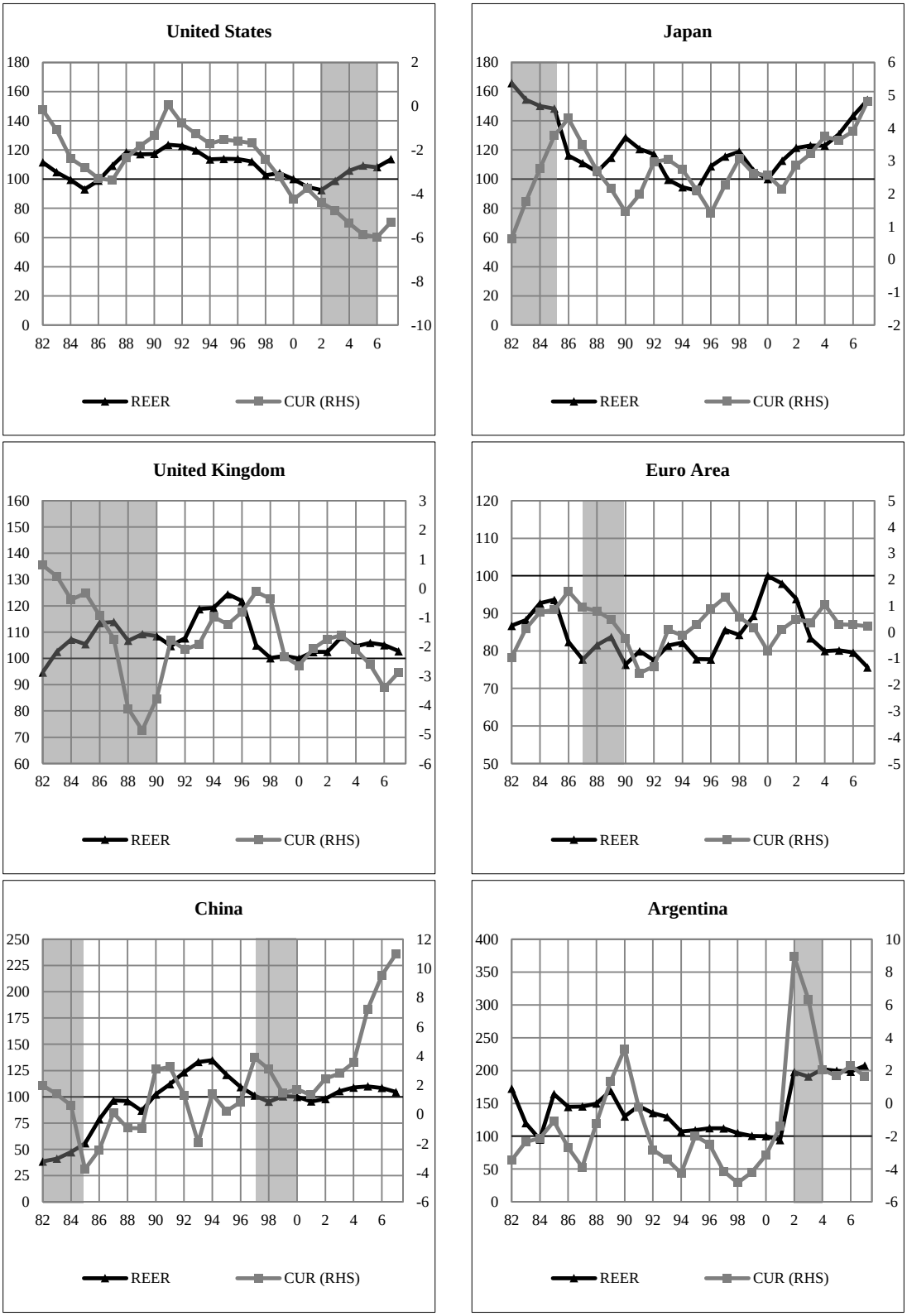


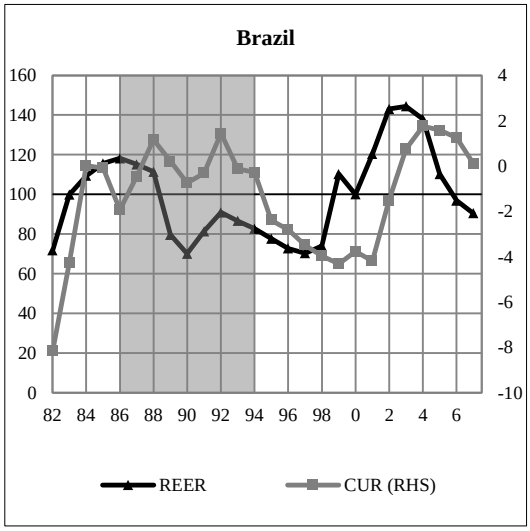


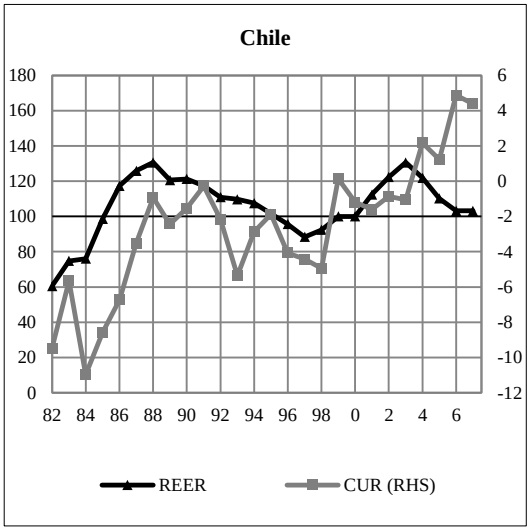


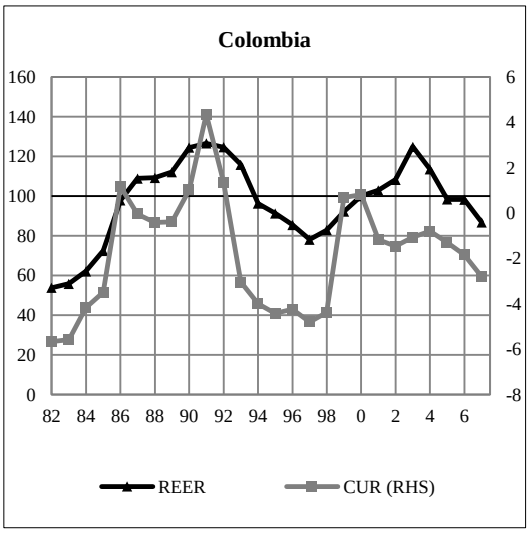
(Source: authors' calculations)

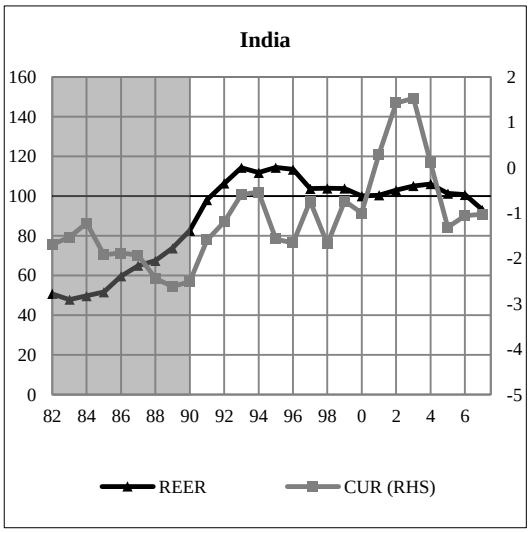
