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Equilibrium Exchange Rates: a Guidebook for the Euro-Dollar Rate
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EQUILIBRIUM EXCHANGE RATES: A GUIDEBOOK FOR THE EURO-DOLLAR RATE

SUMMARY

Assessing the level of exchange rates encounters a number of difficulties. The most immediate one is to define what is meant by "equilibrium" exchange rates. There are two polar views on this issue. The first one considers that, to the extent that they are determined by market forces, observed exchange rates are always at a market equilibrium. This short-term, market equilibrium relies on fundamentals and on expectations about fundamentals. Why then worry about this short-run equilibrium? The reason is that this market-equilibrium exchange rate can be submitted to noise and speculative bubbles, hence it can largely differ from its "fundamental" value.

At the other extreme, the purchasing power parity theory (PPP, hereafter) considers price equalization as the appropriate long-run benchmark, at least for advanced economies. Thanks to the availability of very long time series and of panel cointegration techniques, there is now consensus of the literature that PPP holds in the very long run amongst advanced economies. However, deviations from PPP are long to be reversed (Rogoff, 1996). Additionally, PPP is silent on the way global imbalances can be unwound: it does not address the issue of the United States temporarily having to experience a weak dollar in order to raise its net foreign asset position towards some sustainable path.

From a practical perspective, then, these two extreme views – market equilibrium, and PPP – are of limited usefulness, since they do not address medium-term concerns about global imbalances. Therefore, a large research avenue has been developed to provide medium to long-run norms for the real exchange rate. The bottom line of these approaches is that, despite full capital mobility, current-account imbalances cannot grow forever, so some kind of exchange-rate adjustment will be needed at some point, although it is difficult to provide a timetable. The Fundamental Equilibrium Exchange Rate (FEER) pioneered by Williamson (1985), the Behavioral Equilibrium Exchange Rate (BEER) proposed by MacDonald (1997) and Clark and MacDonald (1998), and the Natural Equilibrium Exchange Rate (NATREX) introduced by Stein (1994) are probably the most popular approaches in this vein, and they are routinely used by the International Monetary Fund for exchange-rate assessment (see IMF, 2006).

In parallel, the buoying literature on global imbalances (e.g. Obstfeld and Rogoff, 2004; Blanchard et al., 2005; Gourinchas and Rey, 2007; Lane and Milesi-Ferretti, 2007) has developed largely aside from that on equilibrium exchange rates, although one outcome of this literature is to provide estimations of exchange-rate adjustments that are needed to unwind global imbalances.

In this paper, different views of equilibrium exchange rates are compared within a single, stock-flow adjustment framework. We show how each concept corresponds to a particular horizon, illustrating this through the euro-dollar case. We estimate a simple model of net foreign asset position (NFA) for a panel of 15 countries over the 1980-2005 period. Then, we calculate current-account targets defined in order to have net foreign asset positions adjust to their equilibrium levels in a given number of years. Equilibrium exchange rates are then derived based on these current-account targets. We further evidence the sensitivity of FEER

estimations to underlying assumptions concerning asset prices. We compare these FEER estimates with BEER estimations based on the same equilibrium NFAs. It is concluded that, although more robust to alternative assumptions, the BEER approach may rely on excessive confidence on past behaviors in terms of portfolio allocation. Symmetrically, FEERs may underestimate the plasticity of international capital markets because they focus on the adjustment of the trade balance. Finally the BEER and the FEER appear as complementary views of equilibrium exchange rates as they depict different moods of foreign exchange markets that are used to put unequal focus on current-account adjustment over time.

ABSTRACT

In this paper, we investigate different views of equilibrium exchange rates within a single, stock-flow adjustment framework. We then compare FEER and BEER estimations of equilibrium exchange rates based on the same, econometric model of the net foreign asset position, with special focus on the euro-dollar rate. These estimations suggest that, although more robust to alternative assumptions, the BEER approach may rely on excessive confidence on past behaviors in terms of portfolio allocation. Symmetrically, FEERs may underestimate the plasticity of international capital markets because they focus on the adjustment of the trade balance.

JEL Classification: F31, C23.
Keywords: equilibrium exchange rates, euro-dollar, FEER, BEER, global imbalances.

TAUX DE CHANGE D'ÉQUILIBRE : UN GUIDE POUR LA PARITÉ EURO-DOLLAR

RÉSUMÉ LONG

Il est très difficile de porter un jugement sur le niveau des taux de change. La raison la plus évidente est qu'il faut définir pour cela un concept de taux de change d'"équilibre". Dans ce domaine, on peut adopter deux points de vue polaires. Le premier considère que, dans la mesure où le taux de change est fixé sur un marché, le taux observé correspond à un équilibre qui prend en compte les fondamentaux de l'économie et les anticipations sur les fondamentaux futurs. Pourquoi, alors, s'inquiéter de cet équilibre de court terme ? Parce que cet équilibre peut être soumis à du bruit et à des bulles spéculatives, écartant le taux de change de son niveau "fondamental".

A l'autre extrême, la théorie de la parité des pouvoirs d'achat (PPA) retient l'égalisation des prix comme la norme pertinente à long terme, au moins pour les économies avancées. Grâce au développement des techniques de cointégration en panel, allié à une plus grande disponibilité des données sur longue période, la littérature dans ce domaine tend maintenant à accréditer la PPA comme force de rappel à long terme pour les économies avancées. Cependant les écarts par rapport à la PPA mettent du temps à se résorber. En outre, la PPA est silencieuse sur la question des déséquilibres mondiaux. Par exemple, elle ne s'intéresse pas au fait que le dollar doive temporairement être faible de manière à ramener la position extérieure nette américaine vers un sentier soutenable.

En pratique, ces deux visions extrêmes – l'équilibre de court terme et la PPA – sont donc d'une utilité limitée dans la mesure où elles ne traitent pas les questions de moyen terme relatives à la résorption des déséquilibres mondiaux. De ce fait, une vaste littérature s'est développée pour proposer des normes de moyen ou long terme pour les taux de change réels. La pierre angulaire de ces approches est que, en dépit d'une parfaite mobilité du capital, les déséquilibres des balances courantes ne peuvent croître indéfiniment, ce qui suppose à un moment donné un certain ajustement du taux de change, bien qu'il soit délicat de prévoir un agenda précis. Le taux de change d'équilibre fondamental (ou FEER) introduit par Williamson (1985), le taux de change d'équilibre comportemental (ou BEER) proposé par MacDonald (1997) et Clark et MacDonald (1998) ainsi que le taux de change réel naturel (ou NATREX) de Stein (1994) sont sans doute les approches les plus utilisées dans ce domaine. Elles sont d'ailleurs régulièrement mises en œuvre par le FMI .

Concomitamment, une littérature foisonnante est apparue sur la question des déséquilibres mondiaux (Obstfeld et Rogoff, 2004 ; Blanchard et al., 2005 ; Gourinchas et Rey, 2007 ; Lane et Milesi-Ferretti, 2007). De manière suprenante, cette littérature s'est développée en marge de celle relative aux taux de change d'équilibre. Pourtant, un des enjeux majeurs est bien d'évaluer les ajustements de taux de change nécessaires à la résorption de ces déséquilibres.

Nous comparons ici plusieurs approches de taux de change d'équilibre dans le cadre d'un modèle d'ajustement stock-flux unique. Ce modèle nous permet de montrer que chaque concept correspond à un horizon temporel particulier, ce que nous illustrons sur le cas euro-dollar. A partir d'un modèle économétrique donnant la position extérieure nette de chacun des 15 pays de notre panel en fonction de ses déterminants fondamentaux sur la période 1980 - 2005, nous calculons des cibles de compte courant permettant un ajustement des po-

sitions extérieures nettes à leurs niveaux d'équilibre en un nombre d'années donné. Nous montrons la sensibilité des calculs de FEER qui en découlent aux hypothèses sur la valorisation des actifs et nous comparons ces estimations avec des estimations de BEER fondées sur les mêmes positions extérieures nettes. Notre principale conclusion est que, bien qu'elle soit plus robuste aux différentes hypothèses, l'approche BEER repose peut-être trop sur les comportements passés des marchés en matière d'allocation des portefeuilles. Symétriquement, l'approche FEER sous-estime la plasticité des marchés de capitaux en se focalisant sur l'ajustement de la balance commerciale. *In fine*, les modèles FEER et BEER apparaissent plus complémentaires que réellement antagonistes dans la mesure où ils rendent compte des différentes réactions possibles des marchés des changes selon l'importance accordée aux ajustements de la balance courante dans le temps.

RÉSUMÉ COURT

Dans cet article, nous analysons différents concepts de taux de change d'équilibre dans le cadre d'un modèle unifié d'ajustement stock-flux. Nous comparons alors des estimations FEER et BEER du taux de change d'équilibre fondées sur le même modèle économétrique de détermination de la position extérieure nette, en mettant l'accent sur le taux euro-dollar. Ces estimations suggèrent que, bien qu'elle soit plus robuste aux différentes hypothèses, l'approche BEER repose peut-être trop sur les comportements passés des marchés en matière d'allocation des portefeuilles. Symétriquement, l'approche FEER sous-estime la plasticité des marchés de capitaux en se focalisant sur l'ajustement de la balance commerciale.

EQUILIBRIUM EXCHANGE RATES: A GUIDEBOOK FOR THE EURO-DOLLAR RATE

Agnès Bénassy-Quéré,[1] *Sophie Béreau*[2] *and Valérie Mignon*[3]

1 Introduction

The empirical literature on exchange rates has suffered long-lasting depression since the celebrated paper by Meese and Rogoff (1983) showing that no macro-econometric model is able to outperform the simple random walk, i.e. that the best prediction of the exchange rate is the present, observed rate. This view has hardly been challenged so far (see Cheung et al., 2005). During this time, however, the old purchasing power parity (PPP, hereafter) theory, which predicts that the price of a given consumption basket in different countries should converge in the long run, has experienced a surprising come-back. Indeed, thanks to the availability of very long time series and of panel cointegration techniques, the new consensus of the literature is that PPP holds in the very long run amongst advanced economies, although deviations from PPP are long to be reversed (the half-life of deviations from PPP is typically of 4 years, see Rogoff, 1996).[4]

Based on these two strands of the literature - the random walk view, and the PPP theory - two extreme approaches to equilibrium exchange rates can be derived: the short-term, market view, which states that, with free capital mobility, the observed exchange rate is a market equilibrium that summarizes all available information, including long-run sustainability issues; and the very long-run view, which poses PPP as a long-run attractor.

