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On Equilibrium Exchange Rates: Is Emerging Asia Different?

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ON EQUILIBRIUM EXCHANGE RATES: IS EMERGING ASIA DIFFERENT?

Antonia López-Villavicencio, Valérie Mignon

NON-TECHNICAL SUMMARY

Fixed exchange-rate regimes, and more specifically the Chinese exchange-rate regime, have often been blamed for being one major building block of global imbalances. In particular, Chinese authorities have been frequently accused of maintaining the value of the yuan against major currencies at a low level to foster China's spectacular growth, through the promotion of its exports. This export-led growth has generated surging Chinese current account surpluses, creating a major source of tension among trading partners who experienced important trade deficits with China (especially the United States and European Union). The persistent misalignment of the yuan—and more generally of other emerging Asian currencies—may thus be a key factor influencing global imbalances.

Within this current context of global imbalances, it is crucial for monetary authorities to have a means to assess long-run values for the real exchange rates that would be consistent with the realization of a long-run stable macroeconomic equilibrium. To this end, various approaches have been proposed in the literature, among which the Behavioral Equilibrium Exchange Rate (BEER) based on the existence of a long-run relationship between the real exchange rate and a set of economic fundamentals. The estimation of this relationship provides the equilibrium value of the considered real exchange rate, and the speed of the adjustment of the observed exchange rate towards its equilibrium level may be obtained from the estimation of the corresponding vector error correction model. Indeed, according to the standard view, the deviations of the observed exchange rate from its equilibrium value are transitory and the adjustment process exhibits a quick mean-reverting dynamics.

This common wisdom may however be challenged by the observation of long-lasting misalignments, especially over the last two decades, notably concerning emerging Asian currencies. In this paper, our aim is to investigate this slow dynamics of the adjustment process of the observed real exchange rates to their equilibrium values within a nonlinear framework. To this end, we retain a smooth transition model, which can be thought as a reduced form of structural models of fundamental exchange rates accounting for various nonlinearities.

Relying upon a wide sample of countries, we show that the adjustment process of the real exchange rate towards its equilibrium value is nonlinear for emerging Asian countries, while it is linear for the G7 currencies. More especially, there exists an asymmetric behavior of the real exchange rate when facing an over or undervaluation in Asia: the adjustment speed is

more important in case of undervaluation, a result that may be explained by the international pressure to limit undervaluations. However, this adjustment being long-lasting, undervaluations may persist over time, as observed since the beginning of the 1990s.

ABSTRACT

The aim of this paper is to provide equilibrium exchange rates values for a large set of currencies and to study the adjustment process of observed exchange rates towards these levels by paying a special attention to emerging Asian countries. Relying on panel smooth transition regression models, we show that the real exchange rate dynamics in the long run is nonlinear for emerging Asian countries, while it is linear for the G7 currencies. More especially, there exists an asymmetric behavior of the real exchange rate when facing an over or undervaluation in Asia: the adjustment speed is more important in case of undervaluation, a result that may be explained by the international pressure to limit undervaluations. However, this adjustment being long-lasting, undervaluations may persist over time, as observed since the beginning of the 1990s.

JEL Classification: F31, C23.
Key Words: Equilibrium exchange rates, misalignments, panel smooth transition models, emerging Asia.

LES TAUX DE CHANGE D'EQUILIBRE DES PAYS EMERGENTS ASIATIQUES

Antonia López-Villavicencio, Valérie Mignon

RESUME NON TECHNIQUE

Les régimes de change fixe, et notamment le régime de change chinois, ont souvent été considérés comme l'une des causes majeures des déséquilibres mondiaux. En particulier, les autorités chinoises ont fréquemment été accusées de maintenir la valeur du yuan à un niveau faible afin de doper la croissance, via le développement des exportations. Cette croissance tirée par les exportations a ainsi généré d'importants surplus de solde courant, créant une source majeure de tensions avec les partenaires commerciaux subissant d'importants déficits avec la Chine (les Etats-Unis et l'Union Européenne notamment). La persistance du mésalignement du yuan, et plus généralement des autres devises des émergents d'Asie, peut ainsi être vue comme un facteur clé influençant les déséquilibres mondiaux.

Dans ce contexte de déséquilibres mondiaux, il est crucial pour les autorités monétaires de disposer d'un moyen pour évaluer les valeurs de long terme des taux de change, valeurs compatibles avec la réalisation d'un équilibre macroéconomique stable à long terme. Diverses approches existent dans la littérature, parmi lesquelles l'approche comportementale (BEER) basée sur l'existence d'une relation de long terme entre le taux de change réel et un ensemble de fondamentaux économiques. L'estimation de cette relation fournit alors la valeur d'équilibre du taux de change ; la vitesse de convergence du taux de change observé vers cette valeur d'équilibre étant quant à elle obtenue grâce à l'estimation du modèle à correction d'erreur correspondant. Selon la vision économique traditionnelle, en effet, les écarts du taux de change à sa valeur d'équilibre sont transitoires et un processus d'ajustement ramène rapidement à l'équilibre.

Une telle vision peut cependant être remise en cause par l'observation de mésalignements durables, surtout au cours des vingt dernières années, notamment pour les devises des pays émergents d'Asie. L'objectif de cet article est d'expliquer la lenteur de cette dynamique d'ajustement des taux de change vers leurs valeurs d'équilibre. A cette fin, nous estimons un modèle à transition lisse en panel, qui peut être considéré comme une forme réduite de modèles structurels de taux de change tenant compte de diverses non-linéarités.

Considérant un large panel de pays, nous montrons que le processus d'ajustement du taux de change vers sa valeur d'équilibre est non-linéaire pour les pays émergents d'Asie, alors qu'il est linéaire pour les pays du G7. Plus spécifiquement, il existe un comportement

asymétrique du taux de change réel face aux sous ou aux sur-évaluations en Asie : l'ajustement est plus rapide en cas de sous-évaluation, résultat qui pourrait s'expliquer par la forte pression internationale visant à limiter les sous-évaluations. Toutefois, l'ajustement n'est pas total et une certaine sous-évaluation peut persister durablement, ce que l'on observe dans le cas des devises émergentes asiatiques depuis le début des années 1990.

RESUME COURT

L'objet de cet article est de déterminer les valeurs d'équilibre des taux de change pour un large panel de pays et d'étudier la dynamique d'ajustement des taux de change observés vers ces valeurs d'équilibre, en accordant une attention particulière aux pays émergents d'Asie. L'estimation de modèles à transition lisse en panel montre que le processus d'ajustement du taux de change vers sa valeur d'équilibre est non-linéaire pour les pays émergents d'Asie, alors qu'il est linéaire pour les pays du G7. Plus spécifiquement, il existe un comportement asymétrique du taux de change réel face aux sous ou aux sur-évaluations en Asie : l'ajustement est plus rapide en cas de sous-évaluation, résultat qui pourrait s'expliquer par la forte pression internationale visant à limiter les sous-évaluations. Toutefois, l'ajustement n'étant pas total, une certaine sous-évaluation peut persister durablement.

Classification JEL : F31, C23.
Mots-clefs : taux de change d'équilibre, mésalignements, modèles à transition lisse en panel, émergents d'Asie.

ON EQUILIBRIUM EXCHANGE RATES: IS EMERGING ASIA DIFFERENT?[♦]

Antonia López-Villavicencio[*] and Valérie Mignon[**]

1. INTRODUCTION

The current context of global imbalances has led to a revival of interest in assessing equilibrium values for exchange rates. Indeed, since the mid of the 1990s—the beginning of a period characterized by the increasing contribution of emerging countries to global imbalances—the accelerating financial integration process has engendered a growing disconnection between exchange rate fluctuations and the real economic activity (Béreau et al., 2009). Moreover, fixed exchange-rate regimes, and more specifically the Chinese exchange-rate regime, have often been blamed for being one major building block of global imbalances (Bénassy-Quéré et al., 2008). In particular, Chinese authorities have been frequently accused of maintaining the value of the yuan against major currencies at a very low level to foster China's spectacular growth, through the promotion of its exports. This export-led growth has generated surging Chinese current account surpluses, creating a major source of tension among trading partners who experienced important trade deficits with China (especially the United States and European Union). The persistent misalignment of the yuan—and more generally of other emerging Asian currencies—may thus be a key factor influencing global imbalances.

Within this context of growing financial integration and global imbalances, it is crucial for monetary authorities to have a means to assess long-run values for the real exchange rates that would be consistent with the realization of a long-run stable macroeconomic equilibrium. To this end, various approaches have been proposed in the literature, among which the Fundamental Equilibrium Exchange Rate (FEER) pioneered by Williamson (1983), the Natural Real Exchange Rate (NATREX) of Stein (1994) and the Behavioral

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Equilibrium Exchange Rate (BEER) introduced by Clark and MacDonald (1998).[1] In this paper, we rely on the BEER methodology, which is based on the existence of a long-run, cointegrating, relationship between the real exchange rate and a set of economic fundamentals, such as the net foreign asset position, the relative productivity and the terms of trade. The estimation of this relationship provides the equilibrium value of the considered real exchange rate, and the speed of the adjustment of the observed exchange rate towards its equilibrium level may be obtained from the estimation of the corresponding vector error correction model (VECM).

