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WORKING PAPER SERIES

NO 929 / SEPTEMBER 2008

REAL CONVERGENCE IN CENTRAL AND EASTERN EUROPEAN EU MEMBER STATES

WHICH ROLE FOR EXCHANGE RATE VOLATILITY?

by Olga Arratibel, Davide Furceri and Reiner Martin

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WHICH ROLE FOR EXCHANGE RATE VOLATILITY?[1]

by Olga Arratibel[2],
Davide Furceri[3]
and Reiner Martin[2]

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CONTENTS

Abstract 4

Non-technical summary 5

1 Introduction 6

2 Exchange rate regimes and real convergence in the CEE countries – stylized facts 7

3 Empirical analysis 9

3.1 Sample selection and volatility measures 9

3.2 Output growth and exchange rate volatility 11

3.3 Credit cycle and exchange rate volatility 15

3.4 FDI and exchange rate volatility 17

3.5 Current account and exchange rate volatility 20

4 Conclusions 22

References 23

Annex 27

European Central Bank Working Paper Series 36

Abstract

This paper analyzes the relation between exchange rate volatility and several macroeconomic variables, namely real per capita output growth, the credit cycle, the stock of inward foreign direct investment (FDI) and the current account balance, in the Central and Eastern European EU Member States. Using panel estimations for the period between 1995 and 2006, we find that lower exchange rate volatility is associated with higher growth (for relatively less financially developed economies), higher stocks of FDI (for relatively more open economies), higher current account deficits, and a more volatile development of the credit to GDP ratio.

JEL: F3, F4, F5.

Keywords: EU, Exchange Rate Volatility, Growth, FDI, Credit, Current Account, Catching-up, Convergence.

Non-Technical Summary

Exchange rate strategies in the Central and Eastern European EU Member States (CEE) differ considerably, from fixed exchange rate to pure floaters. At the beginning of the transition process, most of these countries relied on pegging the exchange rate to a highly stable currency, such as the US dollar or the Deutsche Mark, as a way to import credibility from abroad and reduce inflation. In the course of the 1990s, a number of countries gradually softened their peg and moved towards more monetary policy autonomy and several countries adopted inflation targeting as a monetary policy framework.

When we look at stylized facts regarding the macroeconomic performance of the "hard peg" and "floating" CEE country groups over the period 1995-2006, the evidence is quite mixed. While "hard-pegs" tended to experience faster real GDP growth than "floaters", they also tended to experience relatively larger external imbalances, especially during the last couple of years.

Moving beyond stylized facts, the empirical results of our paper suggest that differences in *de facto* exchange rate volatility – which is used in this paper to account for differences between exchange rate regimes – across the CEE countries during the 1995-2006 period are, indeed, associated with differences in key macroeconomic variables.

More specifically, our findings suggest that, over this period as a whole, lower exchange rate volatility in the CEE countries was associated with higher growth (for relatively less financially developed economies), higher FDI inflows (for relatively more open economies), higher current account deficits, and a more volatile credit cycle.

However, given the limited data availability we are not able to investigate possible endogeneity issues to the full. This makes it impossible to firmly conclude on the direction of causality between exchange rate volatility and the above-mentioned variables.

1. Introduction

Monetary policy strategies in the Central and Eastern European EU Member States (hereafter CEE) differ considerably, from completely fixed exchange rate arrangements to pure floaters. At the beginning of the transition process, most of these countries relied on pegging the exchange rate to a highly stable currency, such as the US dollar or the Deutsche Mark, as a way to (i) achieve macroeconomic stabilization by means of a rapid disinflation process ("hard-pegs" as an external nominal anchor), and (ii) to facilitate the transition process, in the absence of fully developed markets and institutions, from centrally planned to market economies ("hard-pegs" as an institutional device). However, by the beginning of this century, once macroeconomic stability was broadly achieved, a number of CEE countries gradually softened their pegs and moved towards more monetary policy autonomy; countries that did so adopted inflation targeting as a monetary policy framework.