From a practical perspective, however, these two views are of limited usefulness, since they basically say that exchange rates are unpredictable, except in a remote, very-long run. Therefore, a large research avenue has been developed to provide medium to long-run norms for the real exchange rate. The bottom line of these approaches is that, despite full capital mobility, current-account imbalances cannot grow forever, so some kind of exchange-rate adjustment will be needed at some point, although it is difficult to provide a timetable. The Fundamental Equilibrium Exchange Rate (FEER) pioneered by Williamson (1985), the Behavioral Equilibrium

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[4]Allowing for non-linear adjustment, or for goods heterogeneity, some authors come out with lower half-lives. See, e.g., Imbs et al. (2005).

Exchange Rate (BEER) proposed by MacDonald (1997) and Clark and MacDonald (1998), and the Natural Equilibrium Exchange Rate (NATREX) introduced by Stein (1994) are probably the most popular approaches in this vein, and they are routinely used by the International Monetary Fund for exchange-rate assessment (see IMF, 2006).

Surprisingly, the buoying literature on global imbalances (e.g. Obstfeld and Rogoff, 2004; Blanchard et al., 2005; Gourinchas and Rey, 2007; Lane and Milesi-Ferretti, 2007) has developed largely aside from that on equilibrium exchange rates, although one outcome of this literature is to provide estimations of exchange-rate adjustments that are needed to unwind global imbalances.

In this paper, different views of equilibrium exchange rates are compared within a single, stock-flow adjustment framework. We show how each concept corresponds to a particular horizon, illustrating this through the euro-dollar case. We estimate a simple model of net foreign asset position (NFA) for a panel of 15 countries over the 1980-2005 period. Then, we calculate current-account targets defined in order to have net foreign asset positions adjust to their equilibrium levels in a given number of years. Equilibrium exchange rates are then derived based on these current-account targets. We further evidence the sensitivity of FEER estimations to underlying assumptions concerning asset prices. We compare these FEER estimates with BEER estimations based on the same equilibrium NFAs. It is concluded that, although more robust to alternative assumptions, the BEER approach may rely on excessive confidence on past behaviors in terms of portfolio allocation. Symmetrically, FEERs may underestimate the plasticity of international capital markets because they focus on the adjustment of the trade balance. Finally the BEER and the FEER appear as complementary views of equilibrium exchange rates as they depict different moods of foreign exchange markets that are used to put unequal focus on current-account adjustment over time.

The paper is organized as follows. Section 2 discusses the various concepts of equilibrium within a single, stock-flow model. Section 3 derives PPP exchange rates for the euro against the USD. Section 4 then presents a unified methodology for calculating FEERs and BEERs. Section 5 discusses the results. Section 6 concludes.

2 Theoretical overview

One very general way of classifying equilibrium exchange-rate models is to consider the real exchange rate q_t at time t as a function of (*i*) a vector of economic "fundamentals" Z_t, (*ii*) a vector of transitory factors T_t and (*iii*) a random disturbance ϵ_t (see MacDonald, 2000; Driver and Westaway, 2004):

$$q_t = \beta' Z_t + \theta' T_t + \epsilon_t \tag{1}$$

where β, θ are vectors of coefficients. Three equilibrium concepts can then be derived:

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- Short-run equilibrium:

$$q_t^{SR} = \beta' Z_t + \theta' T_t \qquad (2)$$

- Medium-run equilibrium:

$$q_t^{MR} = \beta' Z_t \qquad (3)$$

- Long-run equilibrium:

$$q_t^{LR} = \beta' \bar{Z}_t \qquad (4)$$

where $\bar{Z}_t$ is the long-run equilibrium value of Z_t.

The crucial point then is to disentangle fundamentals, transitory factors and random disturbances. To do so, it is useful to start, as in MacDonald (2000), from the equilibrium of the balance of payments. Using the same notations as in Lane and Milesi-Ferretti (2002):

$$tb_t + ki_t + tr_t = ko_t \qquad (5)$$

where tb_t denotes the trade balance, ki_t net capital income, tr_t current transfers[5] and ko_t the amount of net capital outflows, all expressed in percentage of GDP (i.e. dollar values divided by nominal dollar GDP). The trade balance can be expressed as a function of both domestic and foreign output gaps (y_t and y_t^*), the (log of the) relative price of foreign tradables in terms of domestic ones, e_t, and the logarithm of terms of trade, tot_t:

$$tb_t = \alpha_1 e_t - \alpha_2 y_t + \alpha_3 y_t^* + \alpha_4 tot_t \qquad (6)$$

where α_1, α_2, α_3, $\alpha_4 > 0$. In turn, net interest receipts can be expressed as the product of the world nominal interest rate i_t^* and the net foreign asset position at the end of the last period, nfa_{t-1} (in percentage of GDP), corrected for the growth rate of nominal GDP, γ_t:[6]

$$ki_t = i_t^* \frac{nfa_{t-1}}{1 + \gamma_t} \qquad (7)$$

Finally, net capital outflows depend on the difference between the value, in t, of the net foreign asset position inherited from the previous period, $nfa_{t-1|t}$, and the desired level of net holdings in t. Again, we follow Lane and Milesi-Ferretti (2002) and denote kg_t^* the rate of capital gains or losses on the net foreign asset position, assuming the rate of capital gains is the same on gross assets and liabilities and are expressed here in US dollars. The value of the NFA position inherited from the previous period is:

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[5]Here, net labour income is included in tr_t so as to restrict ki_t to net interest receipts.

[6]γ_t and i_t^* represent a return rate and a growth rate in USD. Here the interest rate on gross foreign assets is assumed to be equal to that on gross foreign liabilities. We come back to this assumption in Appendix A.

$$nfa_{t-1|t} = (1 + kg_t^*) \frac{nfa_{t-1}}{1 + \gamma_t} \tag{8}$$

$nfa_{t-1|t}$ must be compared with desired net holdings that depend on the expected interest-rate differential. This yields:

$$ko_t = k \left(\overline{nfa} + \mu \Delta r_t^e - \frac{1 + kg_t^*}{1 + \gamma_t} nfa_{t-1} \right) \tag{9}$$

where $\overline{nfa}$ represents the desired net foreign asset position in the absence of expected return differential, $\mu > 0$ is the sensitivity of desired net foreign assets to the expected return differential, $k > 0$ represents the adjustment speed of asset holdings, and Δr_t^e is the expected return differential:

$$\Delta r_t^e = r_t^* + \Delta q_t^e - r_t \tag{10}$$

where r_t, r_t^* represent the real return rates at home and abroad, respectively, and $\Delta q_t^e = q_t^e - q_t$ denotes the expected real exchange-rate variation.[7] The relative price of foreign tradables in terms of domestic ones derives from these three equations:

$$e_t = \frac{1}{\alpha_1} \left(k(\mu \Delta r_t^e + \overline{nfa} - nfa_{t-1|t}) - \frac{i_t^*}{1 + \gamma_t} nfa_{t-1} - tr_t + \alpha_2 y_t - \alpha_3 y_t^* - \alpha_4 tot_t \right) \tag{11}$$

The net foreign asset position at the end of period t, nfa_t, is a pre-determined variable that evolves over time based on the following stock-flow relationship (see Lane and Milesi-Ferretti, 2002):

$$nfa_t = (1 + i_t^* + kg_t^*) \frac{nfa_{t-1}}{1 + \gamma_t} + tb_t + tr_t \tag{12}$$

Rearranging Equation (12), we get:

$$\Delta nfa_t = \frac{i_t^* + kg_t^* - \gamma_t}{1 + \gamma_t} nfa_{t-1} + tb_t + tr_t \tag{13}$$

where $\Delta nfa_t = nfa_t - nfa_{t-1}$.

Then, it is necessary to account for non-tradables. Denoting e_t^{NT} the (log of the) ratio of relative price of domestic non-tradables in terms of domestic tradables at home and abroad[8], it can be shown that, conditional on inter-industry labor mobility within each country:[9]

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[7]q_t is the logarithm of the real exchange rate expressed as the relative price of the foreign consumption basket in terms of the domestic one.

[8]i.e. $e_t^{NT} = \left((p_t^{NT} - p_t^T) - (p_t^{*NT} - p_t^{*T}) \right)$, where p is the log of the price index and the NT, T subscripts represent the non-tradable and tradable sectors, respectively, the $*$ subscript representing foreign variables.

[9]See MacDonald (2000).

$$e_t^{NT} = z_t \tag{14}$$

where z_t represents the (log of the) relative productivity of the tradable-goods and the non-tradable goods sector, relative to the rest of the world:

$$z_t = \left(\pi^T - \pi^{NT}\right) - \left(\pi^{T*} - \pi^{NT*}\right) \tag{15}$$

π^T, π^{NT} denote the (log of) productivity in the tradable and in the non-tradable sectors, respectively. Equations (14) and (15) together state that productivity catch-up in traded goods should be accompanied by a rise in the relative price of non-tradables because the latter sector suffers from an increase in domestic wages without a rise in productivity similar to that in the traded-goods sector (Balassa-Samuelson effect).[10] If η denotes the share of tradables in the economy, the logarithm of the real exchange rate can be written as:

$$q_t = e_t - (1 - \eta)e_t^{NT} \tag{16}$$

Plugging (11) and (14) into (16), we get:

$$q_t = f\left(\overset{+}{\Delta r_t^e}, \quad \overset{-}{tot_t}, \quad \overset{+}{(\overline{nfa} - nfa_{t-1|t})}, \quad \overset{-}{nfa_{t-1}}, \quad \overset{-}{tr_t}, \quad \overset{+}{y_t}, \quad \overset{-}{y_t^*}, \quad \overset{-}{z_t} \right) \tag{17}$$

where the signs of the partial derivatives are indicated on the top of each explanatory variable.[11] This general formulation states that the domestic currency should depreciate in real terms (q_t should rise) following a rise in the expected return differential on assets denominated in foreign currencies, a fall in terms of trade, a decline in the net foreign asset position compared to the desired one, a rise in the domestic output gap, a fall in the foreign output gap or a fall in relative productivity in tradables compared to the rest of the world. We now need to distribute the explanatory variables detailed in Equation (17) into the T_t, Z_t and $\bar{Z}_t$ vectors.

- In the *very long run*, prices and stocks have adjusted to equilibrium and productivity levels are equalized. In Equation (17), this translates into $y_t = y_t^* = 0$, $z_t = 0$, $\Delta r_t^e = 0$ and $nfa_t = nfa_{t-1} = \overline{nfa}$. Note that the latter condition does not rule out net capital outflows: with $\Delta r_t^e = 0$ and $nfa_{t-1} = \overline{nfa}$, Equation (9) yields:

$$ko_t = k\left(1 - \frac{1 + kg_t^*}{1 + \gamma_t}\right)\overline{nfa} \tag{18}$$

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[10]An alternative interpretation of this effect is that a positive shock on productivity in the tradable sector leads to a rise in intertemporal income, hence on the demand for both tradables and non-tradables. Because non-tradables cannot be imported, their relative price rises, which amounts to an exchange-rate appreciation. See, e.g., Schnatz et al. (2003).