According to the standard view, the deviations of the observed exchange rate from its equilibrium value are transitory and the adjustment process exhibits a quick mean-reverting dynamics. This common wisdom may however be challenged by the observation of long-lasting misalignments, especially over the last two decades, notably concerning emerging Asian currencies. In this context, although the BEER can be thought as a steady state attractor for the actual rate, the adjustment process towards the equilibrium may however not be appropriately represented by linear equations (Dufrénot et al., 2008). Indeed, the temporal dependence of misalignments implies that the adjustment is likely not to operate at a constant rate as assumed in linear models. Moreover, when disequilibrium appears, prices—due to their imperfect flexibility—do not quickly and painlessly move to bring the actual real exchange rate to its equilibrium level. As a consequence, using an empirical framework based on nonlinear VECM is more appropriate than the standard linear error correction models to describe the adjustment of the observed real exchange rate to its equilibrium value.

In this paper, we thus go further than the usual linear case by investigating the slow dynamics of the adjustment process of the observed real exchange rates to their equilibrium values within a nonlinear framework. More specifically, we retain a smooth transition model to describe the adjustment process, which can be thought as a reduced form of structural models of fundamental exchange rates accounting for nonlinearities produced by transaction costs (Dumas, 1992; Sercu et al., 1995), heterogeneity of market participants (Taylor and Allen, 1992), presence of noise traders causing abrupt changes (De Long et al., 1990), speculative attacks on currencies (Flood and Marion, 1999), existence of target zones (Krugman, 1991; Tronzano et al., 2003), heterogeneity of central banks' interventions (Dominguez, 1998),… Moreover, as highlighted by Béreau et al. (2010), smooth transition

[1] It should be noted that various other concepts of equilibrium exchange rates (EER) exist, such as the capital enhanced EER, the intermediate-term model-based EER, the permanent EER, the atheoretical permanent EER, or the desired EER among others. For a survey, see Driver and Westaway (2004).

models help at modeling asymmetries in the adjustment process, that may notably explain the unequal duration of undervaluations and overvaluations.

While various papers have investigated the nonlinear behavior of the adjustment process in a time series context,[2] very few contributions have been done within a panel framework. We aim at filling this gap here by relying on a large panel of countries, including both industrialized and emerging economies. Considering such a panel seems to be a crucial point to derive consistent equilibrium exchange rates by accounting for the rising share of developing countries—especially Asian—in global imbalances and, more generally, in the international monetary system.

On the whole, our aim in this paper is to investigate the behavior of exchange rate misalignments by paying a particular attention to the case of emerging Asian countries. To this end, the paper is organized as follows. Section 2 presents the estimation of the currency misalignments. In Section 3, we address the question of the nonlinearity of the adjustment process of the observed real exchange rates towards their equilibrium value by estimating panel smooth transition models. Section 4 concludes.

2. ESTIMATION OF CURRENCY MISALIGNMENTS

2.1. The BEER equation and data

We rely on the BEER approach introduced by Clark and MacDonald (1998) that consists in estimating a long-term relationship between the real effective exchange rate and its fundamentals. Based on previous studies (Bénassy-Quéré et al., 2009 ; Béreau et al., 2009, 2010), we consider the following determinants of the real effective exchange rate: the net foreign asset position, a measure of relative productivity and terms of trade. More specifically, we estimate the following relationship:

$$q_{i,t} = \alpha_i + \beta_1 nfa_{i,t} + \beta_2 prod_{i,t} + \beta_3 tot_{i,t} + \varepsilon_{i,t} \qquad (1)$$

where i = 1, …, N denotes the country, and t = 1, …, T the time. $q_{i,t}$ is the real effective exchange rate (in logarithms),[3] $nfa_{i,t}$ denotes the net foreign asset position expressed as percentage of GDP, $prod_{i,t}$ stands for the logarithm of the relative productivity in the traded-goods sector relative to the non-traded goods one, and $tot_{i,t}$ is the logarithm of terms of trade. Finally, $\varepsilon_{i,t}$ is an error term and α_i accounts for country-fixed effects.

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[2] See Michael et al. (1997), Ma and Kanas (2000), Chen and Wu (2000), Taylor et al. (2001), Baum et al. (2001), Dufrénot and Mignon (2002), Dufrénot et al. (2006, 2008), López-Villavicencio (2008).

[3] A rise (resp. decrease) in q denotes a currency appreciation (resp. depreciation).

We expect a positive link between the real effective exchange rate and all those potential determinants. Indeed, the real effective exchange rate is expected to appreciate if (i) the net foreign asset position increases, due to implied net interest receipts, (ii) productivity in the tradable sector increases relative to the rest of the world, according to the Balassa-Samuelson effect, and (iii) terms of trade follow an increasing trend, leading to an improvement of the trade balance.

More precisely, considering first the *nfa* variable, the real exchange rate is supposed to depend on capital flows, as well as imbalances between national savings and investment.[4] Indeed, there are several channels through which the stock of foreign assets can influence the real exchange rate. For instance, relying on a short-term horizon, portfolio-balances considerations suggest that a deficit in the current account creates an increase in the net foreign debt of a country, which has to be financed by international investors who demand a higher yield to adjust their portfolio. At given interest rates, this can only be achieved through a depreciation of the currency of the debtor country. In the long run, current deficits accumulate in net foreign debts, for which interests have to be paid. Facing these higher interest payments, the debtor country needs to strengthen its international price competitiveness. As a consequence, to increase the attractiveness of its exports, the country needs to depreciate its currency (see Maeso-Fernandez et al., 2004). We therefore expect an increase of the net foreign asset position of a country (i.e. a reduction of the foreign debt) to have a positive effect on the currency (i.e. an appreciation). Second, the impact of productivity differentials is expected to follow the well-known Balassa-Samuelson effect which depends on differences in the relative productivity of the tradable and non-tradable sectors across countries. The productivity in the traded goods sector being higher than that in the tradable one, the real exchange rate is expected to appreciate for catching-up countries. Finally, the real exchange rate can also be affected by commodity price shocks through their impact on the terms of trade. Overall, a lasting deterioration of the terms of trade of a country should result in a depreciation of its real exchange rate.

To estimate Equation (1), we use annual data over the 1980-2007 period. To derive consistent equilibrium exchange rates, we rely on a large panel of countries including both developed and developing or emerging countries: Argentina, Australia, Brazil, Canada, Chile, China, Colombia, Costa Rica, Denmark, Egypt, Euro area, Hong-Kong, India, Indonesia, Israel, Japan, Korea, Malaysia, Mexico, New Zealand, Norway, Peru,

[4] Lane and Milesi-Ferretti (2004), among others, explore the theoretical link between the real exchange rate and the net foreign assets, and provide evidence that the net foreign asset position is an important determinant of the real exchange rate for developing as well as developed countries.

Philippines, Singapore, Sweden, Switzerland, Thailand, Turkey, United Kingdom, United States, Uruguay, and Venezuela.[5]

Turning to the variables that enter in the BEER equation, the real effective exchange rate for each country *i* is defined as the weighted average of real bilateral exchange rates against each *j* trade partner. Bilateral real exchange rates are expressed as the ratio of nominal rates to the corresponding consumer price indices (CPI); they are based in 2000. Nominal exchange rates and CPI data are taken from World Bank, World Development Indicators (WDI), except the EUR/USD exchange rate which was extracted from Datastream and China's real exchange rate which was calculated with GDP deflator (WDI). The weights correspond to the share of each partner in average values of imports and exports of goods and services over the 2000-2007 and are extracted from the IMF, Direction of Trade Statistics.[6] Formally, we have:

$$q_{i,t} = \sum_{j \neq i} w_{ij} \left(e_{i,t} - e_{j,t} \right) = \sum_{j \neq i} w_{ij} e_{ij,t} \qquad (2)$$

where $\sum_{j \neq i} w_{ij} = 1$, $e_{i,t}$ is the logarithm of the real bilateral exchange rate of currency *i* vis-à-vis the USD, $e_{ij,t}$ the logarithm of the real bilateral exchange rate of currency *i* against the *j* currency and w_{ij} the trade weights.

Turning to the explanatory variables, the net foreign asset position is built using the Lane and Milesi-Ferretti online database from 1980 to 2004. The series have been completed from 2005 to 2007 using data on gross foreign assets and liabilities provided by IFS (International Financial Statistics, IMF) and WDI. Terms of trade are excerpted from WDI, except for the Euro zone and Chile (IFS). Concerning now the proxy for relative productivity, we use the relative labor productivity of tradables to non tradables, measured by output per worker.[7] The choice of this measure of the Balassa-Samuelson effect compared to other proxies—such as the ratio of the consumer price to the producer price

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[5] We included these high and middle income countries not only for data availability (our estimations require balanced panels), but also because they account for most of the world trade.

[6] Note that intra-Eurozone flows have been excluded and trade weights have been normalized to sum to one across the partners included in the sample.

