Economics Bulletin

Volume 33, Issue 2

Exchange rate misalignments and economic growth: A threshold panel approach

Nabil Aflouk
University of Paris North

Jacques Mazier
University of Paris North

Abstract

This study deals with the link between exchange rate misalignments (ERM) and economic growth, for a large sample of advanced and emerging economies on the period 1982-2010. The estimation of equilibrium exchange rate (EER) is based on a FEER approach. The relation "misalignments-growth" is estimated using a PSTR (Panel Smooth Transition Regression) and GMM models. Our main results show that the impact of ERM on economic growth is nonlinear and asymmetric. An overvaluation has a negative impact on growth while an undervaluation sustains growth until an estimated threshold (15.5% for emerging countries and 9% for developed countries). The coefficient is weaker for emerging countries (0.02) than for developed countries (0.08). Due to non linearity and coefficient's value, the undervaluation has a positive effect on growth even beyond the threshold. We also demonstrate that the impact of ERM on growth is positive only in the case of small undervaluation for emerging countries. However, concerning developed countries, the undervaluation have a positive effect on growth even beyond the estimated threshold.

We would like to thank Franscico Serranito for his precious econometric remarks.
Citation: Nabil Aflouk and Jacques Mazier, (2013) "Exchange rate misalignments and economic growth: A threshold panel approach", *Economics Bulletin*, Vol. 33 No. 2 pp. 1333-1347.
Contact: Nabil Aflouk - aflouknabil@yahoo.fr, Jacques Mazier - mazier@univ-paris13.fr.
Submitted: February 01, 2013. **Published:** June 05, 2013.

1. Introduction

The poor economic performance in some developed countries versus remarkable results observed in other areas of the developing world raises several issues about the reasons of such differences. This heterogeneity questioned on the theoretical and empirical determinants of economic growth. Some studies have emphasized the importance of exchange rate policy as a determinant of the “impressive” performance, in recent years, of some East Asian countries.

Several econometric studies carried out on developed and developing countries have attempted to identify the relationship between economic growth and the exchange rate dynamics. Many studies have measured the effects of the overvalued exchange rate on the growth rate (Magyari, 2008; Béreau and al., 2009). Others have studied the role of exchange rate policies in the development strategy of East Asian countries. Most of them came out with significant correlations between exchange rate misalignments and growth. Indeed, Bresser-Pereira (2004) and Dooley and al. (2005) have shown that competitive currencies of East Asian countries have stimulated investment and consequently the growth rate. Frenkel (2004) noticed that the overvaluation of the exchange rate is among the cardinal causes of crises and stagnation of growth in Latin America during the 1980s and 1990s. This result implies the existence of a significant relationship between economic growth and real exchange rate.

More precisely, two points must be underlined. First, it is the exchange rate misalignment (ERM) in real terms which appears to be the relevant variable more than the real exchange rate by itself. This raises the question of the method used to estimate this ERM. Second, the relation between growth and ERM is not linear. For many reasons increasing ERM may have a decreasing impact on growth and foreign trade. There are limits in the improvement of the foreign trade due to undervaluation. Exports cannot be increased without limits due to supply constraints and many imports cannot be reduced due to problems of non substitutability. Perverse effects can appear with induced inflation and change in the relative prices. High undervaluation may even have negative effects on growth. Symmetrically, there are limits to the imports increase due to overvaluation and exports can become less sensible to larger loss of competitiveness. This non linearity depends of the structural characteristics of each country, especially in terms of specialization, and has to be studied in more details.

The exchange rate misalignment, a concept that refers to a deviation from an equilibrium exchange rate (EER) level, is one of the major pillars of the exchange rate policy. The estimation of ERM is still a very controversial issue in economic literature. Purchasing Power Parity (PPP) remains the reference theory for determining the EER. However, several alternative approaches have been developed recently. The so-called Fundamental Equilibrium Exchange Rate (FEER) is focused on the simultaneous attainment of internal and external equilibrium (Williamson, 1985 and 1994). Other studies calculate the EER using reduced equations. They are based on long-run relationships between the real exchange rate and its fundamental determining factors. In this respect, we may mention the work of Stein and Allen (1997) who have developed the theory of Natural Real Exchange Rate (NATREX). On the other hand, Clark and MacDonald (1997) have proposed a purely econometric model called Behavioral Equilibrium Exchange Rate (BEER).

Most recent studies on the link between ERM and growth are based on the BEER approach to estimate ERM (Magyari, 2008; Béreau and al, 2009; Couharde and Sallenave, 2013).

However, FEER approaches could be also used for two main reasons. First, they can better ensure the coherence and consistency of ERM when dealing with different countries as they use a worldwide trade model to estimate these ERM. This methodology is explained more in detail in Jeong et al., 2010 and Aflouk et al., 2010. This consistency of ERM at the world level is important as we intend to analyze their impact on growth using a panel approach. Second, the FEER approach seems more appropriate as it takes better into account the structural parameters (mainly through foreign trade elasticities) and the growth models adopted by each country. Williamson (1990) has shown that the deviation with respect to the equilibrium level has a negative impact on the growth. The overvaluation implies external imbalances while undervaluation means an internal imbalance and excessive inflation. Undervaluation, although it is beneficial for the growth, may have some negative effect on the economies fundamentals. The analysis of the "misalignments-growth" relationship by means of the FEER needs to be investigated more in details, using a new set of FEER estimations and more appropriate econometric method.

Our work is based on a new econometric technique, namely the PSTR (Panel Smooth Transition Regression) model. These models are an attractive solution to meet the new challenges induced by the use of macroeconomic panel data. The use of switching models in panel data allows both combining the benefits of working on panel data and solving simultaneously the problems of nonlinearity, heterogeneity and time instability of the relationship (Bessec and Fouquau, 2008).