[11]The impact of i_t^*, which depends on the sign and magnitude of the NFA position, is omitted here.

For example, a country with a positive equilibrium NFA position will experiment permanent capital outflows if GDP growth exceeds capital gains. In the very long run, however, due to perfect arbitrage across markets, α_1 can be thought as infinite in Equation (6). Hence, net capital outflows and the NFA position have no impact on the real exchange rate in the very long run (see Equation (11)): q_t is a constant value, which amounts to purchasing power parity:

$$q_t = constant \tag{19}$$

- In the *long run*, only prices and stocks have adjusted. Output gaps have been closed ($y_t = y_t^* = 0$) and the expected return differential is zero (or equal to a constant risk premium), but productivity catch-up is still under way ($z_t \neq 0$), whereas the net foreign asset position is at its equilibrium level: $nfa_t = nfa_{t-1} = \overline{nfa}$.[12] Plugging Equation (6) into (13) with $y_t = y_t^* = 0$ and $\Delta nfa_t = 0$, we get:

$$e_t = -\frac{1}{\alpha_1}\left(\frac{i_t^* + kg_t^* - \gamma_t}{1 + \gamma_t}\overline{nfa} + tr_t + \alpha_4 tot_t\right) \tag{20}$$

Equation (20), which is embodied in (17), points to a depreciation of the real exchange rate when the NFA position falls, because the trade balance must be higher to compensate for lower interest receipts. Accounting for non-tradables, the real exchange rate also depends on the relative level of productivity in both sectors, with productivity catch-up implying real exchange-rate appreciation (see Equation (16)).

- In the *medium run*, neither stocks nor productivities are at their equilibrium level. Only domestic prices have adjusted, which means that output gaps have been closed. Net capital outflows can be positive or negative (see Equation (9)). Consistently, the current account must be positive in the former case, negative in the latter one, which has implications for the relative price of tradables. Indeed, plugging (9), (7) and (6) into (5), and holding $y_t = y_t^* = 0$, we get:

$$e_t = \frac{1}{\alpha_1}\left[k\left(\overline{nfa} + \mu\Delta r_t^e - \frac{1 + kg_t^*}{1 + \gamma_t}nfa_{t-1}\right) - \frac{i_t^*}{1 + \gamma_t}nfa_{t-1} - tr_t - \alpha_4 tot_t\right] \tag{21}$$

which, again, can be combined with the Balassa-Samuelson effect. For instance, large net capital inflows can justify an appreciated exchange rate in the medium run, even if the NFA position is already negative. This is not the case in the long run where a negative NFA position normally leads to a depreciated currency.

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[12]As it will be made clear in the empirical section, the equilibrium NFA position itself can move slowly over time due to structural factors, including economic catch up.

- In the *short run*, finally, prices have not adjusted, which means that output gaps have not been closed and that the real exchange rate is not stabilized. Hence, the equilibrium exchange rate is the solution of Equation (17) with all variables at their observed, short-run values. This rate can be viewed as the short-run fundamental market rate.

3 The very long run: PPP

In the very long run, there is no reason that the level of prices should differ across economically integrated countries. Indeed, when a good is tradable, its price should equalize across countries by virtue of the law of one price. If some price differentials do survive, this must be due to transportation costs, tariffs and other trade barriers, or market imperfections such as imperfect information or monopolistic power, and price differentials must stabilize at a relatively low level in the long run.

Even in the non-traded goods sector (such as personal services), price equalization should hold in the very long run. This is because (i) due to labor mobility between sectors, hourly wages converge across sectors, and (ii) the international diffusion of technological and organizational progress leads to an equalization of productivity in every sector.

Such equalization of wages and prices across the world in the very long run meets the idea of purchasing power converging upward in the very long term.

Capital mobility can accelerate convergence towards PPP if international capital flows are driven by return differentials: if wages and prices are lower in one location, the marginal productivity of capital is higher and capital will move to this location, pushing wages and prices upwards. However risk aversion speeds down this mechanism, because higher capital return is generally associated with higher risk. When productivity convergence is achieved, real returns equalize; the net foreign asset position of each country only corresponds to risk diversification and no longer weighs on the real exchange rate which is at its PPP level.

In the 1980's, economists would usually argue that PPP does not hold even in the long run. This conclusion was based on time-series analyses of key exchange rates over the 1970's and 1980's. Since the 1990's, longer-time and higher-frequency series, together with the use of panel-data analysis (both of which involve an increase in the number of observations included in the regressions), have led to a different conclusion. It has increasingly been recognized that there is some mean-reversion towards a stable real exchange rate among the most advanced economies, although the convergence is very slow: on average, it takes three to five years to close half of the gap between the real exchange rate and its long-term value (Rogoff, 1996). This means that if the exchange rate is overvalued by 10% one given year, it will still be overvalued by 5% after 3-5 years, other things equal. Hence, deviations from PPP are of little help to predict the exchange rate in the medium run. Nevertheless, price comparisons remain of crucial importance for industries since they offer a broad picture of price competitiveness.

Table 1: PPP exchange rate: USD per euro in 2007

Country	WDI consumer (1)	OECD consumer (2)	Big Mac (3)	BLS manuf. (4)	Eurostat manuf. (5)	Eurostat all (6)
France	1.16	1.12	-	0.99	0.94	0.81
Germany	1.13	1.14	-	0.78	0.92	0.89
Italy	1.23	1.17	-	1.15	1.24	1.01
Spain	1.28	1.30	-	1.35	1.54	1.40
Euro area	–	–	1.10	–	1.09	1.04

Sources: World Development Indicators 2007; OECD Economic Outlook 81, 2007; The Economist, February 2007; US Bureau of Labor Statistics, April 2007.

Table 1 reports the PPP value of the euro-dollar, i.e. the nominal euro-dollar exchange rate that would have equalized prices across the Atlantic in 2007. The first two columns display traditional measures of PPP exchange rates that are calculated relying on consumer prices (hence, measuring relative purchasing powers). Column (3) adds the "Big Mac" PPP measure, i.e. the exchange rate that would have equalized the price of a "Big Mac" in February 2007 in the Euro area and in the United States. Finally, Columns (4)-(6) present cost measures of PPP exchange rates, namely the bilateral exchange rate that would have equalized the hourly cost of labor in the manufacturing sector (or in the entire economy) to its level in the United States, at end 2007.

Three conclusions emerge from Table 1. First, consumption-based measures of the bilateral, PPP exchange rate are relatively close for Germany and France - between 1.12 and 1.16 USD for one euro - but the measure based on labor costs leads to a somewhat lower PPP value for the euro in France and Germany (lower than unity). With an average value of 1.35 in 2007, this means that the euro was over-valued by 16-20% against the USD in terms of consumer prices but more in terms of labor costs. Of course, the high cost of labor in Germany does not necessarily translate in high unit labor costs, i.e. high labor costs per unit of output, because hourly productivity is generally found higher in Germany and France than in the United States, and because European producers may choose a more capital-intensive technology. For a multinational firm, however, differences in labor costs are crucial since the same technology can roughly be used in any advanced economy with the same productivity.

Second, the PPP value of the euro is higher and more homogenous across the different measures for Italy and especially Spain, with an over-valuation in 2007 limited to 10-17% in Italy and 0-5% in Spain.

Finally, the "Big Mac" index delivers a somewhat lower equilibrium value of the euro (1.10 USD) than comparisons of aggregate consumer prices.

4 The medium to long run: FEERs and BEERs

4.1 FEERs versus BEERs

As highlighted in Section 2, medium and long-run concepts of equilibrium exchange rates all rely on the equilibrium of the balance of payments, albeit with different assumptions on whether explanatory variables are at their equilibrium levels or not. Consistently, the literature has followed two different avenues to calculate equilibrium exchange rates.

The first concept is the *Fundamental Equilibrium Exchange Rate* (FEER), a medium-run concept of equilibrium launched by Williamson (1985).[13] It is derived from Equation (5) with net capital outflows ko_t exogenously set at a "target" level that corresponds to "sustainable" net capital outflows ("external balance") and output gaps set at zero ("internal balance"). The current-account target can rely on structural factors (a structural model of saving-investment imbalance)[14], on real return differentials, or on specific information on the countries. The stock-flow adjustment (Equation (13)) is not explicitly accounted for in the basic version of the FEER, although current-account targets can be set so that the net foreign asset (NFA) position comes back to a "sustainable", or "desired" level.[15] As a matter of fact, except if the current account target is designed to ensure NFA stability, the FEER does not rely on a constant NFA position. As such, it is a medium-run rather than long-run concept.

There are two ways of calculating FEERs. The first one consists in estimating the coefficients of the trade-balance equation (6). Then, an "adjusted" current-account balance can be calculated by setting output gaps to zero (internal balance). It is this adjusted balance that is compared to the current-account target, the latter being defined exogenously. Finally, the FEER is calculated by inverting the current-account equation and deriving the real exchange rate that would bring the adjusted current account to its target level. This amounts to using Equation (21) where the term under brackets is calculated separately based on the current-account target. This first methodology is used for instance by the International Monetary Fund for its assessments of exchange rates (see IMF, 2006), or by the Institute for International Economies in Washington (Cline and Williamson, 2007).

The second methodology for calculating FEERs relies on macro-econometric models. As in the first one, current-account targets are defined and the output gap is set to zero. But here, the FEER is derived from simulating the multi-equation macroeconomic model. The main advantage of this second methodology is that all significant transmission channels are accounted for, including cross-border interactions as well as supply-side effects. This second approach is used for instance by the National

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[13]On the origins of Williamson's approach, see Isard (2007).

[14]See, e.g., Williamson and Mahar (1998).

[15]A variant of the FEER is the Natural Real Exchange Rate (NATREX) developed by Stein (1994, 2006) where the target current account is estimated based on structural determinants of saving and investment, notably the NFA position and the capital stock, which leads to accounting for stock-flow adjustments. In the following, we propose to reconcile the FEER with the stock-flow adjustment by estimating a target level for the NFA position rather than for the current account balance.

Institute for Economic and Social Research in London, based on its macro model NIGEM (Barrell et al., 2007).

The second research avenue, pioneered by Faruqee (1995), MacDonald (1997) and Clark and MacDonald (1997, 2000), relies on the direct estimation of Equation (17). Because it is considered as a long-run relationship, this equation is estimated with cointegration techniques. Then, the *Behavioral Equilibrium Exchange Rate* (BEER) is derived as the prediction of the estimated equation, and exchange-rate misalignments are calculated by comparing the BEER with the observed exchange rate. One can either derive a long-run BEER or a medium-run one by setting explanatory variables at their equilibrium or observed values (Equations (11) and (20), respectively). The strength of this second approach is that, by construction, a deviation from the cointegration relationship will tend to be progressively reversed, albeit at a speed that can be relatively slow. Hence, there is a force in the market that will push the exchange rate back to its BEER level, which can then be considered as a target level. This strength comes along with a weakness, since a relationship estimated on the past may no longer be valid over the future, due for instance to structural breaks in institutions (e.g. foreign exchange structural changes) or portfolio choices (e.g. diversification of official reserves, change in fly-to-quality standards, etc). The IMF also uses the BEER approach for exchange-rate assessment (IMF, 2006).