[7] It is calculated on the basis of a dataset for output and employment for a 6-sector classification (or 3-sector when the 6-sector data were not available) and data are taken from the following sources: the United Nations Statistics Division, International Labor Office Bureau of Statistics, Eurostat, World Bank and Groningen Growth and Development Centre.

index (PPI) for the home country relative to the same ratio for the country's major trading partners—may be especially relevant in the case of Asian countries. In particular, in the China's case, elements of the CPI, such as utility prices, are still under government control, housing costs are imputed based on prices in rental markets that are not fully developed, and there is mismeasurement of price increases because adequate adjustments for improvements in quality—especially for durable goods—are not made.[8] Liberalization of price control in China has affected the CPI and the PPI by different amounts and at different times, with the resulting changes in the ratio of the two price series potentially being misinterpreted as changes in productivity (Dunaway et al., 2006).

2.2. Estimation results

As a first step, we have applied panel unit root and cointegration tests. The results[9] indicate that all our series are integrated of order 1 and cointegrated. It is thus possible to proceed to the estimation of the long-run relationship (1). To this end, we rely on the PMG (pooled mean group) methodology proposed by Pesaran et al. (1999). This estimator combines two procedures that are commonly used in panels. The first one, known as the "mean group estimate", consists in estimating separate relationships for each country (or group) and averaging the group specific coefficients. The second one is based on the traditional pooled estimators that allow only the intercepts to differ freely across countries, while all the other coefficients are constrained to be the same. The PMG estimator can be viewed as an intermediate estimator since it combines both pooling and averaging. Given that we are dealing with advanced and emerging economies, some degree of heterogeneity between countries would be recommended. In this sense, the advantage of the PMG estimation procedure over other techniques such as FM-OLS (fully-modified OLS) and DOLS (dynamic OLS) is that, while slope homogeneity is imposed, short-run heterogeneity is allowed for each member of the panel.

[8] Moreover, as noticed by Chinn (2000, 2005) and Cheung et al. (2005), another drawback of the relative price ratio is that it can be affected by factors unrelated to the Balassa-Samuelson effect, especially relative demand effects, tax changes, or the nominal exchange rate itself.

[9] All results are available upon request to the authors.

Table 1. Estimation of the cointegrating relationship (PMG methodology)

	nfa	*prod*	*tot*
Coefficient	0.174	0.187	0.155
t-stat	3.969	3.267	4.722

Results are given in Table 1. All the coefficients have the expected positive sign. Indeed, the real effective exchange rate appreciates if net foreign assets rise, as well as the relative productivity and terms of trade.

2.3. Exchange rate misalignments

Given the previous estimations, we can now proceed to the derivation of currency misalignments defined as:

$$m_{i,t} = q_{i,t} - \hat{q}_{i,t} \quad (3)$$

where $\hat{q}_{i,t}$ is the equilibrium exchange rate given by the cointegrating relationship.

Table 2. Currency misalignments in 2007 (in percentage), based on the PMG estimates

Undervalued currencies		Overvalued currencies		Currencies close to equilibrium	
Argentina	-54.79	Australia	21.92	Mexico	3.43
Brazil	-23.59	*Canada*	*11.29*	Peru	-1.66
Chile	-14.90	Colombia	13.43	**Philippines**	**-3.31**
China	**-20.90**	Denmark	6.96	Uruguay	1.40
Costa Rica	-9.38	*Eurozone*	*10.18*	*USA*	*-3.20*
Egypt	-52.06	**Korea**	**12.82**	Venezuela	-1.08
Hong Kong	**-27.61**	New Zealand	21.09		
Indonesia	**-14.91**	Turkey	30.70		
India	**-12.47**	*UK*	*14.37*		
Israel	-21.82				
Japan	*-19.85*				
Malaysia	**-34.70**				
Norway	-20.04				
Singapore	**-9.62**				
Sweden	-14.89				
Switzerland	-9.51				
Thailand	**-16.52**				

Note: In bold: Emerging Asian countries. In italics: G7 countries. A positive (resp. negative) sign denotes an overvaluation (resp. undervaluation).

Table 2 reports the values of misalignments for 2007, the last point of our sample. With the exception of Japan whose currency is undervalued in 2007 and the USD which is slightly undervalued, but very close to its equilibrium value, all other G7 currencies are overvalued in 2007. Turning to the emerging Asian countries, all the currencies but the Korean won are undervalued. The amount of undervaluation is quite large, especially for Malaysia, Hong

Kong and China. The undervaluation of the yuan, around 20%, is in the range of the estimations generally found in the literature, as surveyed by Cline and Williamson (2007). Cheung et al. (2005, 2006, 2007), who have investigated in detail the behavior of the yuan,[10] report however some different results. More specifically, the authors evaluate the value of the yuan using three approaches—relative purchasing power parity (PPP), absolute PPP, and Balassa-Samuelson hypothesis—and show that the undervaluation of the Chinese currency widely varies according to the chosen procedure.

To account for this important finding and as a robustness check, we also estimate misalignments according to the PPP hypothesis. In this case, the equilibrium exchange rate is associated with an international version of the law of one price and is obtained by regressing, on a country-by-country basis, the real exchange rate on a constant and a time trend (when significant). Results are presented in Table A.1 in the Appendix. While there exists some differences in terms of size of the misalignments, the global pattern is similar to that reported in Table 2: indeed, with a few exceptions, these are the same currencies that are over or undervalued. Turning to the special case of Asian currencies, we also find that they are generally undervalued (except Korea which is overvalued). For instance, the undervaluation of the yuan is estimated at 16%, which is quite close to that obtained with the BEER approach.

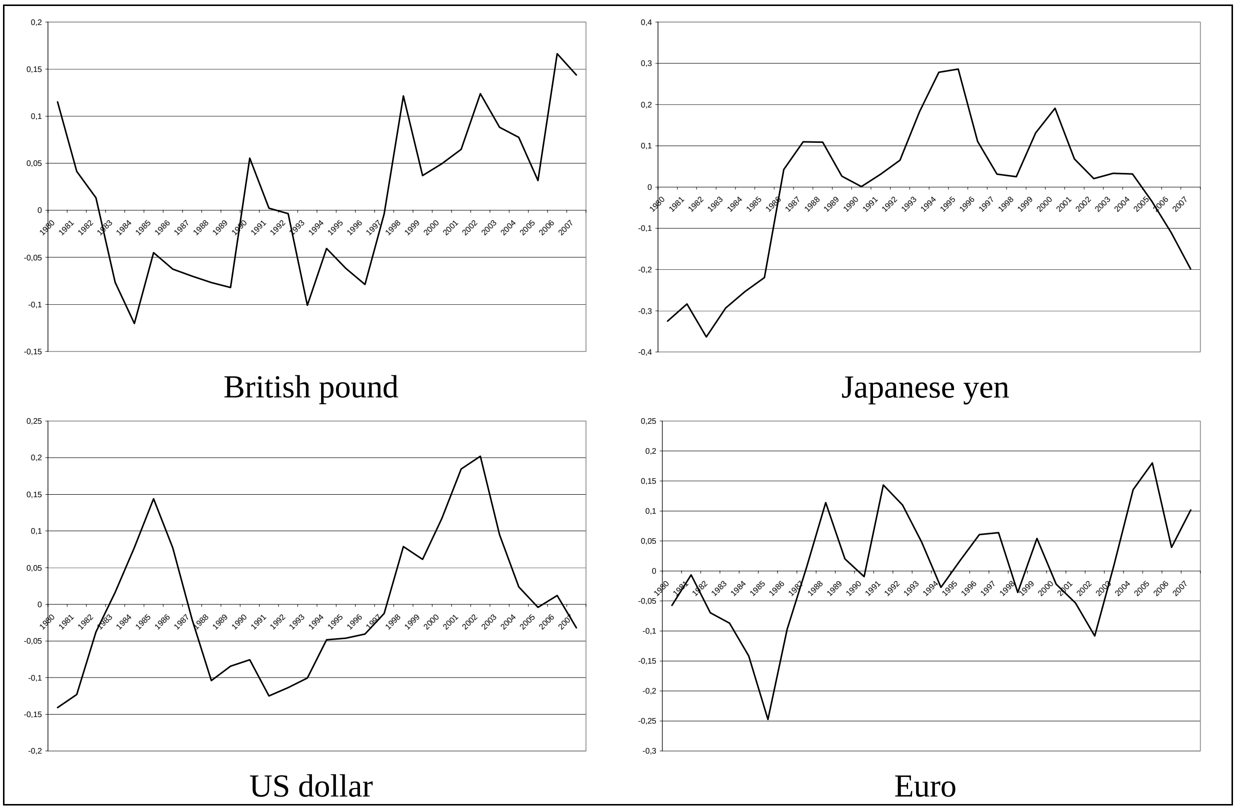
Considering the whole period, 1980-2007, the misalignments of G7 currencies globally follow an increasing trend, as reported in Figure 1 for the British pound, the Japanese yen, the USD and the euro. Consistent with common wisdom, the USD appears overvalued from 1983 to 1986. It is undervalued from 1988 to 1995, and overvalued again from 1997 to 2005. Since 2005, it is close to its equilibrium value, while being slightly undervalued at the end of the period. Turning to the euro, the misalignment is quite stable on the whole period even if the euro follows a clear appreciating trend since 2002 and is overvalued since 2003. The British pound tends to be overvalued since the end of the 1990s, and the Japanese yen, while being overvalued during a long period from the end of the 1980s to 2005, is now undervalued.