This article is presented as follows. A first section examines the adopted methodology. A second section presents data and estimation process. A third part displays the results obtained at the end of these estimates. A final section identifies key finding.

2. Econometric model

González and al. (2005) have proposed an extension of the PTR model (Panel Transition Regression) with brutal transition, developed by Hansen (1999). PSTR models (Panel Smooth Transition Regression models) are characterized by a smooth transition passage.

The process satisfies a PSTR representation with two regimes can be written as follows:

$$z_{it} = \mu_i + \beta_0^{'} X_{it} + \beta_1^{'} X_{it} g(q_{it}; \gamma, c) + \varepsilon_{it} \qquad (1)$$

With z_{it} denoting the dependent variable, μ_i the individual fixed effects, and X_{it} a vector of k exogenous variables, $g(q_{it}; \gamma, c)$ is the transition function, normalized and bounded between 0 and 1, q_{it} the threshold variable, γ the speed of transition from one regime to the other and c the threshold parameter. In this model, the observations in the panel are divided into two regimes[1] depending on whether the threshold variable is lower or larger than the threshold c. The error term ε_{it} is independent and identically distributed. The transition from one regime to another is smooth and gradual. The indicator function of PTR models is replaced by a continuous transition function $g(.)$. González and al. (2005) proposed to work with a logistic transition function of order m (Figure A1 in Appendix A):

[1] It is possible to extend the PSTR model to more than two regimes.

$$g(q_{it};\ \gamma, c) = \left[1 + \exp\left(-\gamma \prod_{j=1}^{m} (q_{it} - cj)\right)\right]^{-1}, \gamma > \ 0, c1 < \cdots < cm \qquad (2)$$

Where c = ($c_1 . . . c_m$) is a vector of dimension $(1, m)$ containing the thresholds parameters and γ is the smoothing parameter supposed positive. The order of the transition function has a direct impact on the transitional dynamics between extreme regimes. Empirically, González and al. (2005) indicate that it is usually sufficient to consider m = 1 or m = 2.

Usually, the alternative to the use of a logistic transition function is the use of an exponential function proposed by Teräsvirta and Anderson (1992). These two transition functions suggest the different dynamics of the process of reversion at the average. The logistic function is characterized by an asymmetric adjustment (z_{it}) compared to its past values according to the transition variable (q_{it}), either below or above the threshold c. The transition function detects the sign of deviations (sign effect). In contrast, the exponential function suggests a symmetric adjustment: it gives the extent of the deviations (size effect). In other words, using a logistic function it is assumed that the positive and negative deviations return to the average with different speeds, while with the exponential function the speed of reversion to the average is the same regardless of the positive or negative sign of the deviations.

PSTR modeling has the advantage of generating less extreme relations than PTR models (Bessec and Fouquau, 2008). First, it is considered as a model with an infinite number of regimes bounded with two extreme regimes. It therefore could be considered as a linear and heterogeneous model for panel data where coefficients may vary depending on the individual and time period chosen. The second solution is to interpret the PSTR model as a nonlinear one where the system gradually moves between two extreme linear and homogeneous regimes.

The values generally enable required changes of the slope coefficients in order to take into account the non-linearity majority of cases due to changes in regimes. Indeed, it was noticed that the higher is the smoothing parameter, the more brutal is the transition between the two regimes. In the PSTR models, the elasticity's value for a given country and at a given date might differ from the value of the estimated parameters of the two extreme regimes (β_0 and β_1). The parameter β_0 is the elasticity when the transition function $g(.)$ tends to 0. The sum of the parameters β_0 and β_1 corresponds to the elasticity when the transition function $g(.)$ tends to 1. Between the two extreme regimes, the elasticity (e_{it}^{q}) is defined as a weighted average of parameters β_0 and β_1 obtained in the extreme regimes.

$$e_{it}^{q} = \frac{\partial z_{it}}{\partial q_{it}} = \beta_0 + \beta_1 g(q_{it}; \gamma, c) \forall i, \forall t \qquad (3)$$

In particular, when parameter γ tends towards infinity, the transition function $g(.)$ tends to the indicator function (equation 4). The PSTR model then has the same transition mechanism as a two-regime PTR model. For the mechanism of transition we consider first a brutal transition (PTR model) as in Hansen (1999). In this case, the function $g(.)$ equals an indicator function:

$$g(q_{it}; \gamma, c) = \begin{cases} 1\ if\ q_{it} \geq c \\ 0\ otherwise \end{cases} \qquad (4)$$

However, the transition function becomes constant when γ tends to 0, thus the PSTR model becomes a linear panel with homogeneous coefficients and individual fixed effects. In the intermediate situation where γ does not tend to zero or to infinity, the evolution of the coefficients can be described by the slope coefficients of one of the extreme regimes, or of a combination of the coefficients of the two extreme regimes (equation 3).

According to Gonzalez and al. (2005) the application of PSTR models requires a three-step procedure:

- *The specification:* The goal of this step is to test homogeneity versus PSTR alternative. For this reason, we use the LM[2] and Fisher tests LMf[3] provided by Gonzalez et al. (2005). This test defines the appropriate transition variable which minimizes the associated p-value, as well as the appropriate transition function order m[4]. The threshold c becomes a "kind" of misalignment reference value. However, it is not arbitrarily determined, but estimated so as to minimize the sum of squared residuals of the model.

- *The estimation:* The non-linear least squares are used to estimate the parameters

- *The evaluation and the selection of the regime number:* The test for nonlinearity (No. Remaining Heterogeneity) enables to test the number of regimes or equivalently the number of transition functions required to determine data heterogeneity and nonlinearity. González and al. (2005) propose to apply constancy parameters tests used by Eitrheim and Teräsvirta (1996) in the context of time series.