Because it relies on a cointegration relationship, the BEER approach generally provides equilibrium exchange rates that are closer to observed rates than in the FEER approach. However, the differences between the two views should not be over-stated. First, Barisone et al. (2006) show that, in fact, like the BEER, the FEER is cointegrated with the observed real exchange rate. Second, a consistent estimation of BEERs requires that the same equation is used for all countries (since the exchange rate of currency x against currency y is the inverse of that of y against x). By construction, this yields larger misalignments than a country-by-country approach. Finally, the FEER can be viewed as the medium-run exchange rate that would bring the NFA position back to its equilibrium level or path.[16] In this sense, the FEER and the BEER are complements rather than substitutes. Indeed, the medium-run BEER can be considered the equilibrium rate conditional on the markets perceiving observed NFAs as sustainable; the FEER then depicts exchange-rate adjustment that would be necessary to move NFAs to a sustainable path. Finally, the long-run BEER reflects a long-run equilibrium where no further adjustment of NFAs is needed. In the following, we try to articulate FEERs and BEERs over different horizons based on the same concept of equilibrium NFA.

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[16]It has to be noticed that the FEER gives only a partial information on the path followed by the real exchange rate to adjust from medium to long-run BEERs. The adjustment *per se* may followed various dynamics between those three points.

4.2 The sample

Contrasting with PPP, FEERs and BEERs are multilateral concepts. Indeed, the exchange rate that is consistent with both internal and external equilibrium is a real, effective exchange rate, not a bilateral one.[17] Therefore, it is necessary to calculate a large set of FEERs or BEERs before being able to derive bilateral equilibrium exchange rates. Here, we work on a sample of 15 countries accounting for 83.3% of world GDP. The selected countries are all members of the G20, a group created in 1999 to deal with international financial stability issues and that brings together G7 countries and large, emerging countries.[18] The G20 has sometimes been viewed as one possible forum for exchange-rate and, more generally, macroeconomic policy coordination. The multilateral consultations launched by the International Monetary Fund in 2006 can be viewed as one step in this direction.[19]

4.3 Net foreign assets and current account targets

We calculate several sets of FEERs and BEERs which we try to make consistent by relating them to a single model of equilibrium NFA position. The equilibrium NFA model is detailed in Appendix A. It relies on Lane and Milesi-Ferretti (2001) who estimate the NFA position of each country as a function of its demographic structure, GDP per capita and public debt-to-GDP ratio. We proceed to panel cointegration estimations for our sample of countries over the 1980-2005 period.[20] The estimation results are reported in Table A.1 of Appendix A. They are consistent with Lane and Milesi-Ferretti's findings. Not surprisingly, an increase in public debt or in the proportion of young generations both lead to a fall in the NFA position. Furthermore, a rise in GDP per capita has a negative impact on the NFA-to-GDP ratio, which can be interpreted as advanced countries enjoying sophisticated financial markets that allow them to run into debts (world investors being attracted by the liquidity-risk combination of sophisticated markets).

From this cointegration relationship, an equilibrium (or "target") NFA position can be derived that corresponds to the NFA position that would fit the demographic structure, the public debt ratio and the GDP per capita for each country at each point of time,

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[17]whereas price equalization across two countries directly yields a bilateral equilibrium exchange rate.

[18]Our sample covers all G20 countries except Russia and Saudi Arabia. France, Germany and Italy are grouped into the Euro area. Hence the country list is the following: Argentina (ARG), Australia (AUS), Brazil (BRA), Canada (CAN), China (CHN), the United Kingdom (GBR), Indonesia (IDN), India (IND), Japan (JPN), Korea (KOR), Mexico (MEX), Turkey (TUR), the United States (USA), South Africa (ZAF) and the Euro area (ZZM).

[19]These consultations started in 2007 on the issue of global imbalances and brought together China, the Euro area, Japan, Saudi Arabia and the United States, see IMF (2007).

[20]The NFA database is updated in 2005 by adding the current account balance of 2005 to the NFA position of end 2004, except in the United States where the revaluation of gross assets is accounted for in the NFA position of 2005. This different treatment of the US NFA derives from the United States being long in foreign currencies but short in U.S. dollars (see Tille, 2005; Lane and Milesi-Ferretti, 2007; Gourinchas and Rey, 2007).

accounting for country-specific factors through fixed effects.[21] As an illustration, Figure 1 compares target and observed NFAs in the case of the United States and the Euro area from 1980 to 2005.[22] According to our model, the impressive fall of the US NFA position from 1983 to 2005 is relatively well explained by the fundamentals of the US economy up to 2000. Then, the NFA ratio should have stabilized according to our model, its observed level declined substantially. In the Euro area, the NFA ratio lies above its equilibrium level during most of the period, except in the most recent one where economic fundamentals would have called for a marked increase in the NFA position.

Figure 1: Observed and Target NFA of the United States and the Euro area

United States   Euro area
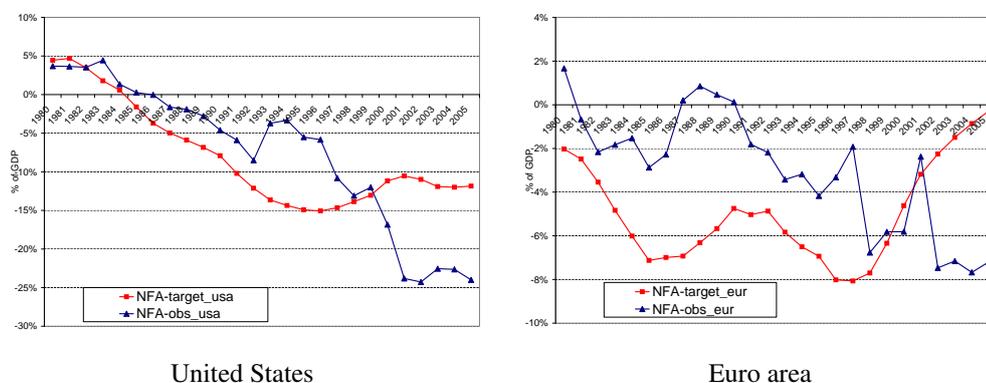
Source: authors' calculations

Table 2 compares observed and target NFA positions in 2005 for each considered country. Strikingly, most countries of our sample display negative observed and target NFAs. This reflects the well-documented world discrepancy, i.e. the fact that current accounts generally sum to negative values worldwide. To the extent that it is not concentrated on specific countries, this discrepancy is benign for the calculation of equilibrium exchange rates. Indeed, our panel methodology with fixed effects prevents all currencies being over-valued simultaneously.[23] The last column of the table reports the difference between observed and target NFAs. Consistent with Figure 1, this difference is negative for the United States and, to a lesser extent, the Euro area. Conversely, it is positive for Japan, China and the three other Asian countries of the sample, as well as for Canada and South Africa. The NFA position lies well below its target level in the United Kingdom and in Australia. It is also below its target in Brazil, Mexico and Turkey, albeit to a lower extent. It is very close to equilibrium in Argentina.

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[21] These targets corresponds to $\overline{nfa}$ in the theoretical setting.

[22] The figures for the other countries are displayed in Appendix B.

[23] For FEER calculations, only the difference between observed and target current accounts is used.

Table 2: Net Foreign Asset positions in % of GDP, 2005

Country	Observed[a]	Target[b]	Obs-Target
Canada	-8.8	-17.7	8.9
Euro Area	-7.2	-0.3	-6.9
Japan	42.8	22.2	20.6
United Kingdom	-15.0	-1.6	-13.4
United States	-24.0	-11.9	-12.1
Argentina	-36.4	-37.0	0.7
Australia	-59.7	-39.6	-20.1
Brazil	-35.3	-27.6	-7.7
China	13.1	-17.7	30.8
India	-10.4	-23.8	13.4
Indonesia	-40.6	-51.2	10.6
Korea	-1.4	-13.9	12.5
Mexico	-38.7	-33.0	-5.7
South Africa	-8.4	-13.8	5.4
Turkey	-45.6	-38.2	-7.4

Sources: [a] Lane and Milesi-Ferretti NFA database (updated); [b] Author's calculations based on Appendix A.

Based on the NFA target model, we derive two sets of current-account targets (see Appendix A):

- Medium-run current account targets designed to progressively close the gap between the NFA position of each country and its equilibrium level in five years;

- Long-run current-account targets based on a stock-flow equilibrium where the NFA-to-GDP ratio stays constant at its equilibrium level.

For the sake of comparability, we also use the current-account targets proposed by Williamson (2006) and IMF (2006), labeled "Benchmark" here.[24] The numerical current-account targets are reported for 2005 in Table 3. These values must be compared with the first column that reports the "underlying" current accounts in 2005. As in Isard and Faruqee (1998), we define the "underlying" current-account balance in percentage of GDP at year t, uca_t as follows:

$$uca_t = ca_t + (m\beta_m + x\beta_x)(0.4dq_t + 0.15dq_{t-1}) + m\Psi_m og_t - x\Psi_x og_t^* \quad (22)$$

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[24]We also used the current account targets proposed by Williamson and Mahar (1998). The results are available upon request to the authors.

where ca_t denotes the current-account-to-GDP ratio, og_t and og_t^* the domestic and foreign output gaps, respectively, dq_t, dq_{t-1} the two last variations of the real exchange rate, m, x the imports and exports-to-GDP ratios, Ψ_m, Ψ_x represent the income elasticities of imports and exports, and β_m, β_x, the price elasticities of imports and exports. These elasticities, which are crucial in the FEER methodology, are taken from the Multimod model of the IMF (Laxton et al., 1998). The values are reported in Table 4.[25]

Table 3: Current account targets in % of GDP

Country	Underlying CA (2005)[a]	Benchmark[b]	Medium-run targets[c]			Long-run target[d]
			T=5	T=7	T=10	
Canada	0.1	1.1	-2.1	-1.6	-1.3	-1.7
Euro Area	−1.4	−0.2	1.4	1.0	0.7	0.0
Japan	4.3	1.1	-6.0	-4.8	-3.9	-1.3
United Kingdom	−1.6	−2.6	2.6	1.8	1.3	0.0
United States	−5.9	−3.0	2.7	2.0	1.4	-0.3
Argentina	5.3	−1.5	2.4	2.4	2.4	-5.3
Australia	−6.9	−2.2	2.1	1.0	0.2	-2.9
Brazil	0.1	−1.5	1.0	0.6	0.3	-6.1
China	10.0	2.6	-6.2	-4.5	-3.2	-1.8
India	−1.3	−0.7	-3.7	-3.1	-2.7	-5.4
Indonesia	2.0	−0.7	-3.6	-2.9	-2.3	-2.0
Korea	−1.0	−0.5	-2.7	-2.0	-1.5	-1.4
Mexico	−1.2	−1.5	0.5	0.2	-0.1	-2.7
South Africa	−3.0	−1.5	-1.7	-1.4	-1.1	-1.3
Turkey	−4.6	−2.2	-1.4	-1.8	2.1	-5.7

Sources: [a] author's calculations based on IMF, *World Economic Outlook*, October 2007, and CEPII-CHELEM. [b] Williamson (2006) for USA, Canada, Japan, Euro area, UK, Korea and China. Otherwise, IMF (2006).[c] CA that would bring the NFA position to equilibrium in 5, 7 and 10 years respectively, see Appendix A. [d] CA consistent with a stable NFA position at its equilibrium level, see Appendix A.