Figure 2: Real effective exchange rates (REER) and current account (CUR)

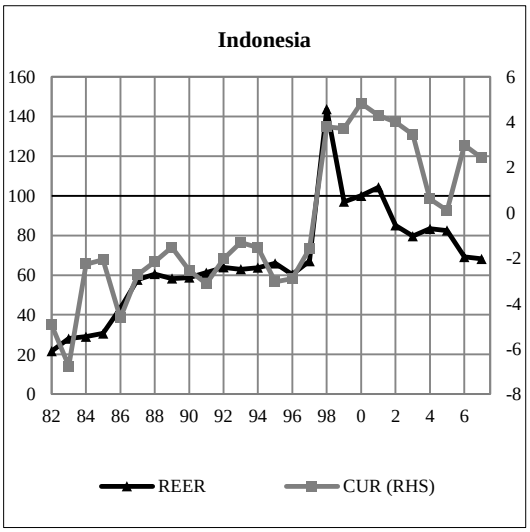


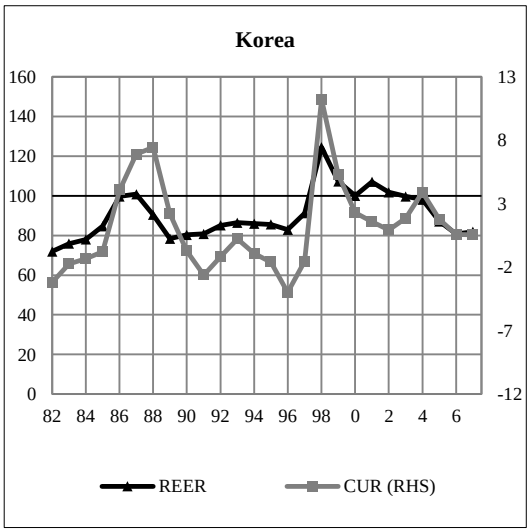

Brazil
160
140
120
100
80
60
40
20
0
4
2
0
-2
-4
-6
-8
-10
82 84 86 88 90 92 94 96 98 0 2 4 6
REER
CUR (RHS)