We introduce in a second step the estimation based on the Generalized Method of Moments (GMM), which can be used solely for comparative basis. This methodology is based on a dynamic model incorporating with panel data (*i.e* the set of explaining variables including a lagged dependent one). As noted by Arellano and Bover (1995) and Arellano and Bond (1991), the advantage of this method is to take into account country-specific effects and overcome endogeneity bias.

3. Estimation process and data

We propose to reexamine the relationship between misalignments of the real effective exchange rate and economic performance based on an econometric study incorporating other explanatory variables that have become standard in the literature. We apply a PSTR (equation 5) specification and the GMM dynamic (equation 6).

[2] $LM = TN\,(SSR_0 - SSR_1)/SSR_0$ (Where SSR_0 is the sum of squared residuals of a linear model with individual effects and SCR_1 the sum of squared residuals of the auxiliary equation. Under the null hypothesis, the LM statistic is distributed according to a χ^2 with mk degree of freedom where k is the number of explanatory variables).
[3] $LMF = (SSR_0 - SSR_1)/mk/SSR_0/\,(TN - N - mk)$
[4] PSTR, which reduce the standard deviations for the threshold parameters and smoothing.

On the whole, considering equation (1), our PSTR model of growth is given by:

$$\mathrm{Y_{it}} = \mu_i + \alpha_i' X_{it} + \beta_0' rc_{it} + \beta_1' rc_{it} g(rc_{it}; \gamma, c) + \varepsilon_{it} \quad (5)$$

Where, Y_{it} represents the growth rate of real GDP per capita, rc_{it} is the real effective exchange rate misalignment, $g(rc_{it}; \gamma, c)$ is the transition function associated to the transition variable rc_{it}, to a threshold parameter c and parameter γ determines the slope of the transition function. $X_{it} = (X_{it}^1, \dots, X_{it}^k)$ is the matrix of k variables representing a vector of contemporaneous and lagged values of growth determinants, μ_i is the vector of individual fixed effects and where ε_{it} is an error term.

The regression estimation equation in its dynamic form (GMM) is provided as follows:

$$Y_{it} = \alpha y_{it-1} + \beta X_{it} + \delta rc_{it} + \mu_i + \nu_t + \varepsilon_{it} \quad (6)$$

Where Y_{it} represents the growth of real GDP per capita, y_{it-1} is the lagged logarithm of real GDP per capita, rc_{it} represents the misalignments of the real effective exchange rate, X_{it} is a vector of control variables, μ_i is the country specific effect, ν_t is the specific temporal effect and ε_{it} is the error term, i and t represents respectively the country and time indices.

Based on previous studies, we retain various explaining variables. The first variable is the lagged income per capita; its coefficient represents the convergence effect, which would be negative according to the neoclassical theory. The second variable is a measure of human capital stock (the human development index(HDI)). The theories predict that the coefficient of the stock of human capital should be positive, since countries with more human capital should have higher growth.

Other control variables include the inflation rate calculated from the consumer price index, the investment rate (I/Y), the Government expenditures(GOV), as an approximation of the fiscal impulse, which were introduced separately in order to distinguish their possible effects, the degree of openness to trade($OPEN$) and the foreign direct investment(FDI). The expected sign of the coefficient of the investment rate is positive, because the accumulation of capital is supposed to stimulate the growth of the real GDP per capita. As Aschauer (1989) and Tanzi and Zee (1997) have pointed out, the public sector consumption aims to represent public expenditures that can generate positive externalities which would enhance private factors productivity. The coefficient for this variable would be therefore positive. Regarding the expected impact of foreign trade, it still remains ambiguous in economic theory (Hadjimichael and al.1997).The expected effects of international capital flows on economic growth are expected positive.

Last, regarding the misalignments exchange variable, two important impacts are expected: an overvaluation tends to slow growth, while an undervaluation increases the exportation competitiveness which generates positive externalities for growth. Our study examines in details in which conditions and to which extent.

In this study, we considered a panel of 25 emerging countries (Argentina, Bolivia, Brazil, Chili, China, Colombia, Ecuador, Egypt, India, Indonesia, Malaysia, Mexico, Morocco, Pakistan, Paraguay, Peru, Philippines, Singapore, Sri Lanka , Thailand, Tunisia, Turkey, Uruguay, Venezuela and Vietnam) and 13[5] OECD countries (Germany, Austria, South Korea, USA, Finland, France, Ireland, Italy, Japan, Netherlands, Portugal, Spain and United Kingdom) over the period 1982-2010, based on annual data. The data are from the CEPII database (CHELEM), the World Bank and IMF. The estimation of the equilibrium exchange rates is based on the FEER approach provided by the work of Jeong and al. (2010) and Aflouk and al. (2010). In this approach we proceed in two steps. First, FEERs are estimated for the main currencies (dollar, euro, yen, yuan, pound sterling) using a world trade model with a methodology which is derived from the SMIM method of Cline (2008). Second, FEERs are estimated for other developed countries (including euro area members) or emerging countries, using national trade models and linking the estimation of the national FEERs to the multinational model's results to get bilateral misalignments. It has been shown that for relatively small country a national model gives results very close to the one obtained with a multinational model where the studied country would be explicitly described (Jeong and Mazier, 2003). These works were taken and extended to a larger sample (Bolivia, Ecuador, Egypt, Morocco, Pakistan, Paraguay, Peru, Singapore, Sri Lanka, Tunisia, Turkey, Venezuela and Vietnam), keeping the same approach (only these new results are given in table A2 of the appendix A). The *HDI* are obtained from the database of Barro and Lee (2010).