Note that Equation (22) depicts the adjustment of the current account through that of the trade balance when output gaps are closed and past exchange-rate variations are factored in, whereas net interest receipts (ki_t) and current transfers (tr_t) are excluded from any adjustment:

$$uca_t = ki_t + tr_t + utb_t \tag{23}$$

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[25]These price elasticities are consistent with those used by Blanchard et al. (2005) and with the impulse-response functions estimated by Fratzscher et al. (2007).

where utb_t represents the "underlying" trade balance:

$$utb_t = tb_t + (\beta_m + x\beta_x)(0.4dq_t + 0.15dq_{t-1}) + m\Psi_m og_t - x\Psi_x og_t^* \qquad (24)$$

This simple observation allows us to mix the FEER approach with our stock-flow adjustment approach. Indeed, our medium and long-run current-account targets, $\widetilde{ca}(T)$ and $\overline{ca}$, respectively, are based on trade-balance targets, $\widetilde{tb}(T)$ and $\overline{tb}$ (see Appendix A):

$$\widetilde{ca}(T) = \widetilde{ki} + tr + \widetilde{tb}(T) \qquad (25)$$

and

$$\overline{ca} = \overline{ki} + tr + \overline{tb} \qquad (26)$$

where $\overline{tb}$ is the trade balance that is consistent with a stable NFA ratio at its target value, and $\widetilde{tb}(T)$ is the trade balance that allows the NFA ratio to reach its target value in $T = 5$, 7 or 10 years, successively. $\overline{ki}$ represents net interest receipts when the NFA position is at its target level, and $\widetilde{ki}$ is net interest receipts (in percentage of GDP) based on the last NFA ratio (see Appendix A). Net interest receipts are assumed to adjust in the long run due to the adjustment of the NFA position, but not in the medium run where the NFA position is predetermined.[26] In contrast, current transfers plus net labour income are assumed to stay constant at their 2001-2005 average level tr both in the medium run and in the long run.

The different sets of current-account targets (benchmark, medium run, long run) are reported in Table 3 and compared to the underlying current account of each country in 2005. Due to discrepancies between GDP growth rates, long-run current-account targets (those that allow the NFA ratio to stay constant at its equilibrium level) are generally different from zero. Most of them are negative, which reflects a negative equilibrium NFA position.

In the United States, the NFA position needs to increase to reach its equilibrium level, which translates in a positive medium-run current-account target (between +1.4 and +2.7% of GDP, depending on the adjustment length). To a lesser extent, this is also the case in the Euro area (between +0.7 and +1.4%). This contrasts with Williamson figures that assume a -3% target for the United States and a close-to-balance one for the Euro area. To be sure, Williamson's targets already suggest halving the US deficit compared to 2005, whereas our own methodology leads to a much more ambitious adjustment. In contrast, our medium-run targets point to a deficit in all Asian countries, whereas Williamson and the IMF are more conservative, suggesting either balanced current accounts or slight surpluses. On the whole, we expect exchange-rate misalignments to be much larger in 2005 when our medium-run targets are used than with Williamson and IMF targets.

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[26] In both cases, interest rates are fixed in US dollar by virtue of the uncovered interest parity: if the domestic currency depreciates and this depreciation was expected, this does not affect interest receipts and payments denominated in foreign currency, because the domestic return in domestic currency is assumed to adjust.

Table 4: Trade elasticities

Countries	β_m	β_x	Ψ_m	Ψ_x
Industrialised	0.92	0.71	1.5	1.5
Developing	0.69	0.53	1.5	1.5

Source: Laxton et al. (1998).

5 FEERs and BEERs: estimated misalignments

5.1 FEERs

The FEER is calculated in logarithm as follows:

$$feer_t = q_t + \frac{1}{[(m\beta_m + x\beta_x) - m]}(\overline{ca} - uca_t) \qquad (27)$$

where q_t denotes the logarithm of the observed real, effective exchange rate.[27] The target current account, $\overline{ca}$ is taken from Table 3. The same equation applies for benchmark, medium-run and long-run current-account targets.[28]

Real effective misalignments obtained with the FEER approach for 2005 (which is our last point in the sample) are reported in Table 5 for our different sets of current-account targets. In all cases, a positive sign denotes undervaluation, whereas a negative one denotes overvaluation of the observed exchange rate, compared to its FEER value. As expected, the US dollar and, to a lesser extent, the euro, appear overvalued in real effective terms in 2005, but less so in the long run (where the NFA position is assumed to have reached its equilibrium value) than in the medium run (where a depreciation is needed to raise the NFA position). The US dollar and the euro are also under-valued relative to Williamson's current-account targets, but to a lesser extent.

Combined with our stock-flow adjustment model, the FEER approach yields very large misalignments for the United States, Japan, China and India. These results illustrate the need for balance-of-payment adjustments to rely on other variables than the current accounts. This conclusion is consistent with the recent literature showing that (unexpected) exchange-rate or asset-price variations may account for a large share of the adjustment through valuation effects (Lane and Milesi-Ferretti, 2007), wealth effects (Fratzscher et al., 2007), or else demand and supply-side adjustment (Algieri and Bracke, 2007; Engler et al., 2007).

To illustrate this point, we calculate alternative sets of FEER estimates for 2005 where the initial value of gross US liabilities is reduced by 20% due to an asset-price crash

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[27]Source: Bilateral real exchange rates are taken from World Bank, *World Development Indicators* and *DATASTREAM* for the EUR/USD exchange rate. The real effective exchange rates are calculated with 2005 trade weights based on IMF, *Direction of Trade Statistics* data.

[28]Because the current account is expressed in percentage of GDP, the standard, Marshall-Lerner condition applies whether both the current account and the GDP are expressed in domestic currency or in US dollar, as it is the case here.

Table 5: Real effective misalignments in 2005 with the FEER approach (in %)

Country	Benchmark targets[b]	Medium-run targets[c]			Long-run targets[d]
		T=5	T=7	T=10	
Canada	−4.1	9.1	7.1	5.5	7.5
Euro Area	−9.3	-21.8	-18.7	-16.3	−10.9
Japan	33.4	108.0	95.4	86.0	54.1
United Kingdom	6.0	-25.2	-20.6	-17.2	-9.5
United States	-48.5	-142.9	-131.3	-122.5	-91.8
Argentina	89.7	38.5	38.0	37.6	138.8
Australia	−40.1	-76.9	-67.3	-60.1	-31.7
Brazil	30.6	-18.5	-9.9	-3.5	128.1
China	73.9	161.7	144.7	132.1	120.5
India	−36.2	152.4	115.4	87.7	280.0
Indonesia	30.4	63.3	55.0	48.8	44.0
Korea	−5.4	16.7	9.8	4.6	5.7
Mexico	−43.9	-27.6	-22.3	-18.3	27.0
South Africa	−22.4	-19.9	-24.5	-27.8	-28.0
Turkey	−52.9	-70.5	-61.9	-55.5	18.7

Notes: [b], [c], [d] see Table 3. A positive sign points to an undervalued currency.
Source: authors' calculations.

in the United States. The loss is distributed equally across all other countries, depending on their gross foreign assets. The results are reported in Table 6 for the case where $T = 5$. Columns (1) and (2) compare the current-account targets deriving from our basic, stock-flow calculation, with current-account targets obtained after the asset-price crash has taken place. The current-account target for the United States is dramatically reduced, from +2.7 to -0.7% of GDP. In contrast, the CA target of the Euro area rises from 1.4 to 4.5% of GDP while that of the UK increases from 2.6 to as much as 8.1% of GDP. The latter result derives from the very large gross asset stock of the UK, which suffers from a large loss in the crash scenario. Columns (3) and (4) then compare real effective misalignments in 2005 under the baseline scenario and under the crash scenario. Unsurprisingly, the amount of USD over-valuation is much reduced in the crash scenario whereas that of the Euro area and of the UK are increased.

A second problem is that FEER estimates are very sensitive to price elasticities of imports and exports. Recent research based on detailed trade data and firm-level data tends to revise these elasticities upwards (see, e.g. IMF, 2007), and some authors have deliberately chosen to use higher elasticities of substitution between domestic and foreign goods (see Lane and Milesi-Ferretti, 2007). Higher elasticities automatically translate into lower misalignments. As an illustration, Column (5) of Table 6 reports FEER misalignments with no crash but doubled price elasticities. All misalignments are dramatically reduced, and the USD appears overvalued by 'only' 30% in 2005, compared to 143% in the base case.

On the whole, our results suggest that FEER calculations are very unstable to underlying assumptions concerning valuation effects and price elasticities. One implication is that the level of the FEER itself depends on the profile of exchange-rate adjustment: a sudden, unexpected depreciation of the dollar would have an immediate, powerful rebalancing effect on the US NFA, reducing the needs for further depreciation afterwards. In contrast, an expected, smooth depreciation of the dollar would be factored in by the markets that would ask for higher returns in the United States, compensating for the valuation effect.

5.2 BEERs

Turning to BEER estimations, a panel cointegration relationship based on Equation (17) is estimated on annual data over the 1980-2005 period for the 15 countries of the sample. Since we are dealing with a long-run relationship, return differentials and output gaps are set to zero. Specifically, the following equation is estimated through a panel cointegration technique:

$$q_t = f(tot_t, nfa_t, z_t) \tag{28}$$

where tot_t is the log of the export-price to import-price ratio relative to the rest of the world[29], and z_t stands for the relative productivity ratio. In both cases, the aggregate

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[29]Source: World Bank, *World Development Indicators*.