Considering emerging Asian currencies (Figures 2 and 3), for five of them their currencies' misalignments progressively move from overvaluation to undervaluation over the period: China, India, Indonesia, Malaysia and Thailand. With the exception of the Thai bath whose undervaluation starts at the end of the 1990s, the other four currencies are undervalued since the beginning of the 1990s. Regarding more specifically the case of the Chinese currency, the yuan is undervalued since the liberalization of the economy; the undervaluation being

[10] The article by Cheung et al. (2005) also provides a complete survey on the theoretical and empirical literature on the Renminbi misalignments.

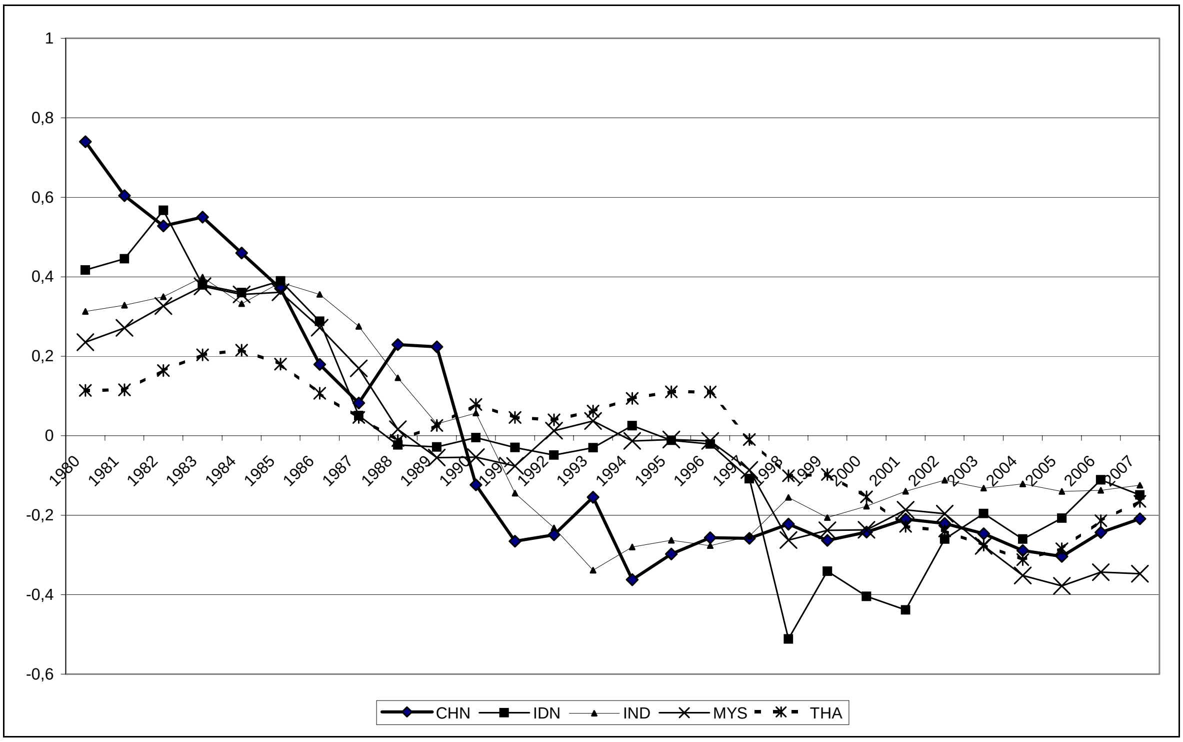
reinforced at the beginning of the 2000s due to various factors—in addition to China's fixed exchange rate regime: (i) very low inflation rate (see Figure A.1 in Appendix) , (ii) depreciation of the USD, (iii) high current-account surpluses that may be a sign of competitiveness advantage for Chinese exports (Figure A.2 in Appendix), and (iv) surging foreign exchange reserves, the latter having accelerated at the beginning of the 2000s due to recurrent Central bank's interventions in order to impede the yuan appreciation (Figure A.3 in Appendix). As noted by Coudert and Couharde (2005), in the absence of such interventions, the yuan would have appreciated, which can be viewed as a clear indication of undervaluation. Turning to Hong Kong, the Philippines and Singapore, the pattern is less clear-cut. The misalignments exhibit a global decreasing trend on the whole period for the Philippines and Singapore, whose currencies have known important overvaluations most of the part of the 1990s and are undervalued since the end of the 1990s.

Figure 1. Misalignments of some G7 currencies



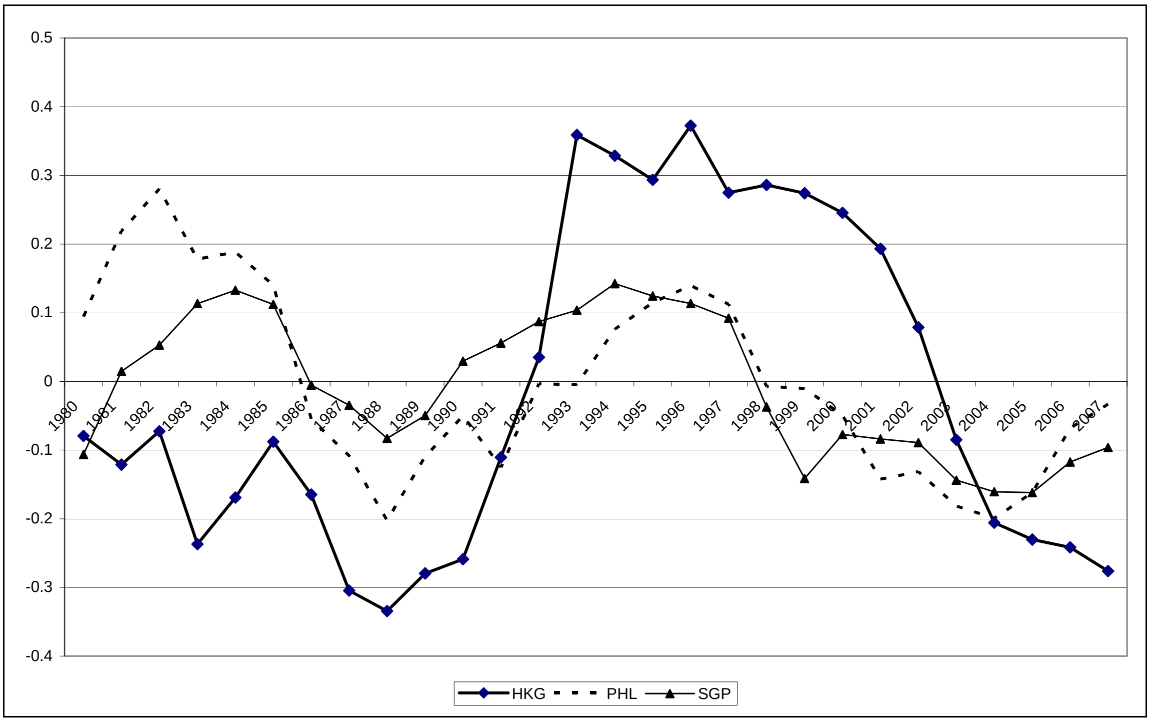
Source: authors' calculations.

Figure 2. Emerging Asia misalignments



Note: CHN: China, IDN: Indonesia, IND: India, MYS: Malaysia, THA: Thailand. Source: authors' calculations.

Figure 3. Emerging Asia misalignments (Continued)



Note: HKG: Hong Kong, PHL: Philippines, SGP: Singapore. Source: authors' calculations.

Not only are emerging Asia's real exchange rates, on average, highly undervalued in recent years, but they are also more volatile and unstable—particularly when compared with the evolution of the misalignment in most of the advanced economies (see Table A.2 in the Appendix).

On the whole, our estimations indicate that real exchange rates seem to exhibit more mean-reverting dynamics for G7 countries than for emerging Asian ones. Indeed, periods of over and undervaluations tend to alternate quite frequently for the currencies of industrialized countries. On the contrary, the dynamics for emerging Asian currencies' misalignments strongly differs: emerging Asian exchange rates are undervalued particularly since the 1990s, and spend a long time away from their equilibrium value, showing no clear mean-reverting dynamics.

3. CONVERGENCE TO EQUILIBRIUM: HOW LONG ARE THE DISEQUILIBRIA?

Our aim in this section is to investigate the dynamics of the adjustment process of the exchange rate towards its equilibrium value. A standard way to proceed is to estimate vector error correction models, that allow assessing the speed at which this adjustment takes place. However, as previously stated, these standard models may be too poor to account for the full dynamics of the adjustment process since they implicitly assume that (i) the adjustment speed towards equilibrium is both continuous and constant, regardless the extent of the real misalignment, and (ii) any deviation from the equilibrium level is temporary since there exist forces ensuring quickly mean-reverting dynamics. This standard view may however be challenged by the results obtained in the previous section evidencing that some countries, especially Asian emerging ones, are characterized by long lasting substantial misalignments. As an example, the yuan is found undervalued since 1990 and never recovers its equilibrium value until 2007, the last point of our sample. The fact that these exchange rates may spend long periods away from their equilibrium values may be explained by nonlinearities such as: transaction costs (Dumas, 1992, Sercu et al., 1995), heterogeneity of market participants (De Long et al., 1990; Taylor and Allen, 1992), or existence of target zones (Krugman, 1991). All these factors may explain a nonlinear adjustment mechanism of the exchange rate towards its equilibrium level with time-dependence properties. This leads us to investigate in more detail the adjustment process within a nonlinear panel framework.