"Hard-pegs" made a significant contribution to restoring market confidence during the early period of transition. More recently, however, the particular policy challenges facing the CEE countries that operate "hard-pegs" have come to the forefront, in view of the rising internal and external imbalances that have emerged in the Baltic States and Bulgaria.

In this paper we analyze, for the period 1995-2006, the relation between exchange rate volatility and several key macroeconomic variables, namely: per capita output growth, the credit cycle, the stock of inward foreign direct investment (FDI) and the current account balance.

The paper is organized as follows. The next section presents some stylized facts regarding the exchange rate strategies and real convergence for the CEE countries. Section 3 investigates empirically the relation between exchange rate volatility and the selected macroeconomic variables in the CEE countries. Section 4 summarizes the main findings.

2. Exchange rate regimes and real convergence in the CEE countries – stylized facts

Exchange rate strategies in the CEE differ considerably, from fixed exchange rate to pure floaters. At the beginning of the transition process, most CEE countries relied on pegging the exchange rate to a highly stable currency, such as the US dollar or the Deutsche Mark, as a way to import credibility from abroad and to reduce inflation from high levels. In the course of the 1990s, however, a number of countries gradually softened their peg and moved towards more monetary policy autonomy and several countries adopted inflation targeting as a monetary policy framework (Table 1). In what follows, countries are subdivided into those with "hard-peg" regimes (i.e. Bulgaria, Estonia, Latvia and Lithuania) and those with inflation targeting regimes combined with flexible exchange rates or relatively "soft-pegs" ("floaters"), i.e. the Czech Republic, Hungary, Poland, Romania and Slovakia.[1]

Looking first at real GDP growth, the "hard-peg" countries performed in most years better than the "floaters" (Figure 1). While both groups show a clear upward trend over time, the gap in growth rates between the two groups has slightly increased to around three percentage points in the most recent years. However, the initial level of GDP per

[1] Most CEE countries, particularly the "floaters", have revised their exchange rate regime on several occasions over the period under study. This, however, does not change the classification of the countries under study between the two groups over the period 1995-2006. The only exception is Bulgaria, which introduced a currency board to the Deutsche Mark (euro since 1999) only on 1 July 1997.

capita at the beginning of the period of analysis was substantially lower in the "hard-pegs" than in the "floaters".

A similar pattern emerges with regard to total domestic credit growth (Figure 2). Especially after the Russian crisis, annual credit growth accelerated in both sets of countries, particularly in the "hard-pegs". In fact, while annual credit growth increased, on average, from around 14% in 1998 to more than 33% in 2006 in the "hard-pegs", it increased from around 17% in 1998 to around 21% in 2006 in the "floaters".

As regards the ability to attract FDI, both sets of countries, with no particular difference, were able to build-up significant stocks of inward FDI (Figure 3). However, a sharply different pattern emerges as regards the current account balance. Looking at Figure 4, the "hard-pegs" show more sizeable external imbalances during most years. Moreover, looking at the developments over time, current account imbalances consistently widened in the "hard-peg" countries, especially during the last two years, whereas they remained rather constant in the "floaters".

In sum, when looking at these stylized facts over the period 1995-2006 as a whole, it seems that "hard-pegs" experienced faster real GDP growth than "floaters". At the same time, "hard-pegs" tended to be associated with relatively higher external imbalances, especially during the last couple of years. The next section provides in-depth empirical tests to gain more insights into these observations.

3. Empirical Analysis

3.1 Sample selection and volatility measures

In order to estimate the relation between exchange rate regimes and key economic indicators, an important decision to be made is the underlying definition of exchange rate volatility. While exchange rate arrangements are often divided into "hard pegs" and "floaters" (as in Section 2 of this paper), there is a broad variety of "intermediate" regimes.[2] *De jure* exchange rate classifications, such as that of the IMF, depend on the countries' *ex ante* self-assessment of their exchange rate regime. However, such classifications may well fail to control for a possible discrepancy between *de jure* and *de facto* regimes. Such a discrepancy has often arisen from the so-called "*fear of floating*", leading countries to pursue exchange rate stabilization even when they declare their exchange rate regime to be flexible (see Calvo and Reinhart, 2002; McKinnon and Schnabl, 2004; De Grauwe and Schnabl, 2005). In this respect, *de facto* measures for exchange rate volatility provide more accurate information to assess the relation between exchange rate volatility and key macroeconomic variables.