Table 6: Alternative measures of real effective misalignments in 2005 with the FEER approach and T=5, in %

Country	CA targets[a]		Exchange-rate misalignments[b]		
	base case	crash scenario	stock-flow	US crash	Price elasticities doubled
	(1)	(2)	(3)	(4)	(5)
Canada	-2.1	-0.8	9.1	3.7	2.7
Euro Area	1.4	4.5	-21.8	-46.9	-6.3
Japan	-6.0	-4.3	108.1	89.8	31.7
United Kingdom	2.6	8.1	-25.2	-58.3	-6.6
United States	2.7	-0.7	-142.9	-86.2	-30.6
Argentina	2.4	3.8	38.5	19.4	8.5
Australia	2.1	3.1	-76.9	-85.4	-20.5
Brazil	1.0	1.4	-18.5	-25.0	-4.2
China	-6.2	-5.6	161.7	156.2	31.1
India	-3.7	-8.8	152.3	473.2	29.0
Indonesia	-3.6	1.7	63.3	3.5	11.6
Korea	-2.7	-2.1	16.7	10.1	2.8
Mexico	0.5	0.8	-27.6	-32.1	-3.8
South Africa	-1.7	-0.9	-19.9	-31.9	-3.0
Turkey	-1.4	-1.1	-70.5	-77.2	-7.6

Notes: [a] in % of GDP. [b] A positive sign points to an undervalued currency.
Source: authors' calculations.

Table 7: BEER panel cointegration estimations

Dependent variable: q	(1)	(2)	(3)	(4)
nfa	-0.331^a	-0.283^a	-0.762^a	-0.374^a
	(-2.59)	(-3.37)	(-4.28)	(-3.94)
tot	-	-0.419^a	-	-1.041^a
		(-8.73)		(-13.70)
$prod1$	-0.829^a	-0.878^a	-	-
	(-11.84)	(-15.14)		
$prod2$	-	-	-0.128	-0.906^a
			(-0.78)	(-8.09)
Fixed effects	yes	yes	yes	yes

Notes: ^{a} significant at 1%; ^{b} significant at 5%; ^{c} significant at 10%. Student-t in parentheses.
Source: authors' calculations.

for the rest of the world is calculated with the same weighting matrix as for real effective exchange rates.

There is no comprehensive data source for productivity in non-tradable and tradable sectors in our sample of countries. Here we use two alternative measures of z_t:[30]

- We follow the literature[31] in proxying z_t by the ratio of the consumer price index (CPI) to the producer price index (PPI), relative to the same ratio in the rest of the world (noted with "*").[32]

$$prod1_t = Log \left(\frac{CPI_t/PPI_t}{CPI_t^*/PPI_t^*} \right) \quad (29)$$

- Alternatively, we calculate the value-added deflator of agriculture, industry and services successively as the ratio between nominal and real value added;[33] we identify non-traded goods to services and traded goods to agriculture and industry, and calculate z_t as the relative deflator of services compared to agriculture and industry:

$$prod2_t = Log \left(\frac{P_t^{Serv}/P_t^{Agr+Ind}}{P_t^{Serv*}/P_t^{Agr+Ind*}} \right) \quad (30)$$

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[30]Two additional proxies are used in Bénassy-Quéré, Béreau and Mignon (2007), with similar results.
[31]See, e.g., MacDonald (1997), Alberola et al. (1999), Schnatz et al. (2003).
[32]Source: World Bank, *World Development Indicators* and IMF, *International Financial Statistics*.
[33]Source: World Bank, *World Development Indicators*.

Table 7 reports the results from the panel cointegration estimations.[34] The signs obtained are consistent with the theory: the real exchange rate appreciates (q falls) in the long-run if the NFA position rises, if terms of trade increase or if the tradable-to-non-tradable productivity ratio rises compared to the rest of the world. However, the second measure of relative productivity is not significant when terms of trade are omitted from the estimation (Column (3)), and the coefficient on the NFA position is much higher, revealing a possible omitted variable problem. Dropping this specification, the estimates suggest that a 10 pp rise in the NFA position leads to a 3-4% appreciation of the real effective exchange rate, while a 10% increase in relative productivity leads to a 8-9% real appreciation. In the following, we concentrate on Columns (2) and (4) that include terms of trade as a control variable.

These estimations are then used to derive two sets of BEERs:

- "Medium-run BEERs": predictions of Equation (28) with observed NFA ratios, i.e. real effective exchange rates that would be consistent with observed NFAs.

- "Long-run BEERs": predictions of Equation (28) with NFAs set at their target levels, i.e. real effective exchange rates that would be consistent with equilibrium NFAs.

It is important to note at this stage that, although significantly different from zero, the impact of the NFA ratio on the real exchange rate is limited. Coming back to Table 2, in 2005 the NFA ratio of the United States lies 12 percentage points lower than its target level. According to our cointegration relationships, the upward adjustment of the US NFA would be consistent with a 3.6 to 4.8% appreciation of the USD between the medium term (constant NFA at its 2005 level) to the long run (constant NFA at its target level). This feature reflects a relatively high adaptability of international portfolios to NFA levels. This estimated plasticity of international portfolios may be overstated by the BEER approach that relies on past behaviors. It leads to a relatively benign view of the impact of world imbalances on exchange rates, contrasting with the FEER approach.

Table 8 reports real effective misalignments in 2005 relating to both medium-run and long-run BEERs and both measures of productivity. As expected, misalignments are more limited than in the FEER case: they never exceed 10%.

The medium-run BEER (observed NFA) with the first productivity measure involves the same amount of overvaluation for the USD and the euro (in effective terms) in 2005. As expected, the misalignment is reduced in terms of the long-run BEER (target NFA): the USD and the euro appear overvalued by only 2.2% and 4.7%, respectively, compared to 6.7% when the medium-run BEER is considered the equilibrium rate. Symmetrically, the Chinese yuan is found under-valued by 31% compared to the medium-run BEER but 'only' 22% compared to the long-run one. The same pattern applies to the Japanese yen, albeit to a much lesser extent (7.9 and 2.1% under-valuation compared to the medium-run and long-run BEERs, respectively).

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[34]Panel unit root tests show that all series included in the estimations are I(1). The results are available upon request.

The BEERs estimated with the second productivity measure broadly deliver the same message for the euro (slightly over-valued in 2005), the USD (close to equilibrium) and a number of other currencies. However, the size of misalignments is dramatically raised in some Asian countries as well as in Turkey and South Africa. Additionally, the Japanese yen and the Indian rupee switch from undervalued to over-valued. In the following, we concentrate on the first productivity measure that is more in line with common wisdom.

Table 8: Real effective misalignments in 2005 with the BEER approach (in %)

	Medium-run		Long-run	
Country	prod1	prod2	prod1	prod2
Canada	8.3	11.4	5.8	8.1
Euro Area	-6.7	-9.5	-4.7	-6.9
Japan	7.9	-6.1	2.1	-13.8
United Kingdom	-15.9	-15.9	-12.1	-10.8
United States	-6.7	-2.7	-2.2	3.2
Argentina	63.5	40.0	63.3	39.7
Australia	-4.3	-2.2	1.4	5.3
Brazil	-29.2	-15.8	-27.1	-12.9
China	31.0	40.2	22.3	28.7
India	9.7	-14.5	5.9	-19.5
Indonesia	13.1	43.1	10.1	-39.1
Korea	-12.4	-22.1	-15.9	-26.8
Mexico	-15.8	-17.3	-14.2	-15.2
South Africa	3.6	21.7	2.0	19.7
Turkey	-1.6	-24.3	0.5	-21.5

Note: a positive value points to an undervalued currency.
Source: authors' calculations.

The BEER and the FEER are complements in the sense that the BEER is consistent with market equilibrium in the medium run (where the NFA position is not assumed to adjust) and in the long run (where the NFA position has adjusted), but not necessarily with the unwinding of world imbalances. In turn, the FEER concentrates on current-account adjustment but may underestimate the plasticity of capital markets.

One way of interpreting Tables 5 and 8 is to use them as successive views of equilibrium exchange rates by the markets. In the medium run, the "medium-run BEER" is to prevail until markets decide that observed NFAs are non-sustainable. Once NFAs are viewed unsustainable, exchange-rate expectations are revised, which triggers current-account adjustments together with large exchange-rate variations (in line with the FEER). When NFAs are back to a sustainable, long-run level, the equilibrium exchange rate is the "long-run BEER". However the "long-run FEER" and the "long-

run BEER" do not coincide according to our results. For instance, the equilibrium value of the dollar that is consistent with the equilibrium NFA ratio is lower from the FEER perspective than it is in the BEER approach. Either the FEER approach misses some adjustment device, or the BEER methodology misses the painfulness of reaching the equilibrium current-account target, when capital markets become perhaps less willing to hold dollars.

5.3 Bilateral misalignments

We now turn to the bilateral misalignment of the euro/dollar exchange rate. The equilibrium bilateral rate is calculated based on the whole set of equilibrium, effective rates, by inverting the weighting matrix of effective rates.[35] Since there are only 14 independent bilateral rates between 15 currencies, one equilibrium effective rate needs to be dropped. Here we drop that of the USD.[36] The results are displayed in Table 9. The first column reports the misalignments obtained for year 2005 (a positive sign points to the euro being under-valued against the USD). The other columns derive the implications of this misalignment for the end of 2007, accounting for the appreciation of the euro against the USD between 2005 and 2007 in real terms and assuming a constant bilateral, equilibrium exchange rate from 2005 to 2007.

According to Table 9, the equilibrium euro/dollar rate was around 1.15 dollars per euro at end 2007, according to both the medium-run and the long-run BEERs. However, FEER estimates point to a much stronger euro: 1.60 dollars per euro for our benchmark case (i.e. with current account targets taken from Williamson, 2006), and even more than 2 dollars per euro when our stock-flow adjustment targets are used. Again, the results are shown to be very sensitive to underlying assumptions: when price elasticities are doubled, or when US liabilities are assumed to fall by 20% initially due to an asset-price crash, the euro/dollar appears very close to its equilibrium value at end 2007 - around 1.45. These various FEER estimates confirm that world imbalances cannot be solve only through exchange-rate adjustment, so other variables such as savings or asset prices need to adjust simultaneously, reducing the needs for further dollar depreciation.

One limitation of the above bilateral misalignment calculations is that they implicitly assume that all currencies adjust to their equilibrium levels. This is obviously not the case in the international monetary system. Since its Boca-Raton 2004 meeting, the G7 has been repeating that "more flexibility in exchange rates is desirable for major countries or economic areas that lack such flexibility to promote smooth and widespread adjustments in the international financial system, based on market mechanisms".[37] As illustrated in Tables 5 and 8, our calculations point to large misalign-

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[35] See Alberola et al. (1999, 2002) and Bénassy-Quéré et al. (2004) for a detailed description of this methodology.

[36] As robustness checks, we used the euro and the yen as alternative numeraires. The obtained results were very similar. They are available upon request from the authors. Alternatively, Carton et al. (2007) use an optimization programme to distribute the Nth currency problem across all N currencies.