To this end, we consider panel smooth transition models, which allow us to investigate the slowness of the adjustment process by accounting for the potential afore mentioned nonlinearities. They also offer a way to model possible asymmetries inherent to the adjustment process that may explain, for instance, the unequal duration of undervaluations and overvaluations.

3.1. Methodology[11]

Let $\{z_{i,t}, s_{i,t}, x_{i,t}; t = 1,...,T; i = 1,..., N\}$ be a balanced panel with $z_{i,t}$ denoting the dependent variable, $s_{i,t}$ the threshold variable, and $x_{i,t}$ a vector of k exogenous variables. The panel smooth transition regression (PSTR) model introduced by González et al. (2005) can be written as follows:

$$z_{i,t} = \mu_i + \beta_0' x_{i,t} + \beta_1' x_{i,t} g(s_{i,t}; \gamma, c) + \upsilon_{i,t} \tag{4}$$

[11] This section is based on Béreau et al. (2009, 2010).

where μ_i denotes the individual fixed effects, $g(s_{i,t};\gamma,c)$ is the transition function, normalized and bounded between 0 and 1, γ the speed of transition from one regime to the other and c the threshold parameter. The threshold variable $s_{i,t}$ may be an exogenous variable or a combination of the lagged endogenous one (see van Dijk et al., 2002). In this model, the observations in the panel are divided into two regimes[12] depending on whether the threshold variable is lower or larger than the threshold c. The error term $\upsilon_{i,t}$ is independent and identically distributed.[13] The transition from one regime to another is smooth and gradual.

Following Granger and Teräsvirta (1993) and Teräsvirta (1994) in the time series context or González et al. (2005) in a panel framework, the following specification can be used for the transition function:

$$g(s_{i,t};\gamma,c)=\left[1+\exp\left(-\gamma\prod_{j=1}^{m}(s_{i,t}-c_j)\right)\right]^{-1} \quad (5)$$

with $\gamma > 0$ and $c_1 \le c_2 \le ... \le c_m$. When $m = 1$ and $\gamma \to \infty$, the PSTR model reduces to the panel threshold regression (PTR) model introduced by Hansen (1999), characterized by an abrupt change from one regime to the other. González et al. (2005) mention that from an empirical point of view, it is sufficient to consider only the cases of $m = 1$ (logistic) or $m = 2$ (exponential) to capture the nonlinearities due to regime switching. In the first case, the adjustment process is asymmetric and the two regimes are associated with small and large values of the transition variable (the misalignment) relative to the threshold. On the contrary, in the case of an exponential specification, the two regimes have similar structures—meaning that increases and reductions of the transition variable have similar dynamics—but the middle grounds are characterized by a different dynamic than that in the extremes.

[12] Of course, it is possible to extend the PSTR model to more than two regimes.

[13] Since this is a strong assumption, we tested this hypothesis on the residuals for each of the nonlinear models presented. In all the cases, the residuals are found to be white noise processes.

Following the methodology used in the time series context, González et al. (2005) suggest a three step strategy to apply PSTR models:

- Specification. The aim of this step is to test for homogeneity against the PSTR alternative. To this end, we rely on the LM-test statistic provided by González et al. (2005) that can be used to select (i) the appropriate transition variable as the one that minimizes the associated p-value and (ii) the appropriate order *m* in Equation (5) in a sequential manner.
- Estimation. Nonlinear least squares are used to obtain the parameter estimates, once the data have been demeaned.
- Evaluation and choice of the number of regimes. We apply misspecification tests in order to check the validity of the estimated PSTR model. We follow González et al. (2005) who propose to adapt the tests of parameter constancy over time and of no remaining nonlinearity introduced by Eitrheim and Teräsvirta (1996) in the time series context.

On the whole, putting together Equations (1) and (4), our complete model is given by:

$$\begin{aligned}\Delta q_{i,t} &= \mu_i + \left(\theta m_{i,t-1} + \delta_1 \Delta nfa_{i,t} + \delta_2 \Delta prod_{i,t} + \delta_3 \Delta tot_{i,t}\right) \\ &\quad + \left(\theta^* m_{i,t-1} + \delta_1^* \Delta nfa_{i,t} + \delta_2^* \Delta prod_{i,t} + \delta_3^* \Delta tot_{i,t}\right) g\left(s_{i,t};\gamma,c\right) + u_{i,t}\end{aligned} \quad (6)$$

where $m_{i,t} = q_{i,t} - \hat{q}_{i,t}$, $\hat{q}_{i,t}$ being the BEER value, and $u_{i,t}$ is an error term.

3.2. Estimation results

We start by testing the null hypothesis of linearity in Equation (6) using the Gonzalez et al. (2005) test with the misalignment series as the relevant transition variable. In other words, we test (i) if there exists a different reverting dynamics of the exchange rate towards its equilibrium value when facing positive and negative misalignments, and (ii) if the transition from one regime to another depends on the size and the sign of the deviation of the real exchange rate to its equilibrium level. The results[14] conclude that (i) the null of linearity is rejected at the 5% significance level, and (ii) the logistic specification is preferred to the exponential one, evidencing that under and overvaluations are corrected differently. Indeed, given that the logistic function proved to be more appropriate than the exponential one, there is no support to the principle that it takes the same time to correct high

[14] Results are available upon request to the authors.

undervaluations and high overvaluations, simply because the "costs" of correcting them might be different. Several reasons can explain this different correcting mechanism. For instance, to correct an undervaluation, the currency has to appreciate. This may happen through a Balassa-Samuelson effect, or similarly, through salaries increasing faster in the home country. We will go back to this idea latter on.

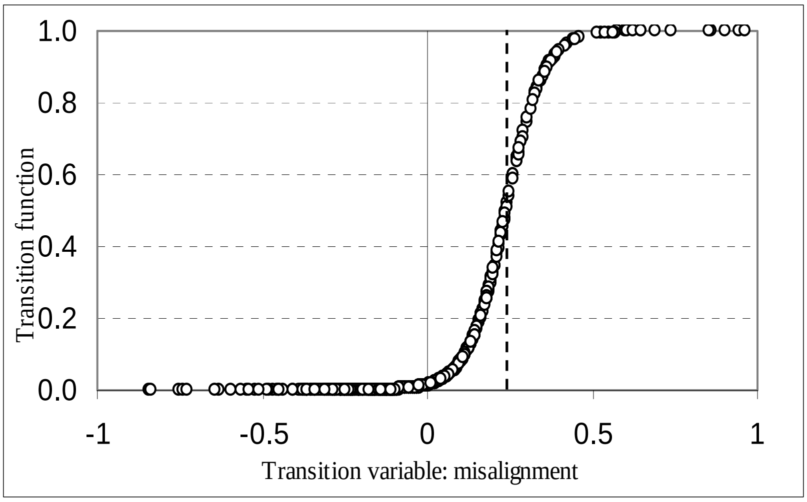
Table 3. PSTR model estimation, 1980-2007

	Regime 1					**Regime 2**				
	Speed of adjustment		Half-life	Range		Speed of adjustment		Half-life	Range	
	θ	t-stat		lower	higher	θ+θ*	t-stat		lower	higher
Whole sample	-0.186	-5.80	4.3	-61.5%	24.4%	-0.238	-3.16	3.2	24.5%	55.6%
Emerging Asia	-0.233	-4.03	3.3	-51.5%	-14.2%	-0.013	-0.84	5.3	-14.3%	56.7%
G7	Linear									

Note: This table reports the estimation of the error-correction terms in both the linear (θ) and the nonlinear (θ+θ*) regimes (Equation (6)), together with their t-statistics. Half-life refers to the number of years for correcting 50% of the deviation from the equilibrium value. The range gives the minimum and the maximum values taken by the misalignment in each regime.

Table 3 reports the results of the estimation of the main parameters, i.e. the error correction coefficients in the two extreme regimes, θ and θ + θ*, the threshold parameter *c*, and the half-lives of deviations from equilibrium. The estimated threshold is equal to 0.244. This means that the first regime, characterized by $g(.) = 0$, corresponds to undervaluations and overvaluations less than 24.4%. The second regime, corresponding to $g(.) = 1$, concerns overvaluations more than 24.4%. We found a negative and statistically significant error correction term in both regimes, implying that if the fundamentals in the last period dictate a lower real exchange rate than that observed, then it will depreciate in the current period. The estimated (average) error correction coefficients show that the adjustment is sizeable, increasing slightly for higher overvaluations. In other words, whereas about 19% of the adjustment is corrected within a year in the case of undervaluations, 24% is corrected for high overvaluations, corresponding to half-lives of 4.3 and 3.2 years, respectively. As illustrated by Figure 4, there is a continuum of observations in each regime, with slightly more observations to the left of the threshold, indicating that most of the currencies were on average undervalued, with a high tendency to revert to equilibrium.

Figure 4. Misalignment versus transition function, whole sample



Source: authors' calculations.