The measure of *de facto* exchange rate volatility against the euro that we use in our empirical analysis is the *z-scores* measure proposed by Ghosh, Gulde and Wolf (2003). It incorporates both exchange rate fluctuations around a constant level and exchange rate fluctuations around a gradual depreciation/appreciation rate:

$$z_t = \sqrt{\mu_t^2 + \sigma_t^2} \tag{1}$$

[2] The official (IMF) classification of exchange rate arrangements, as published in the IMF Annual Report on Exchange Rate Arrangements and Exchange Restrictions, provides a measure for the commitment by the monetary authorities to an specified exchange rate regime. The IMF classifies *de jure* exchange rate arrangements into eight groups with a rising degree of exchange rate flexibility: 1) exchange rate regime with no separate legal tender; 2) currency board arrangements; 3) other conventional fixed peg arrangements (with a band of at most ±1%); 4) pegged exchange rate arrangements with horizontal bands (at least ±1%); 5) crawling pegs (with small, preannounced adjustment); 6) exchange rates with crawling bands; 7) managed floating with no preannounced path for exchange rate; 8) independent floating (market-determined exchange rate and independent monetary policy).

where μ_t corresponds to the arithmetic average of month-to-month changes in the nominal exchange rate vis-à-vis the euro in year *t,* in percentage, and σ_t is the standard deviation of the month-to month changes, of the nominal exchange rate vis-à-vis the euro of the year *t,* in percentage.[3]

In the remainder of this section we explore the relation between exchange rate volatility and a number of key macroeconomic indicators, namely real per capita output growth, the credit cycle, the stock of inward FDI, and the current account balance. We use the fixed effect estimator in order to control for heterogeneity among countries and time periods, and the "sandwich" estimator for the variance and covariance matrix to control for heteroskedasticity and autocorrelation in the error components. For each of the macroeconomic variables under investigation, we use those control variables that the literature has generally found to be significant in explaining the behavior of the respective dependent variable under investigation.

Our sample consists of nine CEE countries: the "hard-pegs", i.e. Bulgaria, Estonia, Latvia and Lithuania, and the "floaters", namely the Czech Republic, Hungary, Poland, Romania and Slovakia. The data sources are IMF International Financial Statistics, EUROSTAT, and UNCTAD. Since the dataset for the cross-country panel is very fragmented until 1994, our analysis period starts in 1995 and ends in 2006. This sample period excludes most of the macroeconomic turbulences that characterized the early transformation years.

[3] The z-scores measure in our example is highly and positively correlated to the standard deviation of the exchange rate (σ_t). Thus, the use of z-scores – which includes a combination of standard deviation and changes of the exchange rate level – or σ_t, as an alternative volatility measure, is quite indifferent.

3.2 Output Growth and Exchange Rate Volatility

To assess the relation between exchange rate volatility and growth, we use a panel data model that explains output growth by a set of standard variables from the growth literature, to which we add our measure of exchange rate volatility.[4] More specifically, we estimate the following model:

$$Y_{it} = \alpha_i + \delta X_{it} + \beta EX_{it} + \varepsilon_{it} \qquad (2)$$

where the dependent variable is real per capita GDP growth for country *i* at time *t*. The vector X includes a set of control variables affecting growth: i) the ratio of investment to GDP; ii) (the log of) openness; iii) (the log of) the stock of inward FDI; iv) the fiscal deficit, in per cent of GDP; v) a dummy for the 1998 (Russian) crisis. The choice of these variables is in line with other papers in the growth economic literature.[5]

The relation between exchange rate volatility and real per capita GDP growth is measured by the parameter β. From a theoretical point of view, there is no clear consensus about the relation between exchange rate volatility and growth. Proponents of fixed exchange rates argue that exchange rate stability promotes growth through higher trade and macroeconomic stability (Dornbusch, 2001; Rose, 2000; Frankel and Rose, 2002; McKinnon and Schnabl, 2004). In contrast, proponents of flexible exchange rates have emphasized the need for macroeconomic flexibility in the face of real asymmetric shocks and in order to foster aggregate demand (Meave, 1951; Friedman, 1953; Fisher, 2001). The results of recent empirical research on this matter seem to suggest that the effect of exchange rate volatility on growth heavily depend on the time period and the sample (Eichengreen and Leblang, 2003).