4. Results and interpretation

We first test the linearity[6] and determine the number of necessary regimes to capture the non-linearity and/or individual heterogeneity and temporal instability of the slope coefficients. In a second phase, we estimate the threshold-based model parameters in order to deduce the elasticity between economic growth and misalignments; we also evaluate the impact of ERM on growth.

We consider two panels composed, first of the emerging markets and second of the developed countries. The applied approach is traditional. In a first step, we test the non-linearity of our growth function using threshold-based specification. If linearity hypothesis is rejected, we must then determine the optimal number of transition functions to capture all the non-linearity. For each specification, we have reported, in Table I, the calculation of LM test statistics as well as Fisher test. These values are given to the first non-rejection of H0. However, we limit our analysis to a model with a logistic transition function (m = 1).

Apparently and whatever the statistics taken or the sample selected, the linearity test clearly rejects the null hypothesis of existence of a linear relationship between economic growth and exchange rate misalignment.

---

[5] For the industrial economies, we use a shorter sample for the series of misalignments (1982-2009) (Jeong and al. (2010).

[6] The linearity test against a PSTR alternative is to test H0: $\theta_1 = 0$ in equation (4) for the specification with a logistic transition function, and H0: $\theta_1 = \theta_2 = 0$ for the logistic function.

Table I: Linearity tests versus the PSTR alternative

	Emerging countries		Developed countries	
	LM	LMF	LM	LMF
H0 : r = 0 vs H1 : r = 1	56.95	9.83	42.87	7.65
	(0.00)	(0.00)	(0.00)	(0.00)
H0 : r = 1 vs H1 : r = 2	1.96	0.31	5.11	0.79
	(0.92)	(0.93)	(0.52)	(0.57)

Note:The test procedure is as follows. First, the linear model (r = 0) is tested with respect to a model with a threshold (r = 1). If the null hypothesis is rejected, the model is tested with respect to a double threshold model. The procedure continues until the additional threshold hypothesis is rejected. The corresponding LM and LM_F statistics follow an asymptotic distribution of χ^2 (1) for a logistic function under the null hypothesis. The p - corresponding values are shown in parentheses. Source: authors' estimates

The estimated slope coefficients for the PSTR model, the smoothing parameters and thresholds parameters and the GMM model results are given in Tables II and III. We consider a logistic transition function (LPSTR model) with $m = 1$, the coefficients have the expected signs: β_0 is always positive, while $\beta_1$is negative. The values of the estimated smoothing parameters γ are relatively small. This confirms the impossibility to use a brutal transition model to describe the nonlinear relationship between economic growth and ERM. The results prove that the ERM impacts differently economic growth, depending on the adopted models (PSTR, GMM) or the selected sample.

We first pay more attention to the set of control factors for the two considered samples. All explanatory variables have expected signs, whatever the retained specification (PSTR, GMM).

The regressions show a very negative significant effect of lagged real *GDP* per capita. This result supports the hypothesis of the convergence effect mentioned in the literature review. The investment rate seems to play a greater role in the case of developed countries. In most emerging countries, the more reduced impact could be tributary to the fact that investment is sometimes oriented towards unproductive projects (real estate, oversized projects, etc ....). The variables that reflect the external relations of the countries raise some questions. Contrary to *FDI* which gives an expected effect for the various specifications, the unexpected effect of trade openness for developed countries according to the PSTR model, would rather mean that the high levels of trade openness that have marked these economies have not promoted economic growth. Such an effect can be explained *inter alia*, by the application of growth models that are more fueled by domestic demand. On the other hand, the HDI (Human Development Index), despite its positive sign for the different specifications, seems to have a more significant impact on growth in emerging countries. The impact of inflation is predicted with a negative and has a significant impact on growth. The public expenditures variable has been discarded from the regressions models given the limited availability of data and / or even if they existed, they were only part of public expenditures (public administrations expenditures). These difficulties prevented us from accurately interpreting the expected impact of this variable.

Regarding the effect of ERM on economic growth, the PSTR model results appear relatively consistent throughout the two samples. The results depicted in Tables II and III show some differences. First, the estimated threshold varies between the two groups of countries: only 9% for developed countries versus 15.5% for emerging countries. This difference can be explained by the fact that exchange rate misalignments are generally higher in emerging countries than in the developed ones. We can note that many emerging economies are based on export led growth engaged in a catching up process. An undervalued currency may boost exports significantly, thus raising significantly growth.

Table II: Growth determining variables: PSTR and GMM; Emerging Countries

	PSTR		GMM	
Variable	*Coeff*	*T-Stat*	*Coeff*	*T-Stat*
Initial GDP per capita (log)	-0.053	-6.674	-0.053	-6.699
Inflation	-0.001	-3.653	-0.001	-3.614
Investment (% of GDP)	0.032	1.467	0.032	1.440
HDI	0.023	4.619	0.025	5.291
Trade openness (% of GDP)	0.052	2.738	0.058	3.000
FDI (% of GDP)	0.280	3.748	0.280	3.667
Real exchange rate misalignment	0.022	2.549	0.009	1.538
Real exchange rate misalignment * $G(.)$	-0.031	-2,022		
c	0.155			
γ	5.000			