Let us now turn to the panel constituted by emerging Asian countries. The results strongly differ from those obtained for the whole sample. Indeed, the estimated threshold is now equal to -0.142, corresponding to an undervaluation of 14.2%. The negative sign of the threshold parameter is consistent with the fact that Asian emerging currencies are undervalued on average (see Figures 2 and 3). The estimated error correction term θ is negative and significant in the first regime, corresponding to high undervaluations. On the contrary, the estimated coefficient is not significant in the second regime, taking a value close to zero $(\theta + \theta^* \cong -0.03)$. This means that the adjustment process is clearly more effective in case of an undervaluation than when an overvaluation occurs, putting forward the asymmetric property of the real exchange rate adjustment towards equilibrium.[15] This

[15] As a robustness check, we have estimated the PSTR model for Asian emerging countries on the two distinct sub-periods characterizing the evolution of their real exchange rates: 1980-1989 (overvaluation period) and 1990-2007

asymmetric behavior may be explained by the fact that, while undervaluations can be viewed as a means for a country to enhance its growth through the promotion of its exports, the international pressure for limiting undervaluations is stronger than for overvaluations. This may explain why undervaluations tend to be corrected faster than overvaluations. One may also wonder whether this result comes from the nature of the exchange rate regime. Indeed, as recalled by Coudert et al. (2008) among others, a peg tends to hinder the adjustment of the real exchange rate to its equilibrium value, as all the adjustment has to be made through prices, known to be rigid in the short run. This is especially true in the downward sense, making pegged currencies more prone to overvaluation. Hence, the nature of the exchange rate regime may be an explanation of the asymmetric adjustment process. To check this hypothesis, we investigate whether the misalignments obtained for 2007 (Table 2) are linked to the exchange rate regime, relying upon the IMF classification. As it can be seen from Table A.3 in Appendix, there seems to be no systematic link between the nature of the exchange rate regime and the misalignments, confirming the results by Coudert et al. (2008).[16]

Note that, as for the calculation of the misalignments, we proceeded to robustness checks by estimating the PSTR model based on the PPP measure of the real exchange rate misalignment. Our findings show that this asymmetric behavior is a robust phenomenon since the error correction term is negative and significant in the first regime (θ = -0.66), while it is close to zero and non significant in the second regime $\left(\theta + \theta^* \cong -0.05\right)$.[17] Some potential explanations to this asymmetric adjustment of emerging Asian currencies are provided in Section 3.3.

As seen in Figure 5, even though most of the observations are to the left of the zero line (i.e. observations reflecting undervaluations), those that present an important mean reversion (i.e. with undervaluations higher than 18%) are less abundant. The results of the nonlinear estimation show that mean reversion gets weaker the smaller the size of the undervaluation, and for overvaluations in general. Most of the points to the right of the zero line in Figure 5, correspond to the overvaluations characterizing the beginning of the period under study

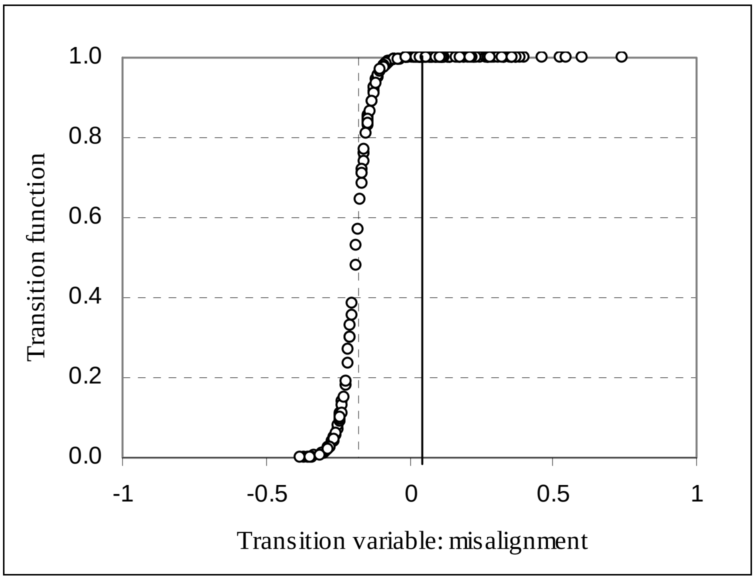
(undervaluation period). Turning to the most recent period of undervaluation, our findings show that while undervaluations tend to be corrected (the error correction term being significantly negative), high overvaluations (more than 30%) are not corrected (the error correction term being positive). On the whole, these results tend to confirm that the adjustment process of the exchange rate towards its equilibrium value is more effective in case of undervaluations than for overvaluations.

[16] As a robustness check, we did the same exercise using the Ilzetzki et al. (2008) classification, which leads to similar results.

[17] Complete results of the PSTR estimation are available upon request to the authors.

(remember that most of the Asian currencies were overvalued between 1980 and 1990). As illustrated by Figure 2, the period of overvaluation lasted about ten years, with a very slow descending trend towards, first, equilibrated real exchange rates and, then, to the period of undervaluation that has lasted since then.[18] In this second period, the average misalignment is considerably lower than in the first period, and reversion towards equilibrium seems to be more important.

Figure 5. Misalignment versus transition function, emerging Asia



Source: authors' calculations.

Finally, results in Table 3 indicate that the case of G7 economies alone is strongly different from the rest of the panel. Indeed, the null hypothesis of linearity is not rejected when the misalignment is used as the threshold variable. As a consequence, in the most industrialized countries, reversion to equilibrium happens regardless of the size of the deviation from

[18] China, for instance experienced an average overvaluation of 40% between 1980 and 1989 (with an overvaluation of almost 75% at the beginning of the period). Since 1990, the Chinese undervaluation has been 24.5% on average, reaching the highest value (36%) in 1994.

equilibrium.[19] This result is consistent with our previous findings relating to misalignments (see Section 2.3), in particular with the fact that periods of over and undervaluations tend to alternate quite frequently for the currencies of the most industrialized countries.

3.3. Explaining the asymmetric adjustment of emerging Asian currencies: the case of China

Two main facts emerge from our previous results. First, after a decade of high overvaluations, Asian real exchange rates have been, in general, undervalued since the beginning of the 1990s. Yet, this undervaluation is, on average, smaller in magnitude than the observed overvaluation during the 1980s. Second, and related to the previous point, disequilibria in emerging Asia are corrected faster in case of undervaluations than in case of overvaluations. In other words, our results tend to indicate that real exchange rate appreciations are faster than depreciations.

Looking at the specific case of China, whereas the overvaluation reached levels higher than 50% at the beginning of the 1980s (almost 75% in 1980, during the exchange rate administered system), the undervaluation has not exceeded 40%. At the same time, there seems to be a tendency to reduce this undervaluation, which, in 2007, was approximately equal to 20% according to our presented BEER model (16% regarding the PPP measure, see Table A.1 in Appendix). In other words, whereas during the 1980s there was an important, lasting gap between the real effective exchange rate and the economic fundamentals with a corresponding significant overvaluation, since 1990 we observe a reduction of this deviation between the observed and the equilibrium exchange rates. Before attempting to explain this dynamics, it should be mentioned that the Chinese exchange rate regime was different during these two decades. Indeed, during the 1981-1994 period, it was characterized by a dual system composed by an official rate together with a foreign exchange market (swap market). In January 1994, this system was replaced by a unified exchange rate market, leading to a managed float regime.

There are several possible explanations for the behavior of the Chinese misalignment and, in particular, the asymmetric adjustment of the yuan when facing under or overvaluations. Certainly, given that the real effective exchange rate adjustment is, by definition, exerted through prices or nominal exchange rates, the flexibility of these factors would play a crucial role.

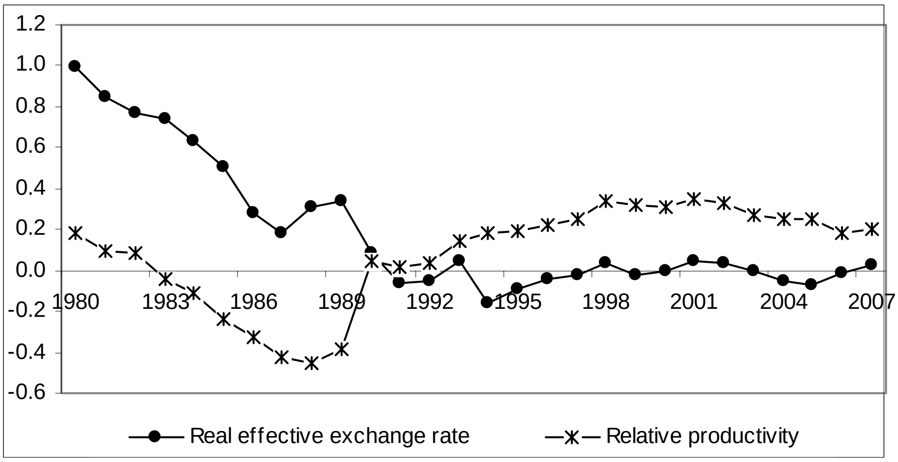
Regarding the flexibility of the nominal exchange rate, and as it was mentioned before, the argument according to which a stronger yuan would help reducing global imbalances in general, and the US trade deficit in particular, explains the increasingly international

[19] This result confirms previous studies in a time series context; see López-Villavicencio (2008) among others.

pressures to allow the Chinese currency to appreciate and therefore, to limit the yuan undervaluation, especially during the 2005-2007 period. Even though the Chinese authorities have not strongly reacted to these urges, some changes can be seen in the reevaluation of their currency. In this respect, Frankel and Wei (2007) suggest that the increase in Chinese currency flexibility, small though it is, has been gradually accelerating, at a rate that would suggest the likelihood of some genuine flexibility. China allowed the yuan to rise by 21% against the dollar in the three years to July 2008, a fact that may be opposed to the long period of depreciation of the yuan between 1980 and the beginning of the 1990s.