[4] For instance, see Ghosh, Gulde and Wolf (2003), Edwards and Levy-Yeyati (2003), De Grauwe and Schnabl (2005), Aghion et al. (2006), Schnabl (2007).
[5] We exclude human capital variables, as the relevant data are not available for all CEE countries throughout the period 1995-2006.

Let us first start with the baseline assumption that the risk of endogeneity between exchange rate volatility and growth is low, as there is no empirical evidence that countries with a higher growth are more prone to adopt either a fixed or a flexible exchange rate regime (see De Grauwe and Schnabl, 2005. for a similar approach). Hence, we estimate equation (2) by means of a standard country-fixed effects panel and a robust variance and covariance matrix (*Sandwich Estimator)*. The results, reported in the first column of Table 2, suggest that exchange rate volatility does not play a significant role in explaining per capita real output growth, or at least that there is no linear relation between these two variables. This is consistent with other studies, such as Aghion et al. (2006), which also show that the relation between exchange rate volatility and growth critically depends on the level of financial development. We, therefore, add to equation (2) an interaction term between the ratio of the stock of credit to GDP (as a proxy of financial development) and the measure of exchange rate volatility:

$$Y_{it} = \alpha_i + \delta X_{it} + \beta EX_{it} + \gamma EX_{it} \cdot Credit_{it} + \varepsilon_{it} \qquad (3)$$

Our hypothesis is that $\beta < 0$ and $\gamma > 0$, i.e. that the relation between exchange rate volatility and output growth $(\beta + \gamma \cdot Credit)$ is more negative at a low level of financial development. In other words, less financially developed economies may derive through the "credit channel" larger growth benefits from low exchange rate volatility and the associated stimulation of the process of financial deepening than financially more developed economies.

Moreover, if the two parameters have opposite signs, it is possible to identify a threshold level for the credit/GDP share for which the relation between exchange rate volatility and output growth is null. This threshold level, which varies with the sample under study, is computed as the ratio between the absolute value of the estimated coefficient for exchange rate volatility, β, and the coefficient of the interaction term, γ.

We therefore estimate equation (3) controlling again for country-fixed effects and using the *Sandwich Estimator* for the variance and covariance matrix. The results support our initial hypothesis: estimates of the parameters β and γ have the expected sign and are statistically significant. In other words, less financially developed economies may obtain larger growth benefits from adopting a more rigid exchange rate regime. Once countries are moving to a higher level of financial development, which normally suggests making progress in real convergence, the growth advantage initially obtained from having less flexible exchange rate arrangements becomes smaller. In economies with a level of financial deepening above the threshold level (which for the CEE country sample covered in this paper is equal to a credit/GDP ratio of 67%), it could become even negative. In other words, for those CEE countries covered in this paper that reached a credit/GDP ratio of 67% or above, the relation between exchange rate volatility and growth is null or positive, for the others the effect is negative.[6]

These results are broadly confirmed when we add in our regression time-fixed effects in order to control for heterogeneity over time[7], although the significance of the z-scores as well as the interaction term is smaller (Column 3).

To check the robustness of our results, we repeat the analysis using the standard deviation of month-to-month changes of the nominal exchange rate as an alternative measure of exchange rate volatility. The results, which are reported in column 4 of Table 2, confirm that our findings are extremely robust. In particular, both the magnitude and statistical significance of the coefficients of exchange rate volatility and of the interaction term are almost unchanged.