[37] Statement of G7 Finance Ministers and Central Bank Governors Boca Raton, Florida February 7,

Table 9: Euro-dollar equilibrium rate, FEER and BEER approaches

Model	Misal. 2005 (%)	RER var 2005-2007 (%)[a]	Misal. 2007 (%)	EUR/USD Dec. 2007	Eq. EUR/USD Dec. 2007
BEER MR, prod1	-4.7	-14.8	-19.5	1.45	1.17
FEER bench.	25.0	-14.8	10.2	1.45	1.60
FEER (T=5)	67.9	-14.8	53.1	1.45	2.22
FEER (T=7)	60.6	-14.8	45.8	1.45	2.11
FEER (T=10)	55.3	-14.8	40.5	1.45	2.04
FEER (T=5) elas2[b]	14.8	-14.8	-2.2	1.45	1.42
FEER (T=5) crash[c]	13.3	-14.8	-1.5	1.45	1.43
BEER LR, prod1	-5.9	-14.8	-20.7	1.45	1.15

Notes: [a] based on a 16.6% nominal appreciation of the euro and of a 4.3% and 6.1% cumulated inflation in the Euro area and in the United States, respectively. [b] refers to FEER results when MUTIMOD trade elasticities are doubled. [c] refers to FEER results when assuming a US asset price crash that affects both the US and equally all its trade partners. MR=medium run; LR=long run. Source: authors' calculations.

ments in Asia, and especially in China. In the latter country, monetary authorities have accepted the idea of progressive appreciation and modified their exchange-rate regime accordingly in July 2005. However, the pace of exchange-rate appreciation has been rather limited so far.

Here, we quantify how euro/dollar scenarios are impacted by China refraining from letting its real effective exchange rate appreciate to equilibrium. In other words, we calculate new bilateral misalignments which are conditional on the lack of adjustment of the yuan, and compare them to those obtained when all currencies adjust. More specifically, we assume that the yuan stays fixed in real terms against the USD. The results are reported in Table 10, focusing on the BEER approach with the first productivity measure.

As already noted, in 2007 both the USD and the euro appear over-valued in real effective terms, but more so for the euro, which entails the euro being over-valued against the dollar. When the yuan stays fixed against the USD, the amount of bilateral misalignment between the USD and the euro is increased by approximately 10% against the USD, which is far from negligible.

6   Conclusions

In this paper, we have tried to provide a unified view of equilibrium exchange rates by arguing that each concept corresponds to a specific horizon and illustrating these views on the euro/dollar case. Assuming that observed net foreign asset positions

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2004, available on `www.g8.utoronto.ca/finance/`.

Table 10: Euro-dollar equilibrium rate, BEER approach, impact of China failing to adjust

BEER	Misal. 2005 (%)	RER var 2005-2007 (%)[a]	Misal. 2007 (%)	EUR/USD Dec. 2007	Eq. EUR/USD Dec. 2007
Medium run	-4.7	-14.8	-19.5	1.45	1.17
No adj. in China	-14.8	-14.8	-29.6	1.45	1.02
Long run	-5.9	-14.8	-20.7	1.45	1.15
No adj. in China	-16.7	-14.8	-31.7	1.45	0.99

Notes: [a] based on a 16.6% nominal appreciation of the euro and of a 4.3% and 6.1% cumulated inflation in the Euro area and in the United States, respectively. MR=medium run; LR=long run.
Source: authors' calculations.

are viewed as sustainable by the markets or, alternatively, that they have converged to their long-run target values, the equilibrium euro/dollar rate is found to be around 1.20 at end 2007, which is not very far from the purchasing power parity rate of Germany and France (around 1.15). These figures point to a much lower euro than calculations based on target current account ratios, i.e. exchange rates that would be consistent with the unwinding of global imbalances. Using Williamson's (2006) current-account targets, the equilibrium value of the euro/dollar rises to 1.60 at end 2007. Furthermore, we show that current-account targets derived from stock-flow adjustment towards equilibrium net foreign asset positions lead to even higher values for the euro. Our analysis illustrates that valuation effects will be key to solving global imbalances. Although more robust to alternative assumptions, the BEER approach may rely on excessive confidence on past behaviors in terms of portfolio allocation. Symmetrically, FEERs may underestimate the plasticity of international capital markets because they focus on the adjustment of the trade balance.

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Appendix A: NFA and current-account targets

Here we estimate "equilibrium" net foreign asset positions through a panel cointegration method. We then derive long-run and medium-run current accounts targets that are consistent with stock-flow equilibrium and stock-flow adjustment, respectively.

NFA targets

We rely on Lane and Milesi-Ferretti (2001) who estimate the NFA-to-GDP ratio nfa as a function of the demographic structure ($dem1$, $dem2$, $dem3$), the logarithm of GDP per capita in purchasing power parity ($lgdppc$) and the ratio of public debt to GDP ($gdebt$).

Like Lane and Milesi-Ferretti, we follow Fair and Dominguez (1991) and Higgins (1998) in capturing the demographic structure of the population[38] along through a parsimonious parametrization: the population is first divided into twelve cohorts; then, the coefficient on each cohort is supposed to be a cubic polynomial function of the coefficients on $dem1$, $dem2$ and $dem3$.[39]

NFA positions are taken from the Lane and Milesi-Ferretti online database.[40] Data for the Euro area are those of the "Euro area composite" which stand for the sum of each member's foreign position minus intra-zone flows. NFA positions for 2005 are recovered by adding 2005 current account figures to 2004 NFA positions. Finally, the nfa variable is calculated by dividing NFA positions in USD by nominal GDPs in USD.

GDP per capita is extracted from the World Bank, *World Development Indicators database.* It is introduced in logarithm in the equation. Finally, the public debt ratio is taken from Lane and Milesi-Ferretti (2001) and updated.[41]

The NFA model is estimated through a panel, DOLS cointegration technique with country fixed effects, for our 15-country sample over the 1980-2005 period:

$$nfa_{i,t} = f\left(dem1_{i,t}, dem2_{i,t}, dem3_{i,t}, lgdppc_{i,t}, gdebt_{i,t}\right) \tag{31}$$

where the i subscript denotes countries and t represents time. The target NFA, $\overline{nfa}_{i,t}$ is then defined as the prediction of Equation (31):

$$\overline{nfa}_{i,t} = \widehat{\beta}_i + \widehat{\beta}^1 dem1_{i,t} + \widehat{\beta}^2 dem2_{i,t} + \widehat{\beta}^3 dem3_{i,t} + \widehat{\beta}^4 lgdppc_{i,t} + \widehat{\beta}^5 gdebt_{i,t} \tag{32}$$

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[38]Population data are taken from the United Nations' quinquennial estimates and projections over the 1950-2050 period. To full blanks, linear interpolations have been made.

[39]For further details, see Fair and Dominguez (1991), Higgins (1998), Lane and Milesi-Ferretti (2001), and Benhima and Havrylchyk (2006).

[40]www.imf.org/external/pubs/cat/longres.cfm?sk=18942.0

[41]Public debt-to-GDP ratios are taken from IMF, *International Financial Statistics*, and completed with data on total debt from World Bank, *World Development Indicators* when public debt was unavailable.

where $\widehat{\beta}^1$, $\widehat{\beta}^2$, $\widehat{\beta}^3$, $\widehat{\beta}^4$, $\widehat{\beta}^5$ are the estimated coefficients of Equation (31), and $\widehat{\beta}_i$ denote the estimated country fixed effects. The results are provided in Table A.1 below.

Table A.1 - NFA model: estimation results

	$dem1$	$dem2$	$dem3$	$lgdppc$	$gdebt$
Coefficient	1.545^b	-0.426^a	0.029^a	-0.127^a	-0.374^a
t-stat	2.02	-2.62	3.20	-2.95	-7.62

Note: ^{a} significant at the 1% level; ^{b} significant at the 5% level

Trade balance targets

Two alternative trade balance targets can then be derived from this estimation: a long-run one, and a medium-run one. Both rely on the stock-flow adjustment equation presented in the text:

$$\Delta nfa_t = \frac{i_t^* + kg_t^* - \gamma_t}{1 + \gamma_t} \cdot nfa_{t-1} + tb_t + tr_t \qquad (33)$$

Long run trade balance targets

In the long run, the NFA position is constant as a percentage of GDP, equal to $\overline{nfa}$. From Equation (33), this implies the following trade-balance target, with constant values of i^*, kg^* and γ:

$$\overline{tb} = (1 - \beta)\overline{nfa} - tr \qquad (34)$$

with $\beta = \dfrac{1 + i^* + kg^*}{1 + \gamma}$.

β is independent from exchange-rate adjustment, because the numerator and the denominator are expressed in the same currency. Additionally, Equation (34) relies on a single return and capital gain rate ($i^* + kg^*$) for gross assets as and gross liabilities. As evidenced by Lane and Milesi-Ferretti (2001, 2007) and Gourinchas and Rey (2007), differentiated interest rates and capital gains on assets and on liabilities (including exchange-rate adjustments) have accounted for a large part of NFA dynamics. However, such departure from uncovered interest parity cannot be assumed to survive forward if markets are rational.[42] Here we assume the golden rule to apply globally in the long run, so that $i^* + kg^*$ is equal to world nominal growth rate in USD. As for γ, it is equal to the countries' nominal growth rate in USD. Both growth rates are calculated as averages over the last five years. If domestic growth differs from world growth, then $\beta \neq 1$ and the trade balance that keeps the NFA ratio constant is not zero.

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[42]We are grateful to Philip Lane for making this point to us.

To recover the target current account, one must add current transfers tr and net interest payments ki to the target trade balance. Here, we assume current transfers to stay constant as a percentage of GDP over the adjustment process. In turn, net interest payments are calculated in three steps. First, the implicit interest rate on gross assets and liabilities is calculated as the ratio of interest receipts (payments) to gross assets (liabilities), averaged over the 2001-2005 period:

$$i_t^a = \frac{(1 + \gamma_t)kir_t}{gfa_{t-1}} \text{ and } i_t^l = \frac{(1 + \gamma_t)kip_t}{gfl_{t-1}} \tag{35}$$

where gfa_t, gfl_t, kir_t, and kip_t stand respectively for 5-year averages of gross foreign assets, gross foreign liabilities, capital interest receipts and capital interest payments (in % of GDP). ki_t data have been extracted from the CEPII-CHELEM database.