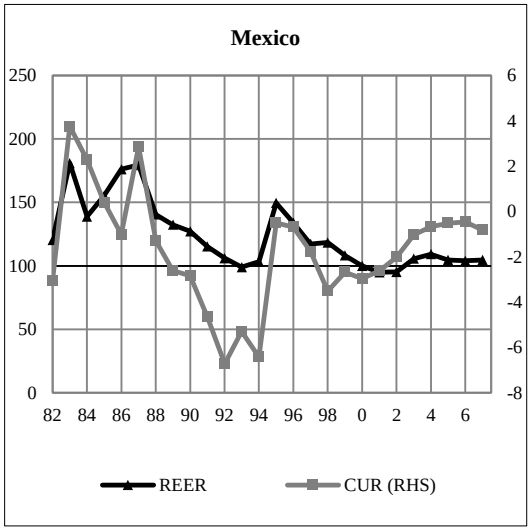

Chile
180
160
140
120
100
80
60
40
20
0
6
4
2
0
-2
-4
-6
-8
-10
-12
82 84 86 88 90 92 94 96 98 0 2 4 6
REER
CUR (RHS)

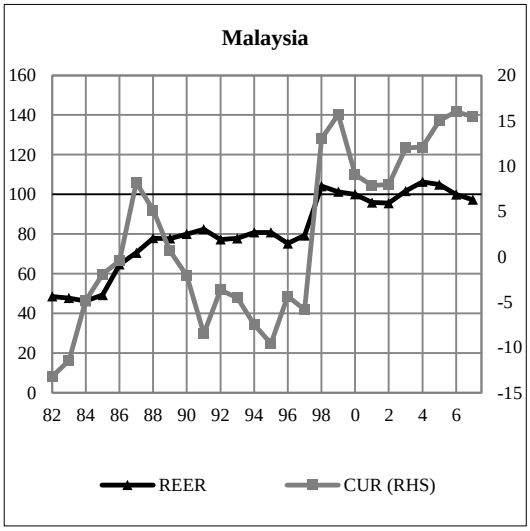

Colombia
160
140
120
100
80
60
40
20
0
6
4
2
0
-2
-4
-6
-8
82 84 86 88 90 92 94 96 98 0 2 4 6
REER
CUR (RHS)

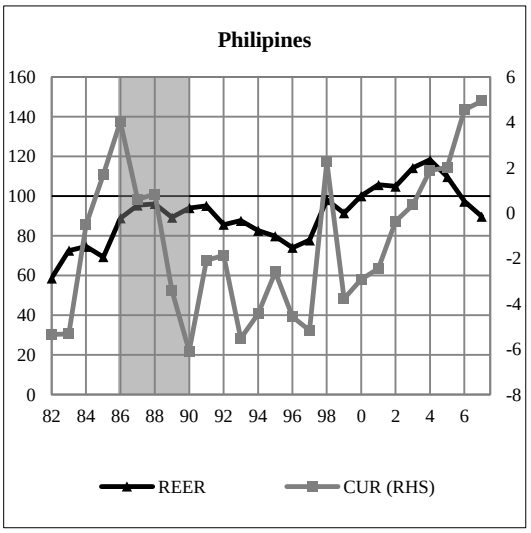

India
160
140
120
100
80
60
40
20
0
2
1
0
-1
-2
-3
-4
-5
82 84 86 88 90 92 94 96 98 0 2 4 6
REER
CUR (RHS)

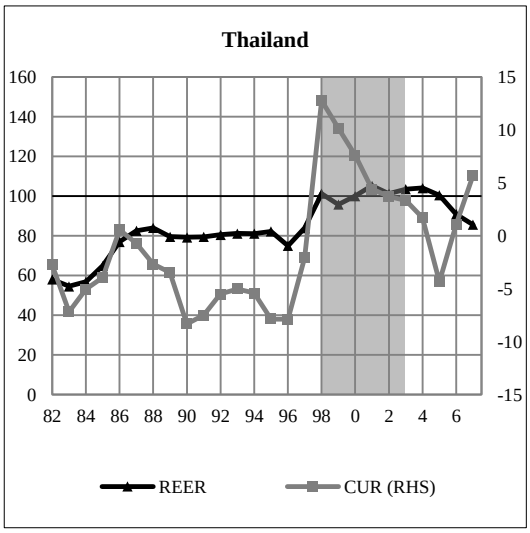

Indonesia
160
140
120
100
80
60
40
20
0
6
4
2
0
-2
-4
-6
-8
82 84 86 88 90 92 94 96 98 0 2 4 6
REER
CUR (RHS)