[6] The level of the threshold is determined by the countries and the time span considered in our sample. Any modification in the country sample and / or the time span would, of course, change the numeric value of the threshold.

[7] The result holds, for example, for the first period of our sample that is characterized by high inflation.

Finally, we conclude this empirical exercise by controlling for possible endogeneity between exchange rate volatility and growth. To test for endogeneity, we use three different estimation techniques. The first is the 2SLS, where we instrument our independent endogenous variables by their lags and the lag of the growth rate of GDP. The second method is the "difference" GMM approach proposed by Arellano and Bond (1991). The third method is the "system" GMM approach proposed by Arellano and Bover (1995) and fully developed by Blundell and Bond (1998).

The results are reported in Table 3, which shows that, while the magnitude of the coefficients of exchange rate volatility and of the interaction term is almost unchanged or increased, their significance level is decreased. In particular, once we introduce GMM estimators, the effect of exchange rate volatility on GDP growth turns out not to be statistically significant. This makes the interpretation of our result more difficult. In fact, given the limited data available, we cannot infer whether the association between exchange rate and growth would disappear when we control for endogeneity, or whether the non-significance of our estimates is based on the poor performance of this class of GMM estimators when N is low (in fact, these GMM estimators have been designed for situations with small T and large N, thus in situations when N is small the country-fixed effect model (LSDV) may perform better than the GMM).

In sum, although based on these empirical results we cannot firmly conclude that different patterns of exchange rate volatility in the CEE countries have determined different patterns in their growth rate, we cannot reject that hypothesis either. In any case our results suggest that for relatively less financially developed economies, exchange rate volatility is associated with higher growth. This is in line with the theoretical and empirical evidence in Aghion et al. (2005).

3.3 Credit Cycle and Exchange Rate Volatility

In this section we explore the relation between exchange rate volatility and the deviation of the credit to GDP ratio from its trend (hereafter, the credit cycle). The economic literature has usually focused on developments in credit growth, rather than in the credit cycle. However, given that the countries under study are embarked on a process of rapid catching-up and financial deepening, it is very likely that the rapid increase in credit growth observed in the CEE countries over the last decade may be partly attributable to a long-run catching-up process (credit trend). Hence, focusing on the credit cycle should help us to separate this effect from the "real" boom and bust episodes that seen to have occurred during the sample period (Egert et al., 2006; Kiss et al., 2006).

Indeed, looking at Figure 5a and 5b, which show the credit cycle for our sample of CEE countries from 1995 to 2006, and considering a 5% threshold of the relative deviation of the credit cycle (Gourinchas et al. 2001), we can observe six cases of over- respectively undershooting: i-ii) Bulgaria 1996, 1999; iii) Estonia 1997; iv-v) Lithuania 2005, 2006 and vi) Romania 1996.[8] However, the purpose of this paper is not to identify booms and downturns in the credit to GDP ratio, but to asses whether or not exchange rate stability contributed overall to a smoother credit/GDP ratio around its long-term trend. For this purpose we estimate the following econometric model:

$$C_{it} = \alpha_i + \gamma X_{it} + \beta EX_{it} + \varepsilon_{it} \tag{4}$$

where the dependent variable is the credit cycle for country i at time t. Measures of credit cycle are obtained by detrending the series of credit to GDP ratios using the HP filter.[9] The

[8] The number of overshooting episodes increases considerably if we take as reference a threshold of 2%.

[9] The selected smoothness parameter is equal to 6.25. See Gourinchas et al. (2001) for a similar approach. As pointed out by Ravn and Uhlig (2002), the Hodrick-Prescott filter with this smoothness parameter produces cyclical components comparable to those obtained by the Band-Pass filter. Moreover, it usually produces a measure of the cycle that is on average closer to other measures, such as differencing and HP filtering with a smoothness parameter equal to 100.

vector X includes a set of control variables affecting the credit cycle[10]: i) HICP inflation; ii) (the log of) GDP; iii) the credit/GDP ratio; iv) investment; v) public debt relative to GDP; vi) (the log of) openness.