Second, we take the average between the implicit interest rate on assets and on liabilities:

$$i_t^* = \frac{i_t^a + i_t^l}{2} \tag{36}$$

Finally, we multiply this interest rate by the long-run NFA ratio, accounting for growth:

$$\overline{ki} = \frac{i^* \overline{nfa}}{(1 + \gamma)} \tag{37}$$

Using Equations (26) and (34), it follows:

$$\overline{ca} = -\frac{i^* + kg^* - \gamma}{1 + \gamma} \cdot \overline{nfa} + \overline{ki} \tag{38}$$

Medium-run trade balance targets

In the medium run, the NFA position gradually adjusts to its target level through both current-account accumulation and capital gains or losses. Iterating Equation (33) forward, and assuming i^*, kg^* and γ^* to be constant over time we get:

$$nfa_{t+T} = \beta^T nfa_t + \sum_{s=1}^{T} \beta^{T-s}(tb_{t+s} + tr_{t+s}) \tag{39}$$

Assuming that the target level of NFA, $\overline{nfa}$ is reached in T years, and denoting nfa the initial level of the NFA ratio, the constant trade-balance level (in percentage of GDP) that is consistent with NFA adjustment is $\widetilde{tb}$ such as:

$$\widetilde{tb}(T) = \frac{1 - \beta}{1 - \beta^T} \left(\overline{nfa} - \beta^T nfa \right) - tr \tag{40}$$

As previously, net interest payments in the medium run can be recovered by multiplying the implicit interest rate with the NFA ratio. This time, however, we do not

take the target NFA ratio but the observed ratio, meaning that net interest payments have not adjusted in the medium run to changes in NFA:

$$\widetilde{ki} = \frac{i^* nfa}{1 + \gamma} \tag{41}$$

with i^* the implicit interest rate as previoulsy defined.

Finally, using Equation (25), it comes:

$$\widetilde{ca}(T) = \frac{1 - \beta}{1 + \beta^T}(\overline{nfa} - \beta^T nfa) + \widetilde{ki} \tag{42}$$

Here we assume $T = 5, 7, 10$ years, successively. We use a 5-year average for nominal GDP growth.

The computed values of $\widetilde{tb}$, $\widetilde{ki}$, $\overline{tb}$, and $\overline{ki}$ for the different adjustment speeds (5, 7 and 10 years) are provided in Table A.2. below.

Table A.2 - NFA, capital interest and trade balance targets in 2005 (in % of GDP)

| Country	nfa	$\overline{nfa}$	$\widetilde{ki}$	$\overline{ki}$	$\widetilde{tb}(5)$	$\widetilde{tb}(7)$	$\widetilde{tb}(10)$	$\overline{tb}$
Canada	-8.8	-17.7	-0.3	-0.7	-1.8	-1.3	-0.9	1.2
Euro Area	-7.2	-0.3	-0.1	0.0	1.9	1.5	1.2	0.4
Japan	42.8	22.1	1.0	0.5	-6.9	-5.7	-4.8	1.9
United Kingdom	-15.0	-1.6	-0.6	-0.1	4.0	3.3	2.7	0.8
United States	-24.0	-11.9	1.0	-0.4	5.0	4.1	3.4	0.6
Argentina	-36.4	-37.0	-1.4	-1.5	3.5	3.5	3.5	3.7
Australia	-59.7	-39.6	-1.9	-1.2	4.0	2.9	2.1	1.9
Brazil	-35.3	-27.6	-1.0	-0.8	1.6	1.1	0.8	5.1
China	13.1	-17.7	0.3	-0.5	-7.5	-5.8	-4.5	0.5
India	-10.4	-51.2	-1.3	-1.6	-4.2	-3.8	-3.4	2.1
Indonesia	-40.6	-23.8	-0.5	-1.0	-3.9	-3.1	-2.6	0.4
Korea	-1.4	-13.9	0.0	-0.4	-2.4	-1.7	-1.2	1.5
Mexico	-38.7	-33.0	-1.4	-1.2	-0.1	-0.5	-0.7	-0.4
South Africa	-8.4	-13.8	-0.4	-0.7	-1.2	-0.9	-0.6	0.7
Turkey	-45.6	-38.2	-1.9	-1.6	-0.4	-0.8	-1.1	3.4

Appendix B: Observed and equilibrium NFA positions
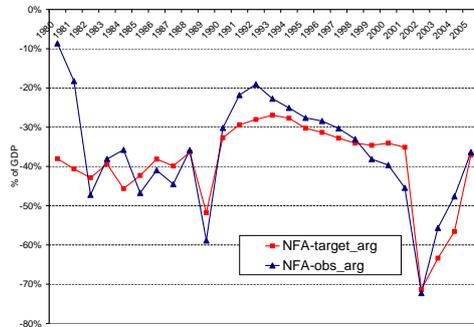
Argentina
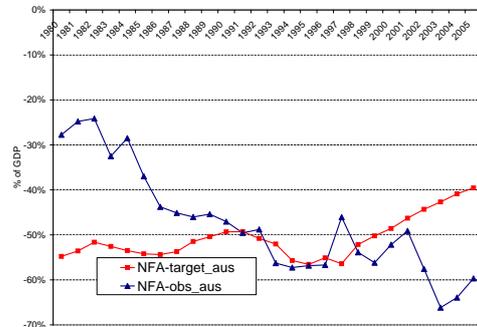
Australia
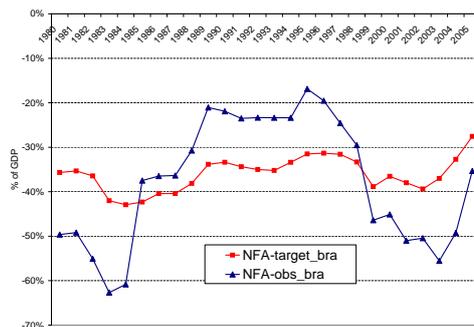
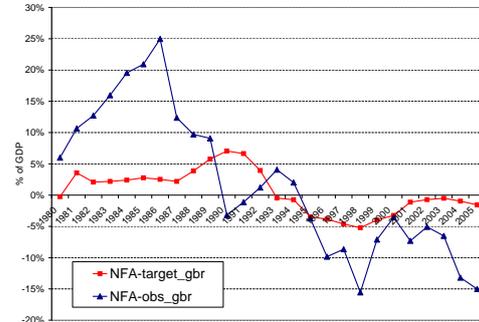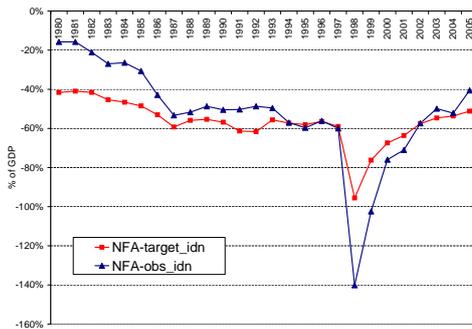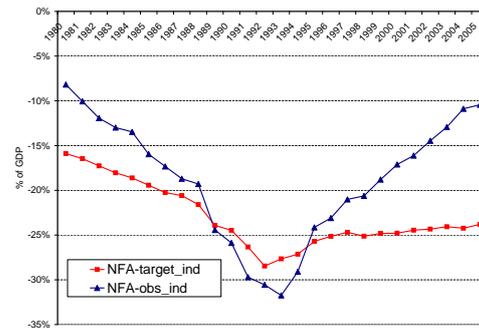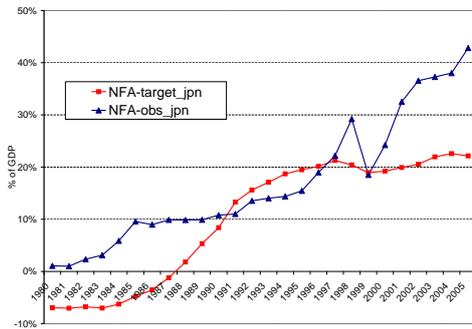Brazil
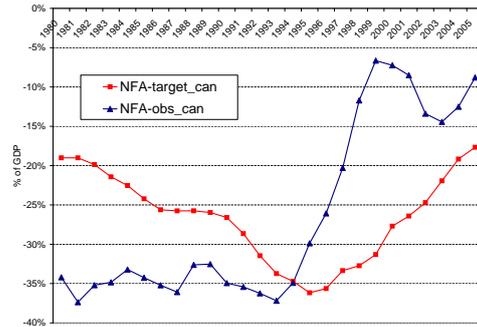
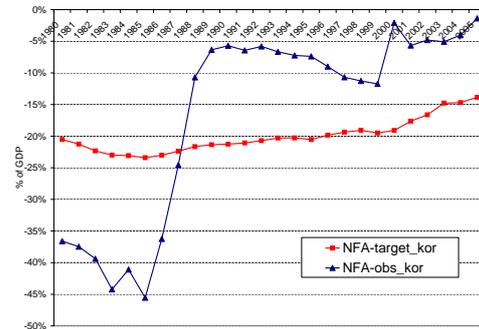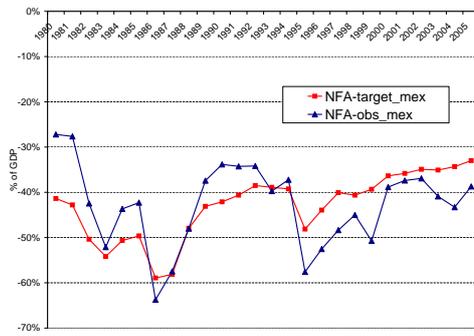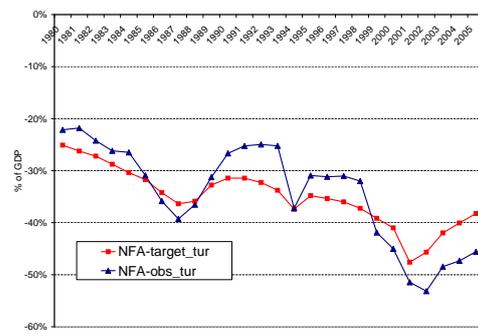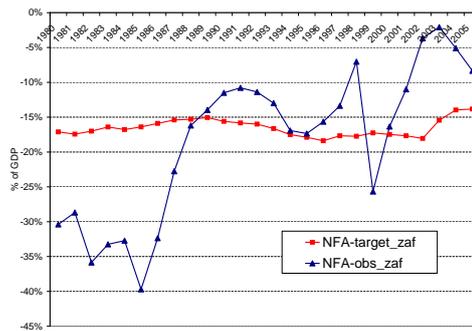
Canada
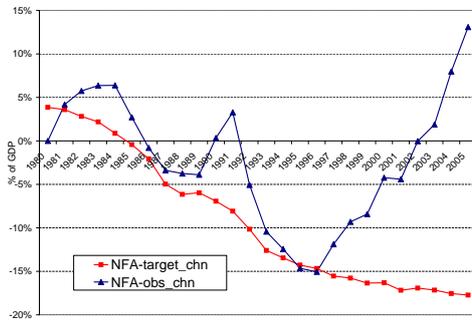
China

United Kingdom

Indonesia

India

Japan

Korea

Mexico

Turkey

South Africa

Source: authors' calculations

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