Source: Authors estimates

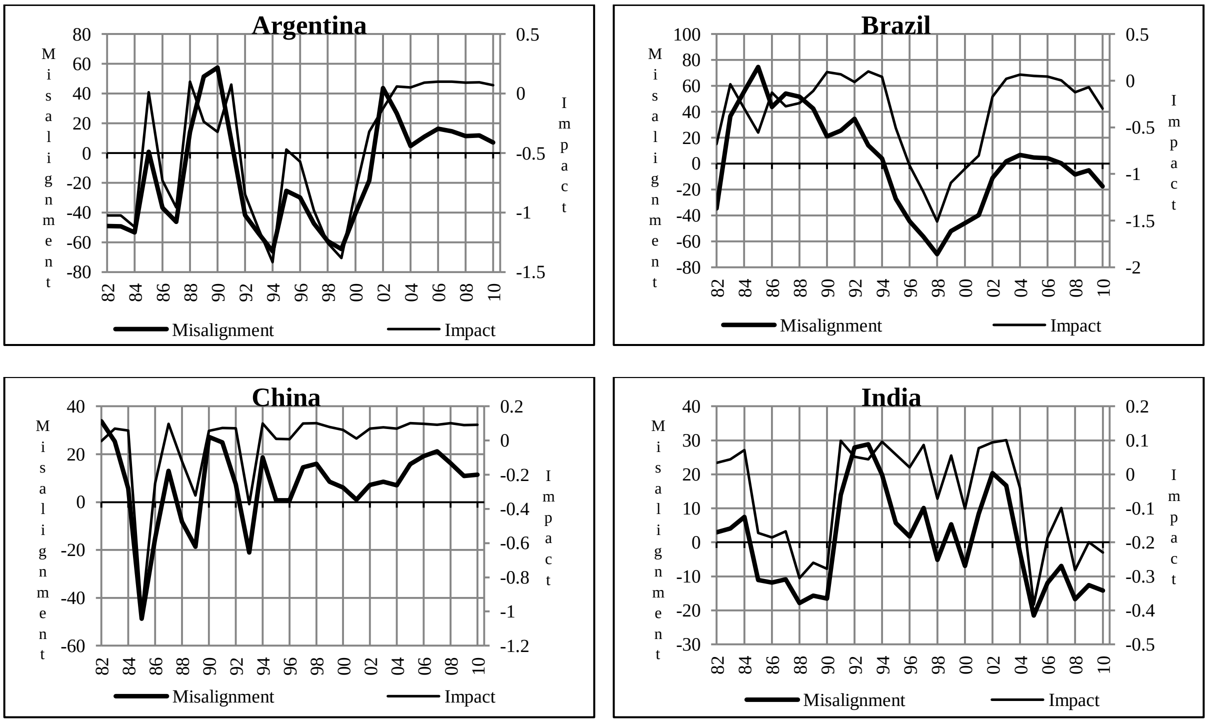
Second, for the emerging countries the coefficient is 0.022 in the first regime. Our results confirm the negative impact of the overvaluation ($r < 0$) on growth, regardless of its value. Furthermore, an average undervaluation, ($r > 0$) till about 15.5%, is favorable to economic growth. This finding is consistent with the results of Aguirre and Calderón (2005) and Berg and Miao (2010). However, in the second regime, misalignments appear to act differently on growth. The impact of relatively high level of undervaluation on growth is negative and significant in the case of the extreme regime. Beyond 15.5%, an increase of the undervaluation of 1% contributes to a reduction of the GDP per capita of 0.9%[7], Aguirre and Calderón (2005) have showed that the impact on growth is positive only for the undervaluation of small size (up to 12%). Our results are not consistent with those of Béreau and al. (2009). Indeed, the authors showed that the undervaluation, irrespectively of how big it is, has a positive impact on growth. Conversely, they concluded that large overvaluations do not seem to have important effects on economic growth.

In theory, industrialization can be obtained through real undervaluation by generating profits in the tradable sector. However, some difficulties could be encountered. A higher undervalued currency implies distortion in income distribution and can lead to excessive inflation and recession, by reducing real income. This inflation-devaluation spiral can cause a serious delay in the economic development (Dervis and Petri, 1987; Isard, Symansky and Ito, 1997).

Based on the GMM econometric models (Table II), the ERM's has little influence on the emerging countries growth. The ERM do not seem to play an important role in the economic performance of the studied countries. First, this finding may be explained by the different levels of development of these countries and by the significant misalignments' volatility, especially in some emerging economies. Second, as the relationship is non-linear, the influence of ERM on growth cannot be well captured by a linear relationship.

[7] The coefficient in the second regime = $\beta_0 + \beta_1 =$(0,022-0,031= - 0,009)

Figure 1: ERM in % and impact on Growth in % in Argentina, Brazil, China and India.



Source: Authors computations. The impact of ERM on growth is calculated based on the following transition function $g(rc_{it};\ \hat{\gamma}, \hat{c}) = \left[1 + \exp\left(-5(rc_{it} - 0.155)\right)\right]^{-1}$.

The PSTR model results on the contrary show that the undervaluation has a negative effect on growth for emerging country above the estimated threshold (15.5%). This is illustrated in Figures 1, which represent the ERM and their effects on growth (ie elasticity). The higher undervaluation (values below the estimated threshold), the more important is the effect of misalignment on growth (see, for example, Argentina from 2002 and China after 1994). Instead, overvaluations have negative effects (Brazil between 1996 and 2002, for example). For emerging countries, the support of undervaluation for growth seems rather limited (China specially) but the overvaluation of the Argentina peso during the 1990's , of the Indian rupee during the 2000's, of the Brazilian real at the end mi 1990's and of the 2000's appear clearly significant.

Third, for developed countries, even beyond the threshold of 9%, the undervaluation has a significant and positive impact amounting to 0.028[8]. This could be explained by the better control of the exchange rate misalignments volatility in developed countries than in emerging countries. This finding highlights the positive effects of monetary policy adopted by developed economies. This policy promotes price stability and consequently the stability of the real exchange rate in the developed economies. In addition, the flexible exchange rate regime adopted by these countries induces more stability of the exchange rate by allowing more automatic adjustment. This is also true for European countries belonging to the European Monetary System until 1999 and then to the European Monetary Union. Exchange rate adjustments have been realized inside the EMS, the last adjustments being in 1992-1993 during the crisis of the EMS. After that date the European currencies anchored to the mark and the euro after 1999 have been floating.