Our parameter of interest, β, measures the relation between exchange rate volatility and the credit cycle. From a theoretical point of view, there is no clear consensus about the sign of the relationship between exchange rate stability and the credit cycle. On the one hand, a "hard peg" regime could help to provide an economic framework that enhances confidence and facilitates long-term stable decision-making among economic agents. Higher exchange rate stability should, thus, increase the credit growth trend and reduce credit volatility (around the trend). On the other hand, the CEE-specific case of a "hard-peg" to the euro may exacerbate expectations about euro area entry that, by temporarily inducing domestic demand euphoria, increases the volatility of credit.

In order to test these hypotheses, we estimate equation (4) using a standard panel country-fixed effects and robust variance and covariance matrix (*Sandwich Estimator*). The results are reported in the first column of Table 4. The effect of exchange rate stability on the absolute deviations of the credit cycle is negative and statistically significant. This implies that, other things equal, "hard-pegs" are likely to be associated with a more volatile credit cycle. In terms of the control variables we find that countries with relatively higher HICP inflation, higher public debt and a lower credit/GDP ratio are characterized by a more volatile credit cycle. These results are broadly confirmed by a robustness check that includes also time-fixed effects (column 2). The parameter for exchange rate volatility is almost unchanged and its significance level is the same. However, inflation becomes less insignificant and investment and private debt play a more important role.

[10] See Calza et al. (2001, 2003), Cottarelli et al. (2005), Boissay et al. (2006), Kiss et al. (2006).

As a final robustness check, we include in our baseline regression an index for financial account liberalization based on the IMF classification included in the Annual Reports on Exchange Rate Arrangements and Exchange Restrictions for the period 1995-2006. The results are reported in column 3. While the index for capital controls is not found to be significant[11] the effect of exchange rate volatility on credit cycle is still negative and significant.

3.4 FDI and exchange rate volatility

Next we use a cross country panel data model to investigate the relation between exchange rate volatility and the stock of inward FDI in the CEE countries:

$$\ln FDI_{it} = \alpha_i + \delta X_{it} + \beta EX_{it} + \varepsilon_{it} \qquad (5)$$

The dependent variable is the (log of the) stock of inward FDI in county *i* at time *t*. The vector X includes a set of control variables. Following the literature[12] we propose eight main variables as standard determinants for inward FDI: i) (the log of) the level of real GDP; ii) (the log of) the level of real GDP per capita; iii) (the log of) openness, defined as the GDP's share of exports plus imports; iv) barriers to trade; v) the average corporate tax rate; vi) unit labor costs and vii) dummies for the announcement of EU enlargement in 1998 ("first-wave") and 2000 ("second-wave").

Real GDP is used as a proxy for market size and GDP per capita is an indicator for the purchasing power of local consumers. Both variables are expected to influence the stock of FDI positively. The level of openness of the host countries is expected to be positively related to the stock of inward FDI whereas the effect of barriers to trade is

[11] This could be explained by the fact that differently from exchange rate volatility the index has not much time variability, and our sample has more time than country observations.
[12] See, for example, Lansbury et al. (1996), Altomonte (1998), Holland and Pain (1998), Resmini (2000), Woodward et al. (2000), Cartensen and Toubal (2003),Clausing and Dorobantu (2005).

expected to be negative.[13] Corporate tax and unit labor costs are expected to be negatively correlated to the level of inward FDI in the host countries, while the dummies for the announcement of EU membership are expected to be positively correlated with the stock of inward FDI.[14]

Our parameter of interest, β, measures the relation between exchange rate volatility and the stock of inward FDI in the host country. From a theoretical point of view, there is no clear consensus about the sign of this relation. A more flexible exchange rate could be used to cushion asymmetric economic shocks and, thus, create a more stable and favorable environment to investment. Yet, from a microeconomic perspective, lower exchange rate volatility can be associated with lower transaction costs for capital flows that in turn are expected to foster inward FDI.