Yet, in spite of these small nominal adjustments to increase the value of the Chinese currency, China keeps its exchange rate tightly fixed to the dollar. Therefore, the evolution of the USD exchange rate against other currencies, as well as the dynamics of the Chinese economic fundamentals—as the relative productivity and the terms of trade—which influence prices, should also be important to explain the reduction of the exchange rate misalignment and the fact that the real exchange rate seems to be closer to the fundamentals during recent years.

Figure 6. Real effective exchange rate and relative productivity in China

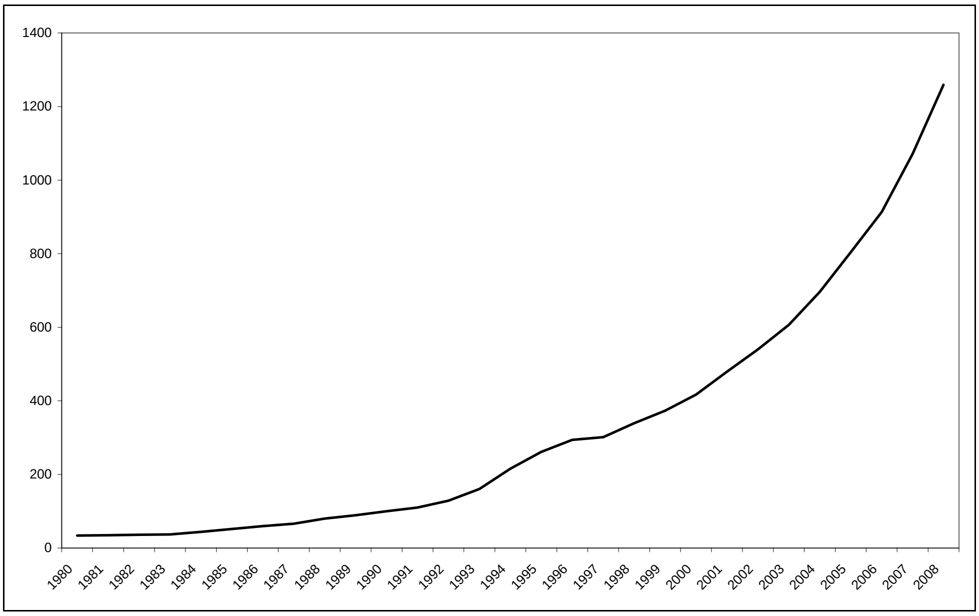


As it can be seen in Figure 6, after a long falling trend in the relative productivity during the 1980s, relative productivity has been increasing vis-à-vis China's main trading partners since the beginning of the 1990s. In this respect, McKinnon and Schnabl (2006) suggest that, in order to preserve the exchange rate anchor and to balance international competitiveness, nominal wages have to rise in line with the rapid productivity growth and thereby much faster than in the rest of the world.[20] Indeed, balancing international competitiveness requires real wages in China to increase much faster than those in its trade partners to reflect China's much higher growth in labor productivity.[21] According to this proposition, given that the Chinese currency is, basically, fixed to the US dollar, wages (and prices) should adjust to preserve competitiveness. Therefore, as suggested by the Balassa-Samuelson hypothesis, this rapid economic growth and the increase in real wages should be accompanied by a real exchange rate appreciation. The increasing trend of wages in China is clearly illustrated in Figure 7, especially since the beginning of the 1990s.

[20] For instance, from 1994 through 2004, money wages in manufacturing increased by 11.7 percent in China per year and by only 3.0 percent in the United States (see McKinnon and Schnabl, 2006). Much of this extraordinary growth in Chinese wages reflects the upgrading of skills and greater work experience of the manufacturing labor force.

[21] McKinnon and Schnabl (2006) suggest that, if the exchange rate is safely fixed (as it might be the case in China), wage growth can be highly responsive to varying rates of labor productivity growth so as to better balance international competitiveness. Based on the so-called "Scandinavian Model" of wage adjustment, they show that fixing the nominal exchange rate to a stable external monetary anchor facilitates faster adjustment (growth) in real wages than leaving the exchange rate "flexible" with the threat of appreciation.

Figure 7. Average wages in China (relative to the US)

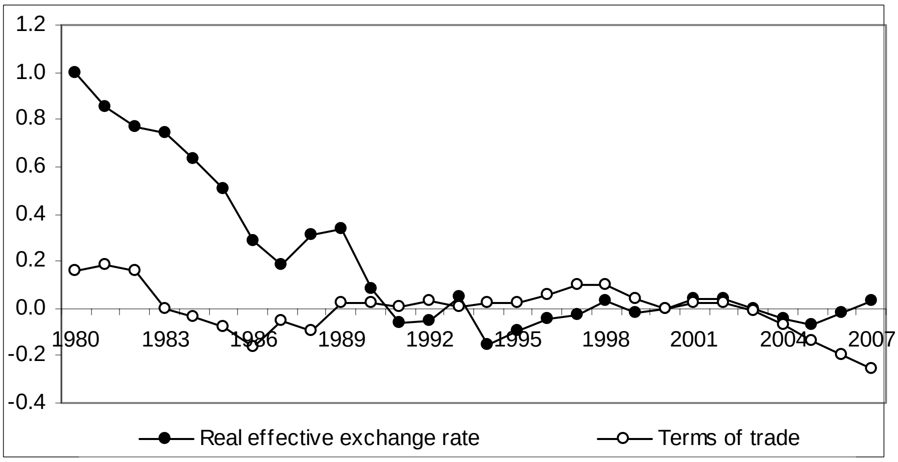


This figure reports the average wage in money terms per person for staff and workers in enterprises, institutions, and government agencies in China relative to the US (1990 = 100). Source : Datastream.

In this context, even though our results do not allow us to draw any conclusion in that sense, we could conjecture that wages were characterized by more flexibility to increase since the 1990s and more rigidity to decrease during the 1980s. It is a wide-spread view that both wages and prices are “downward sticky”, i.e. they take longer to go down than to increase. Indeed, it seems reasonable to think of wages and prices in China as flexible, despite its large size and Communist historical path: because the economy is so dynamic, wages are fluid, in the sense that they are growing rapidly in nominal terms—regardless of price inflation—because of productivity growth; so there is less reason to fear nominal stickiness (Frankel, 2006).

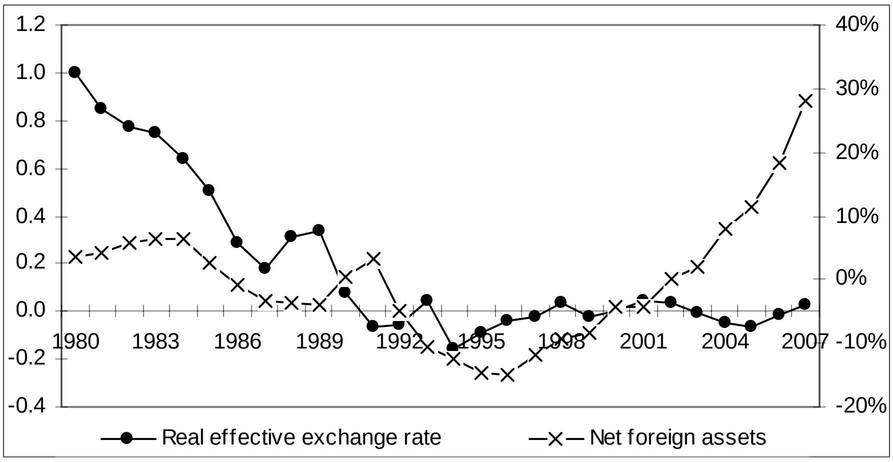
Regarding the terms of trade (Figure 8), after a decade of deterioration at the beginning of the period, since 1990 not only the real exchange rate has somehow stabilized, but also the terms of trade show a more stable path with small deviations of the exchange rate from the terms of trade.

Figure 8. Real effective exchange rate and terms of trade in China



Finally, turning to our third determinant, the *nfa* series exhibits a different pattern. Indeed, as reported in Figure 9, there is an important increasing gap between the net foreign asset position and the real effective exchange rate since the beginning of the 2000s, a fact that may explain the undervaluation of the Chinese currency on the recent period.

Figure 9. Real effective exchange rate and net foreign asset position in China



On the whole and to sum up, whereas it took longer to bring the real exchange rate close to its fundamentals, which explain the first period of overvaluation, since the 1990s deviations of the exchange rate from its fundamentals are less pronounced, justifying the more rapid correction of undervaluations.