[8] The coefficient in the second regime = $\beta_0 + \beta_1 =$(0,076 - 0,048 = 0,028).

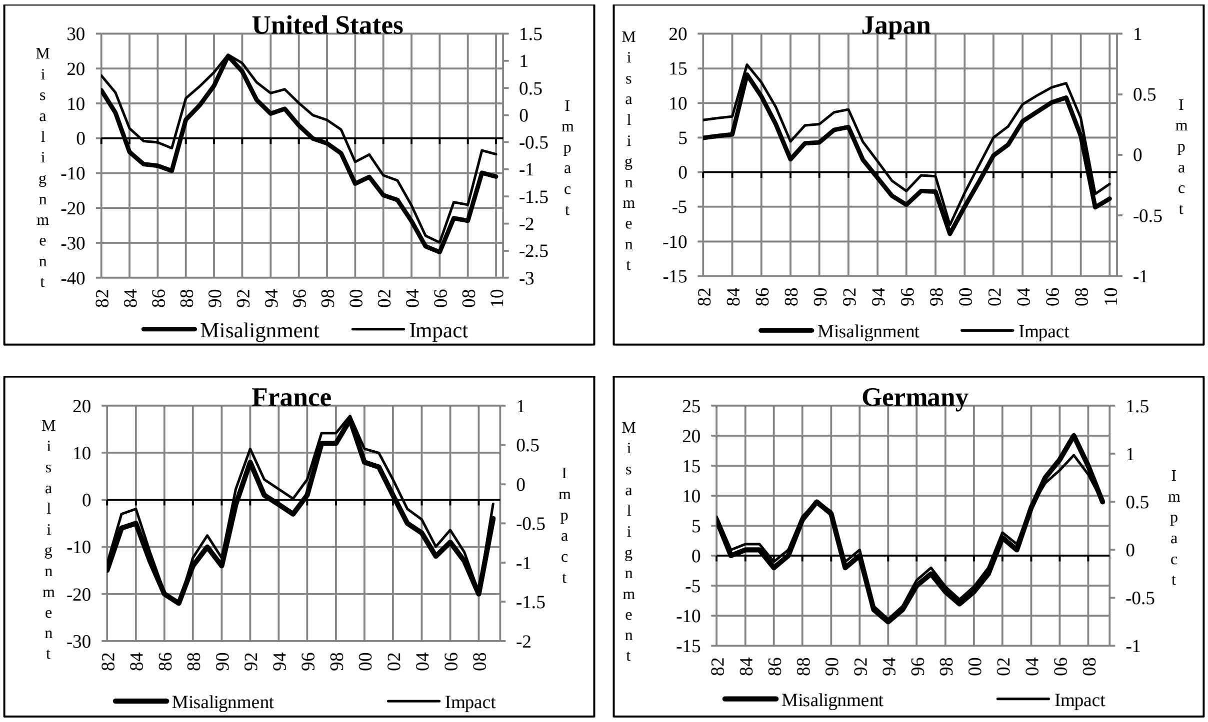
Table III: Growth determining variables: PSTR and GMM; Developed Countries

	PSTR		GMM	
Variable	*Coeff*	*T-Stat*	*Coeff*	*T-Stat*
Initial GDP per capita (log)	-0.048	-6.954	-0.43	-19.53
Inflation	-0.228	-5.422	-0.23	-3.53
Investment (% of GDP)	0.466	8.137	1.38	15.15
HDI	0.002	1.218	0.06	11.36
Trade openness (% of GDP)	-0.036	-1.337	0.08	1.93
FDI (% of GDP)	0.158	4.844	0.06	2.05
Real exchange rate misalignment	0.076	5.325	0.04	2.66
Real exchange rate misalignment * $G(.)$	-0.048	-1.988		
c	0.090			
γ	5.000			

Source : Authors estimates

For developed countries, some specific results can be underlined (cf. figure 2). The negative impact of overvaluation of the euro for south European countries appears clearly during the 2000's, while German growth is supported by the undervaluation of German euro. Similarly, undervaluation of dollar has strongly supported US growth at the end of 1980's and beginning of 1990's. Japanese growth has also been supported during the 1980's and 2000's by yen undervaluation.

Figure 2: ERM in % and impact on Growth in % in United States, Japan, France and Germany



Source: Authors computations. The impact of ERM on growth is calculated based on the following transition function $g(rc_{it};\ \hat{\gamma}, \hat{c}) = \left[1 + \exp\left(-5(rc_{it} -\ 0.09)\right)\right]^{-1}$.

The results obtained by the GMM estimates support the findings demonstrated beforehand. The misalignments with a positive and significant coefficient appear as a growth determinant factor for developed economies (Table III).

According to the results of estimates of equilibrium exchange rates, it was found that exchange rate misalignments for emerging markets are higher and less stable than those in developed countries (Aflouk and al., 2010). This finding can be partially explained by inappropriate macroeconomic policies, especially at the level of trade (Ghura and Grens, 1993). The high degree of misalignments and their persistence turned out to be a significant factor for slowing down growth. Indeed, we concluded that the adjustment of the exchange rate towards equilibrium levels seems to be more flexible in developed countries than in emerging ones.

5. Conclusion

The main objective of this article was to study the impact of misalignments of real effective exchange rate on economic growth. Our study has confirmed the presence of nonlinearity and asymmetry in this relation between misalignment and growth. Besides, the use of threshold-based specifications with a logistic transition function has characterized in a better way misalignments-growth relationship for the two samples, the emerging and the developed countries.

Working with sub-samples of countries enabled to notice that the threshold value varies from developed countries to emerging ones: a threshold of 9% for industrialized economies versus 15.5% for developing ones. The initial level of development, as well as misalignments generally higher in emerging countries than in advanced ones, can explain the different values of the threshold between both classes of economies.