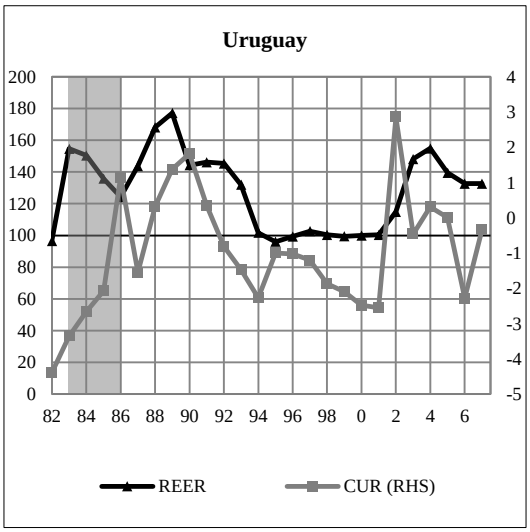

Korea
160
140
120
100
80
60
40
20
0
13
8
3
-2
-7
-12
82 84 86 88 90 92 94 96 98 0 2 4 6
REER
CUR (RHS)





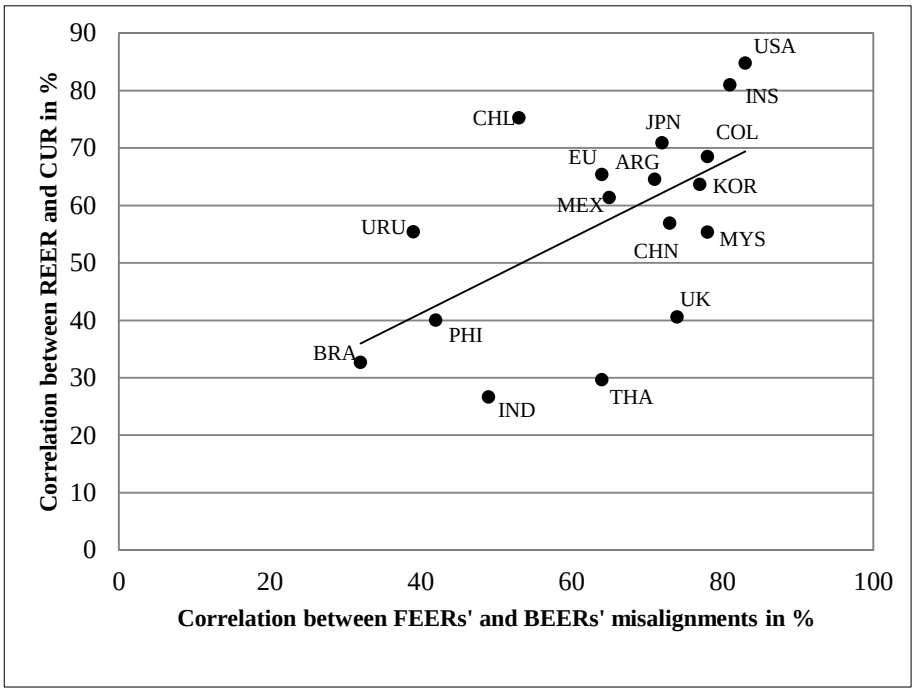






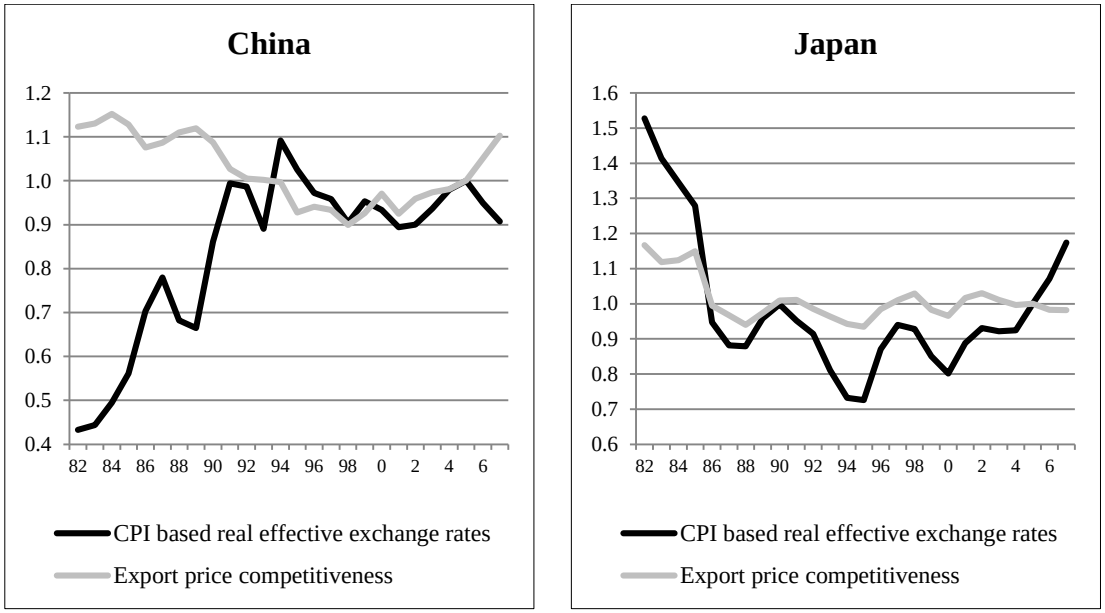
(Source: International Monetary Fund (World Economic Outlook, April 2010) for the observed current account as % of GDP, Bank for International Settlements for the real effective exchange rate basis 100 in 2000 (annual average of monthly data))