4. CONCLUSION

The aim of this paper was to provide equilibrium exchange rate values and to study the adjustment process of observed exchange rates towards these levels by paying a special attention to emerging Asian countries. Relying upon a wide sample of countries and on the BEER approach, we have shown that emerging Asian currencies are globally undervalued on our period under study, especially since the end of the 1990s. These undervaluations may be viewed as the result of competitive devaluations that drive the exchange rate to a level that encourages exports and reduces imports, stimulates domestic production and investment and, as a result, encourages economic growth.

Following a dynamic perspective, we have estimated panel smooth transition regressions in order to model the adjustment process of the real exchange rate towards its equilibrium BEER value. We have shown that the real exchange rate dynamics in the long run is nonlinear for emerging Asian countries, while it is linear for the G7 currencies. More especially, there exists an asymmetric behavior of the real exchange rate when facing an over or undervaluation, the adjustment speed being more important in case of undervaluations in Asia. This result is consistent with our findings that emerging Asian currencies tend to be globally undervalued since the 1990s, but these undervaluations have been lower in size than the overvaluations observed at the beginning of the 1980s.

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Appendix

Table A.1. Currency misalignments in 2007 (in percentage), based on PPP measure

Undervalued currencies		Overvalued currencies		Currencies close to equilibrium	
Argentina	-43.2	Australia	18.8	Mexico	2.2
Brazil	-13.6	*Canada*	*11.7*	Peru	3.4
Chile	-1.6	Colombia	1.1	**Philippines**	**2.3**
China	**-16.04**	Denmark	8.6	Norway	3.3
Costa Rica	-4.7	*Eurozone*	*7.7*	**Singapore**	**0.0**
Egypt	-42.6	**Korea**	**13.5**	Switzerland	0.0
Hong Kong	**-6.2**	New Zealand	19.4	*USA*	*-4.1*
Indonesia	**-15.2**	Turkey	23.8		
India	**-7.5**	Venezuela	13.0		
Israel	-18.9	*UK*	*6.5*		
Japan	*-16.3*				
Malaysia	**-22.0**				
Sweden	-6.7				
Uruguay	-6.5				
Thailand	**-7.5**				

Note: In bold: Emerging Asian countries. In italics: G7 countries.

Table A.2. Currency misalignments, average (in percentage) and volatility, 2000-2007

Country	Misalignment	Volatility
Canada	*-3.71*	*0.12*
Eurozone	*3.54*	*0.10*
Japan	*0.01*	*0.12*
UK	*9.32*	*0.05*
USA	*7.48*	*0.09*
Average	*3.32*	*0.10*
China	**-24.56**	**0.33**
Hong Kong	**-6.52**	**0.23**
Indonesia	**-25.32**	**0.28**
India	**-13.56**	**0.24**
Korea	**-1.56**	**0.10**
Malaysia	**-28.56**	**0.24**
Philippines	**-12.09**	**0.13**
Singapore	**-11.63**	**0.10**
Thailand	**-23.40**	**0.16**
Average	**-16.35**	**0.20**

Note: In bold: Emerging Asian countries. In italics: G7 countries.

Table A.3. Exchange rate regimes and sign of the misalignments in 2007

Undervalued currencies		Overvalued currencies		Currencies close to equilibrium	
Argentina	(2)	Australia	(8)	Mexico	(8)
Brazil	(8)	*Canada*	*(8)*	Peru	(6)
Chile	(8)	Colombia	(6)	**Philippines**	**(8)**
China	(1)	Denmark	(10)	Uruguay	(6)
Costa Rica	(4)	*Eurozone*	*(8)*	*USA*	*(9)*
Egypt	(7)	**Korea**	**(8)**	Venezuela	(2)
Hong Kong	**(3)**	New Zealand	(8)		
Indonesia	**(6)**	Turkey	(8)		
India	**(7)**	*UK*	*(8)*		
Israel	(8)				
Japan	*(9)*				
Malaysia	**(7)**				
Norway	(8)				
Singapore	**(5)**				
Sweden	(8)				
Switzerland	(9)				
Thailand	**(6)**				

Note: In bold: Emerging Asian countries. In italics: G7 countries. (1): Crawling peg, with the US dollar as exchange rate anchor; (2) Other conventional fixed peg arrangement, with the US dollar as exchange rate anchor; (3) Currency board arrangement, with the US dollar as exchange rate anchor; (4) Crawling band, with the US dollar as exchange rate anchor; (5) Managed floating with no predetermined path for the exchange rate, with a composite exchange rate anchor; (6) Managed floating with an inflation targeting framework; (7) Managed floating with other monetary policy framework; (8) Independently floating with inflation targeting framework; (9) Independently floating with other monetary policy framework; (10) Other conventional fixed peg arrangement, with the Euro as exchange rate anchor.

Source of the classification of exchange rate regimes: IMF (2008).

Figures: Evolution of China's fundamentals

Figure A.1. Inflation, China and main trade partners

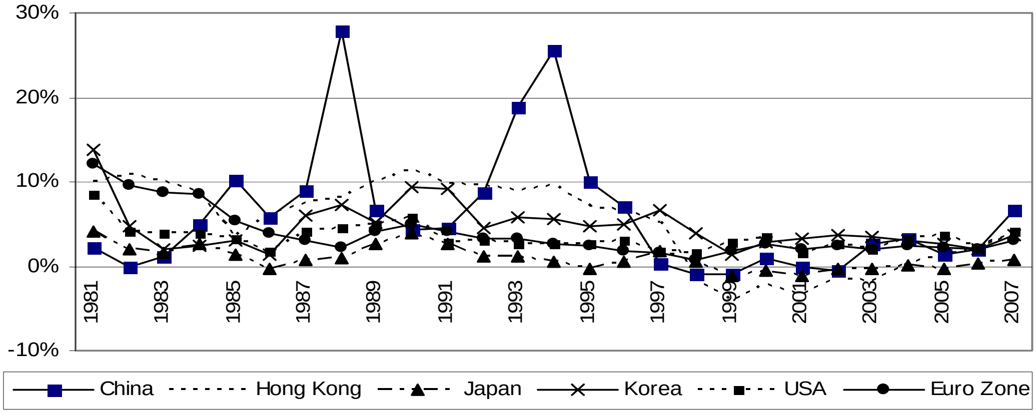


Figure A.2. Net exports (% GDP), China

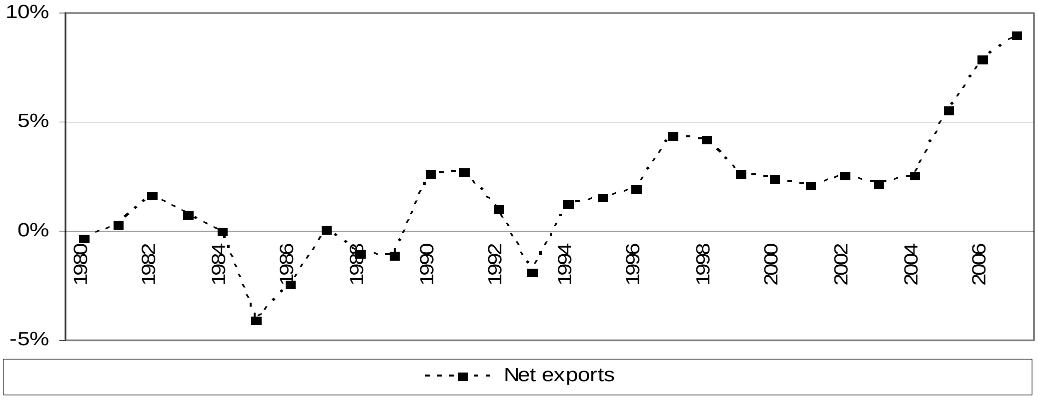
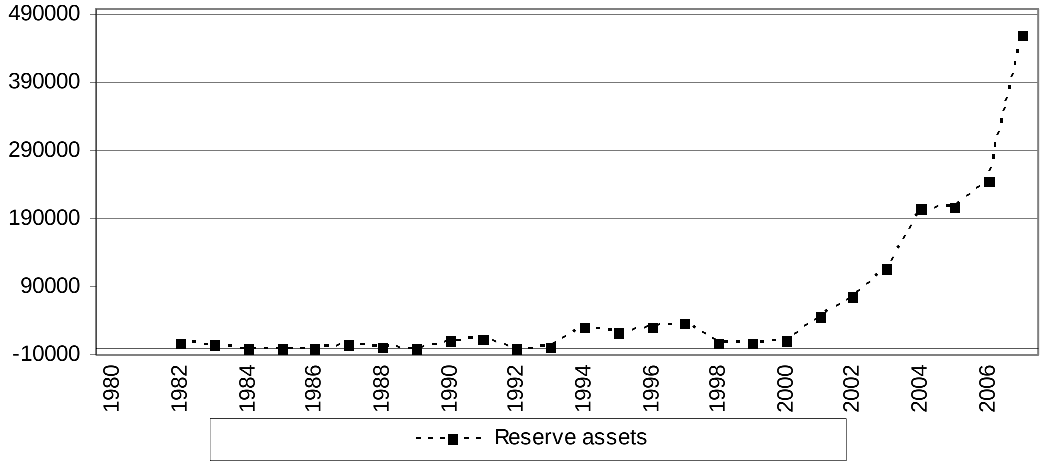


Figure A.3. Reserve assets (USD), China



Note: Source for Figures A.1 to A.3: IFS, IMF.

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