We concluded that the effect of misalignments on growth depends on the size of these misalignments in the case of undervaluation. The effect on growth is negative; whatever how large is the overvaluation. The impact on growth is positive in the case of slight undervaluation (up to 15.5%) and negative in the case of significant undervaluation for emerging countries. In developed countries the undervaluation seems to have a positive impact, even beyond the estimated threshold.

The conduction of an analysis based on GMM model led to conclusions that can be used solely for comparison. In that respect, the findings showed variation in the exchange rate inter-countries and not intra-countries. The GMM results showed that exchange rate misalignments, even if they have an expected sign, did not seem to be a determining factor on the economic performance of emerging countries.

References

Aflouk, N., Jeong,S., Mazier, J., and Saadaoui, J. (2010). "Exchange Rate Misalignments and World Imbalances: A FEER Approach for Emerging Countries". International Economics, 124.

Aguirre, A., and Calderón, C. (2005). "Real exchange rate misalignments and economic performance". Central Bank of Chile WP 315, April, 1–49.

Arellano, M., and Bover, O. (1995). "Another look at the instrumental variable estimation of error-components models". Journal of econometrics, 68(1), 29–51.

Barro, R. J., and Lee, J. W. (2010). “A new data set of educational attainment in the world”, 1950–2010. National Bureau of Economic Research Cambridge, Mass., USA.

Béreau, S., Villavicencio, A. L., and Mignon, V. (2009). “Currency misalignments and growth”: A new looks using nonlinear panel data methods. WP.

Bessec, M., and Fouquau, J. (2008). “The non-linear link between electricity consumption and temperature in Europe”: A threshold panel approach. Energy Economics, 30(5), 2705–2721.

Bresser-Pereira, L. C. (2004). “La politique macroéconomique brésilienne (1994-2003) et le second consensus de Washington”. Problèmes d’Amérique Latine, 81–104.

Cline, W. R. (2008). “Estimating consistent fundamental equilibrium exchange rates”, 08-6, July, Peterson Institute for International E, Washington, DC. WP

Couharde,C. and Sallenave, A. (2013). “How do misalignments' threshold affect economic growth?” Journal of Macroeconomics, Volume 36, Pages 106–120.

Dooley, M. P., Folkerts-Landau, D., and Garber, P. M. (2005). “Interest rates, exchange rates and international adjustment”. National Bureau of Economic Research Cambridge, Mass., USA.

Eitrheim, O., and Terasvirta, T. (1996). “Testing the adequacy of smooth transition autoregressive models”. Journal of Econometrics, 74(1), 59–75.

Frenkel, R. (2004). “Real exchange rate and employment in Argentina, Brazil, Chile and Mexico”. Group of, 24.

Ghura Thomas, J., and al. (1993). “The real exchange rate and macroeconomic performance in Sub-Saharan Africa 1”. Journal of Development Economics, 42(1), 155–174.

González, A., Terasvirta, T., and Van Dijk, D. (2005). “Panel smooth transition regression models”. School of Finance and Economics, University of Technology.

Jeong, S. E. and Mazier, J. (2003). “Exchange rate regimes and equilibrium exchange rates in East Asia”, Revue Economique 54, September, Presses de Sciences Politiques, 1161-82.

Jeong, S. E., and al. (2010). “Exchange rate misalignments at world and European levels: A FEER approach”. International Economics, (1), 25–57.

Magyari, I. (2008). “Exploring the Correlation between Real Exchange Rate Misalignment and Economic Growth in the CEE Countries”. Advances in Economic and Financial Research- WP.

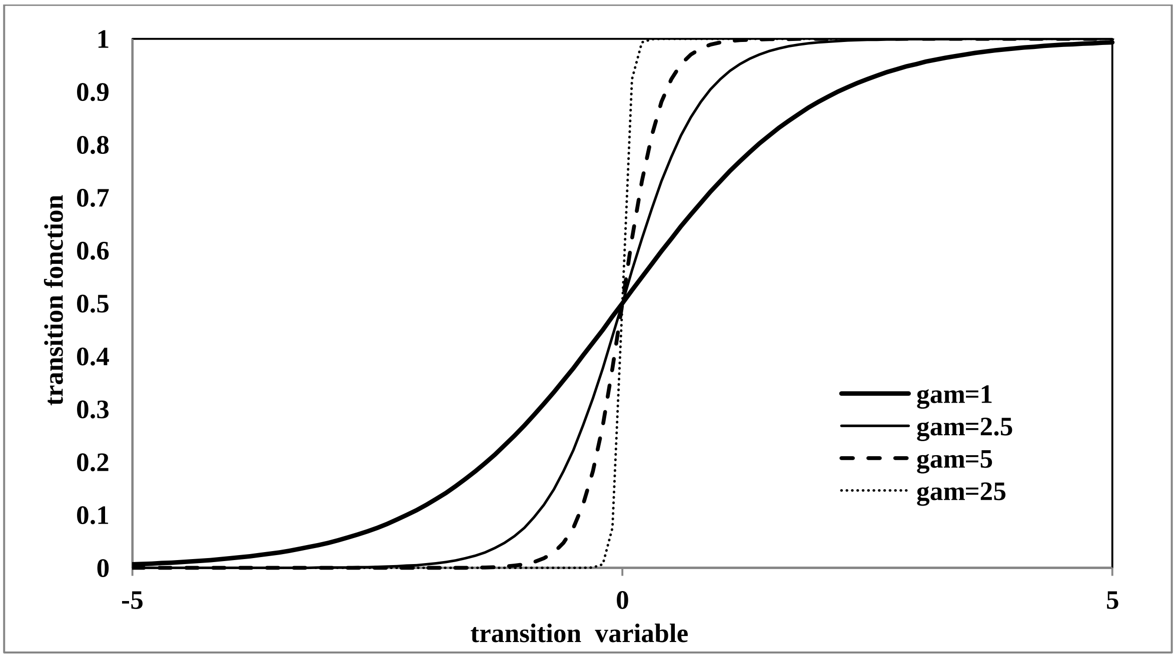
Miao, Y., and Berg, A. (2010). “The Real Exchange Rate and Growth Revisited”: The Washington Consensus Strikes Back? IMF WP.