Figure 3: Correlation between real effective exchange rate and current account versus correlation between BEER and FEER misalignments



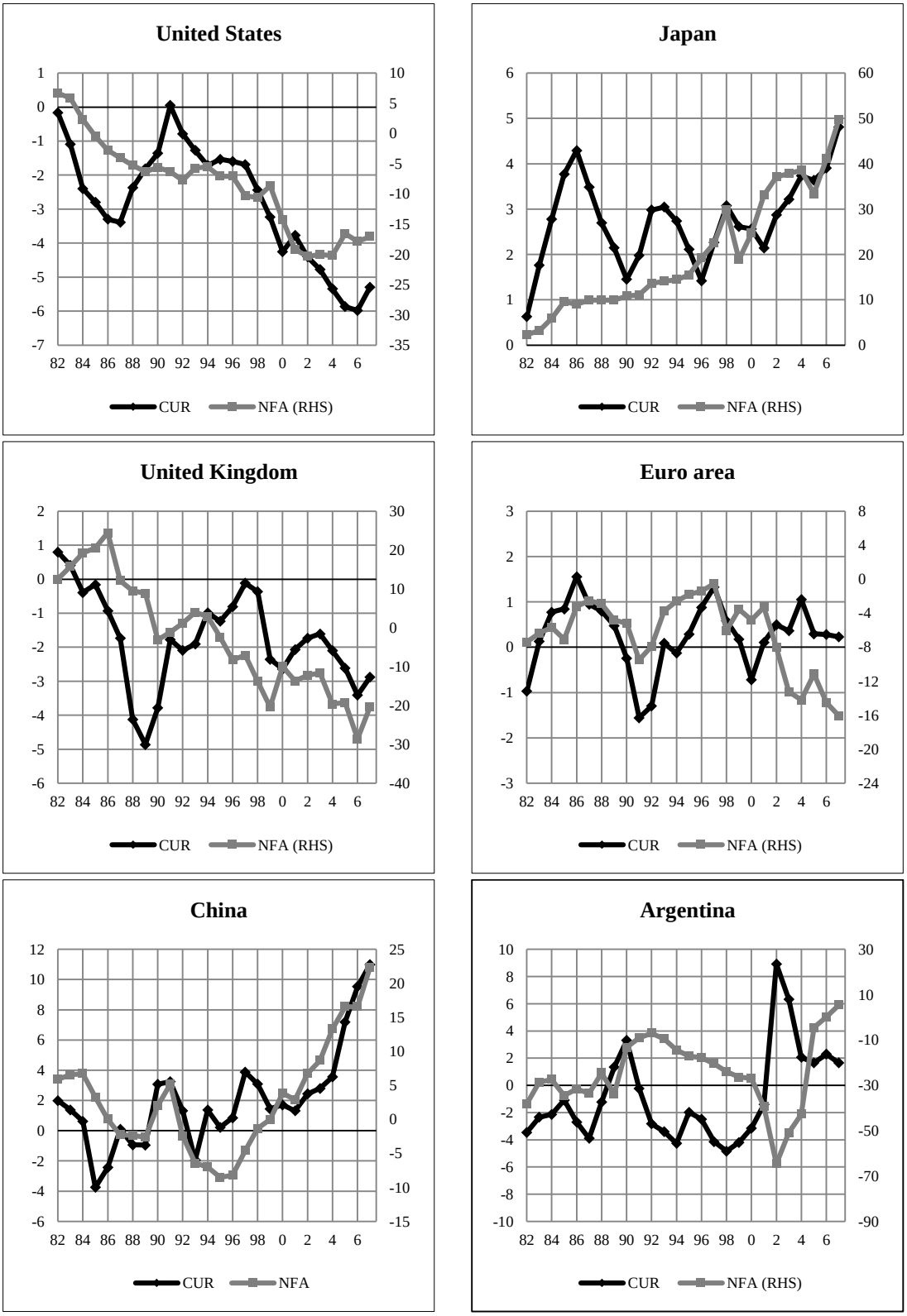
(Source: authors' calculations)

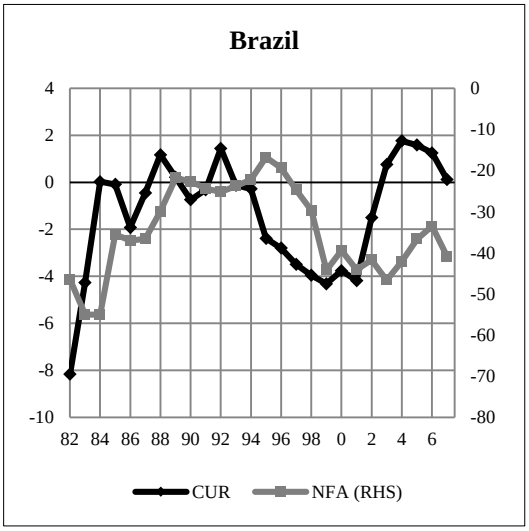
Figure 4: Export price competitiveness and CPI based real effective exchange rates

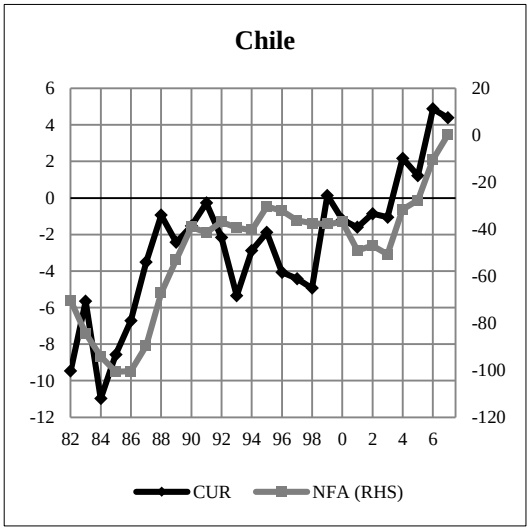


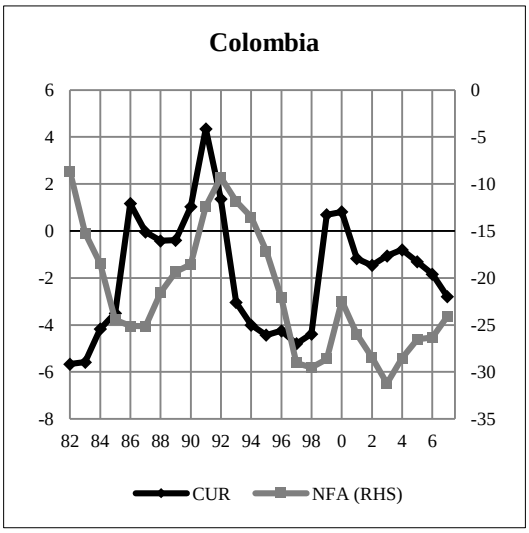
(Source: Bank for International Settlements for the real effective exchange rate basis 1 in 2005 (annual average of monthly data), authors' calculations for the export price competitiveness basis 1 in 2005)

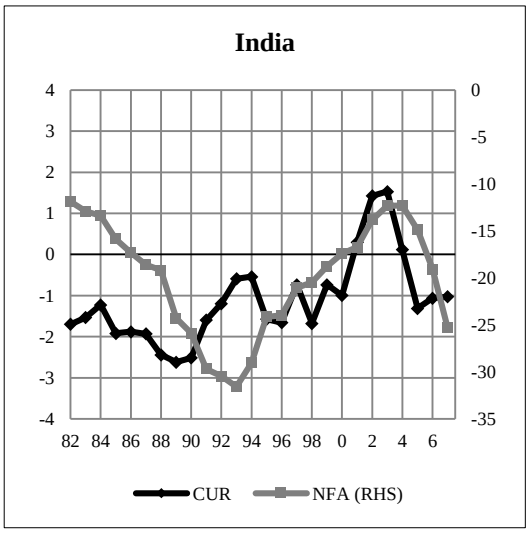
Figure 5: Current account (CUR) and Net Foreign Assets (NFA) in % of GDP