Williamson, J. (1983). “The Exchange Rate System”, 1st edition, 2nd edition 1985, Institute for International Economics, Washington, DC.

Williamson, J. (1994). “Estimating Equilibrium Exchange Rates”, Institute for International Economics: Washington.

Appendix A

Figure A1: Logistic transition function with $c = 0$



The figure A1 represents the logistic function where the threshold parameter c = 0 and m = 1. q_{it} is the value of the transition variable, taken arbitrarily between 5 and -5 and $g(q_{it}; \gamma, c)$ is the value of the transition function.

Table A2. ERM: Bolivia, Paraguay, Peru, Singapore, Ecuador, Egypt, Morocco, Pakistan, Sri Lanka, Tunisia, Turkey, Venezuela and Vietnam.

	BOL	PRY	PER	SGP	ECU	EGY	M0R	PAK	LKA	TUN	TUR	VEN	VNM
82	0,01	-0,51	-0,46	0,47	-0,14	-0,18	0,27	0,50	-0,27	-0,30	0,48	-0,34	na
83	0,02	-0,37	-0,25	0,31	0,07	-0,08	-0,04	0,16	-0,17	-0,21	0,63	0,16	na
84	0,14	-0,55	0,23	0,09	0,05	-0,32	0,04	-0,19	0,29	-0,38	0,66	0,21	na
85	-0,35	-0,42	0,34	0,14	0,12	-0,06	-0,41	0,16	0,01	-0,02	0,63	0,09	na
86	-0,26	-0,69	-0,16	0,08	-0,02	0,20	0,03	0,18	-0,09	-0,13	0,42	-0,54	na
87	-0,71	-0,60	0,02	0,18	-0,14	0,49	-0,16	0,09	-0,02	0,26	0,50	-0,17	na
88	0,12	-0,08	-0,36	0,04	-0,03	0,45	0,44	0,03	-0,09	0,24	0,66	-0,49	na
89	0,41	0,35	0,58	0,01	-0,09	0,43	0,21	0,04	-0,04	0,04	0,53	-0,01	-0,45
90	-0,02	0,39	-0,12	0,04	0,05	0,21	0,28	0,12	0,09	0,05	0,27	0,39	-0,31
91	-0,11	0,30	-0,02	0,02	-0,01	0,54	0,39	0,12	0,04	0,16	0,45	0,10	-0,15
92	-0,45	0,23	-0,20	0,04	0,18	0,57	0,28	0,31	0,10	0,16	0,32	-0,26	0,05
93	-0,60	0,27	-0,68	0,07	0,03	0,62	0,15	-0,14	0,11	0,00	-0,28	-0,20	-0,18
94	-0,16	-0,01	-0,35	-0,05	0,01	0,16	0,06	0,15	-0,06	0,01	0,08	0,02	-0,14
95	-0,21	0,04	-0,65	-0,04	0,05	0,17	-0,14	0,14	0,02	0,02	-0,18	-0,03	0,35
96	-0,21	-0,11	-0,38	0,00	0,14	0,03	0,16	-0,21	0,01	0,05	-0,03	0,33	0,10
97	-0,44	-0,26	-0,17	-0,03	0,07	0,02	0,03	-0,17	0,08	0,03	0,02	0,12	0,14
98	-0,50	0,00	-0,36	0,05	-0,24	-0,34	0,04	0,12	0,11	0,03	0,19	-0,48	0,10
99	-0,39	-0,05	0,02	0,00	0,21	-0,31	-0,05	0,03	0,03	0,02	-0,04	-0,20	0,21
00	-0,30	-0,10	0,03	-0,02	0,14	-0,27	-0,20	0,37	-0,08	-0,07	-0,40	0,22	0,12
01	-0,10	-0,15	0,05	-0,02	-0,08	-0,20	0,16	0,26	0,05	-0,10	0,00	-0,15	0,05
02	-0,12	0,09	0,07	-0,05	-0,13	-0,14	0,08	0,58	0,04	-0,12	-0,13	-0,09	-0,04
03	0,17	0,09	0,11	-0,03	-0,05	-0,01	0,08	0,54	0,08	-0,07	-0,26	-0,19	-0,08
04	0,21	0,08	0,19	-0,03	-0,04	0,06	-0,02	0,21	-0,02	-0,04	-0,25	-0,04	-0,06
05	0,25	0,06	0,23	-0,07	0,03	-0,02	-0,02	-0,13	0,00	0,02	-0,26	0,14	-0,05
06	0,32	0,06	0,31	-0,11	0,09	-0,07	0,04	-0,62	-0,09	0,00	-0,29	0,16	-0,05
07	0,34	0,08	0,19	-0,02	0,07	-0,05	-0,08	-0,63	0,00	0,03	-0,22	0,05	-0,07
08	0,23	-0,02	-0,12	-0,10	0,04	-0,10	-0,29	-0,54	-0,37	0,00	-0,21	0,17	-0,06
09	0,01	0,02	0,13	-0,07	-0,09	-0,28	-0,30	-0,60	0,38	0,02	-0,10	-0,30	-0,05
10	-0,10	-0,02	0,08	-0,08	-0,11	-0,37	-0,30	-0,68	0,21	0,03	-0,18	-0,08	-0,07

Source : Authors estimates