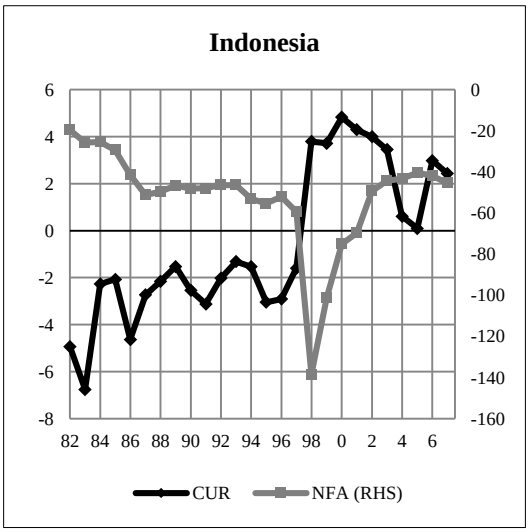


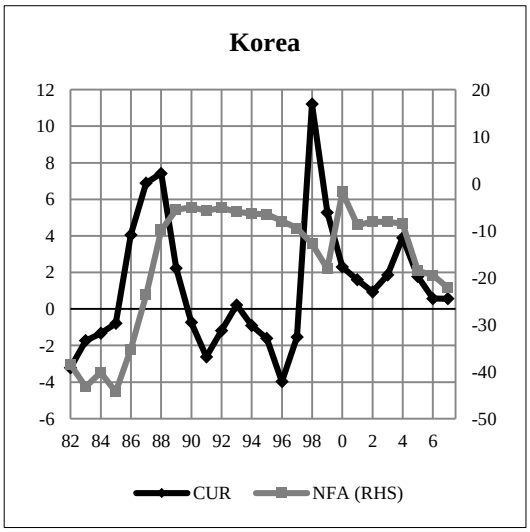

Brazil
4 2 0 -2 -4 -6 -8 -10
0 -10 -20 -30 -40 -50 -60 -70 -80
82 84 86 88 90 92 94 96 98 0 2 4 6
CUR
NFA (RHS)

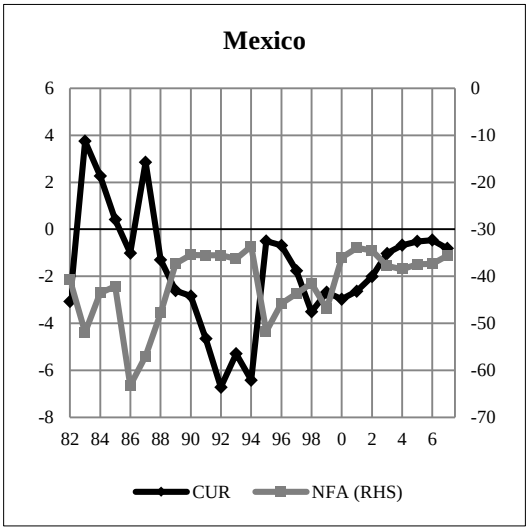

Chile
6 4 2 0 -2 -4 -6 -8 -10 -12
20 0 -20 -40 -60 -80 -100 -120
82 84 86 88 90 92 94 96 98 0 2 4 6
CUR
NFA (RHS)

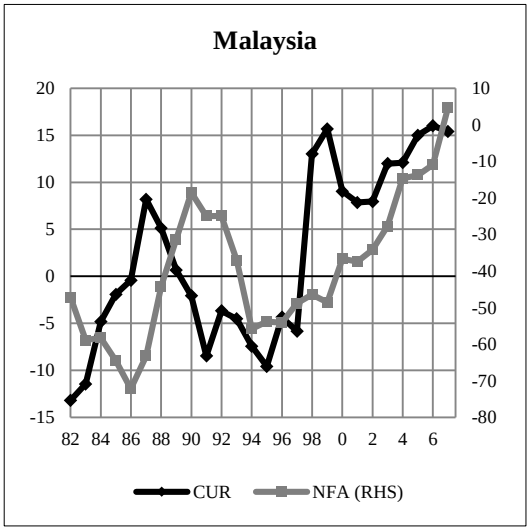

Colombia
6 4 2 0 -2 -4 -6 -8
0 -5 -10 -15 -20 -25 -30 -35
82 84 86 88 90 92 94 96 98 0 2 4 6
CUR
NFA (RHS)

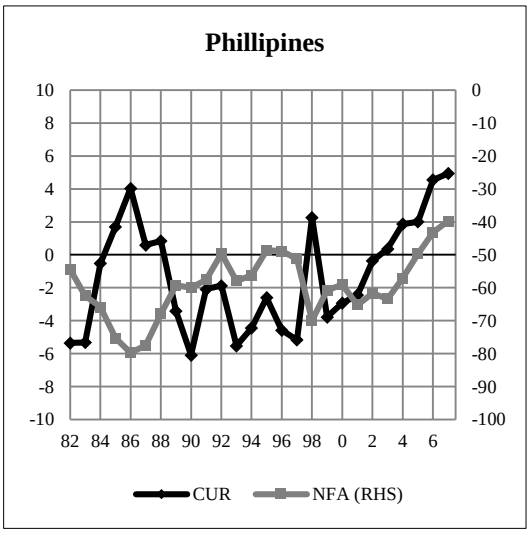

India
4 3 2 1 0 -1 -2 -3 -4
0 -5 -10 -15 -20 -25 -30 -35
82 84 86 88 90 92 94 96 98 0 2 4 6
CUR
NFA (RHS)

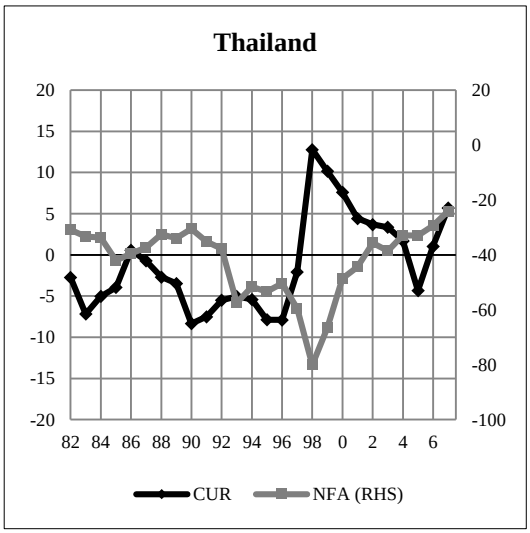

Indonesia
6 4 2 0 -2 -4 -6 -8
0 -20 -40 -60 -80 -100 -120 -140 -160
82 84 86 88 90 92 94 96 98 0 2 4 6
CUR
NFA (RHS)

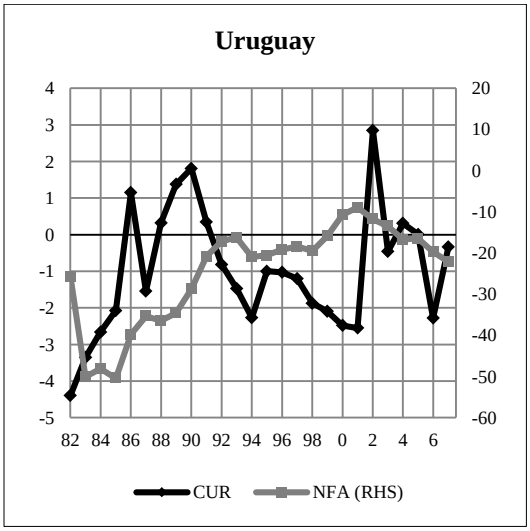

Korea
12 10 8 6 4 2 0 -2 -4 -6
20 10 0 -10 -20 -30 -40 -50
82 84 86 88 90 92 94 96 98 0 2 4 6
CUR
NFA (RHS)





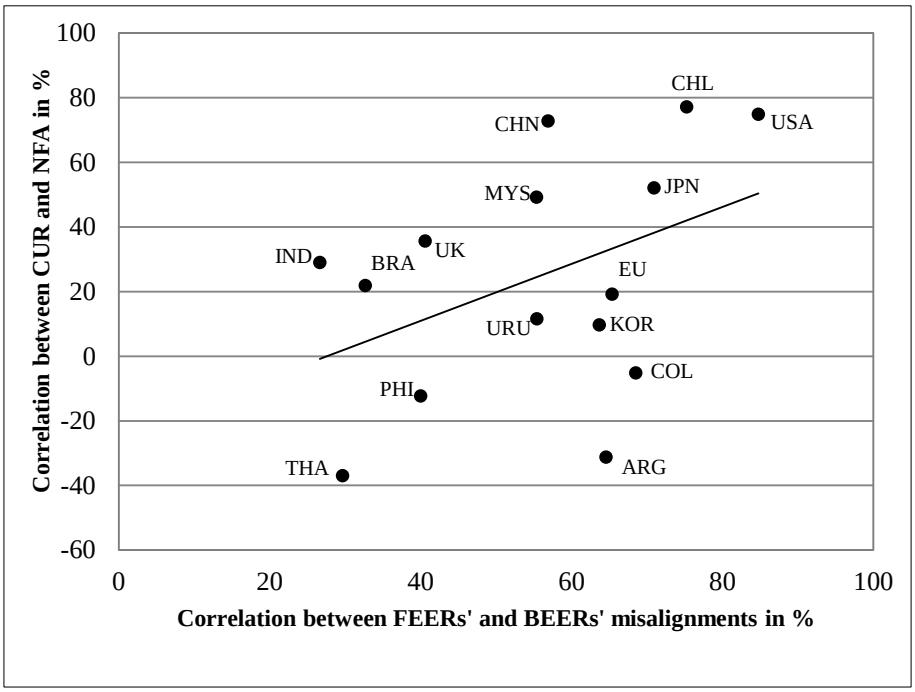






(Source: International Monetary Fund (World Economic Outlook, April 2010) for the observed current account as % of GDP, P.R. Lane and G.M. Milesi-Ferretti's Database (2009) for the net foreign asset as % of GDP)

Figure 6: Correlation between current account and NFA position versus correlation between BEER and FEER misalignments



(Source: authors' calculations)