We estimate equation (5) taking into account, again, country-fixed effects and a robust variance and covariance matrix (*Sandwich Estimator*). The results are reported in Table 5. In the first column we present the results obtained including the z-scores as measure of exchange rate volatility. While all our control variables are significant (except unit labor costs) and the associated signs correct, we do not find any significant relationship between exchange rate volatility and the stock of FDI inward. However, the relation between exchange rate volatility and FDI may not be linear and may be interrelated with the level of openness. In fact, it could well be the case that while for a relatively closed economy the relation is negligible, for relatively open economies higher exchange rate stability could support FDI inflows. For this purpose, we add to our basic

[13] The proxy for the barriers to trade is obtained from the residual of the regression of the host country's imports on both the level and the square of its population.

[14] The first dummy (ANN1) is equal to one from 1998 onwards for the Czech Republic, Estonia, Hungary and Poland (countries identified as "first-wave") and zero otherwise. The second dummy (ANN2) is equal to one from 1998 onwards for Bulgaria, Latvia, Lithuania, Romania and Slovakia (countries identified as "second-wave") and zero otherwise. See Clausing and Dorobantu (2005) for a similar approach.

regression another variable measuring the interaction between exchange rate volatility and openness (*Inter*):

$$Y_{it} = \alpha_i + \delta X_{it} + \beta EX_{it} + \gamma EX_{it} \cdot OPEN_{it} + \varepsilon_{it} \tag{6}$$

Our hypothesis is that $\beta \geq 0$ and $\gamma < 0$, so that the relation between exchange rate volatility and inward FDI $(\beta + \gamma \cdot Openness)$ is positive or null at a low level of openness, but becomes negative at a higher level of openness. In other words, our hypothesis is that exchange rate flexibility could help to mitigate the impact of external shocks in countries with a low degree of openness. In countries with a high degree of openness, however, the transaction costs associated with exchange rate volatility outweigh the potential benefits of using the exchange rate as an adjustment tool.

The results in the second column show that while the significance level and the sign of the estimated coefficients of the control variables are broadly unchanged, our measure of interaction between exchange rate volatility and openness becomes strongly significant. This implies that the effect of exchange rate volatility on FDI indeed appears to depend on the level of openness. The more open an economy is, the more negative appears the relation between exchange rate volatility and FDI.[15] These results are broadly confirmed when we add time-fixed effects in our regression, although the significance of some of the control variables is strongly reduced (Column 3).

[15] Analyzing from another point of view, we can say that the effect of openess on FDI depends on the level of exchange rate volatility. In fact, while for countries with low level of exchange rate volatility the effect of openess on FDI is positive, for countries with high exchange rate volatility this effect could become null (when a threshold level is reached) or negative (when the measure of exchange rate volatility is above the threshold level).

3.5 Current Account and exchange rate volatility

In order to estimate the relation between exchange rate volatility and the current account balance, we decompose the latter into the difference between domestic savings (private and public) and investment. Normalizing for the level of GDP we have:

$$\frac{CA}{Y} = \frac{S_p}{Y} + \frac{S_g}{Y} - \frac{I}{Y}$$

This approach allows us to identify several control variables and determinants for the analysis of the effect of exchange rate volatility on the current account balance. More specifically, we estimate the following equation:

$$\frac{CA}{Y}_{it} = \alpha_i + \delta X_{it} + \beta EX_{it} + \varepsilon_{it} \qquad (7)$$

where the dependent variable is the ratio of the current account balance to GDP for country *i* at time *t*. The vector X includes a set of control variables affecting private and public saving as well as investment. In particular, we include the following variables: i) relative GDP per capita (compared with the average of the EU15 countries); ii) (the log of) openness; ii) the investment to GDP ratio; iv) (the log of) FDI inflows; v) the ratio between the growth rate of real aggregate consumption and the growth rate of real GDP (consumption smoothing); vi) the fiscal deficit, in per cent of GDP; vii) the stock of total credit, in per cent of GDP; viii) HICP inflation.

Relative real per capita income represents an important factor in explaining current account developments, which has been found to be positively correlated with the savings ratio and, thus, with the current account balance.[16] On the contrary, more open economies are more likely to attract FDI inflows and, thus, to experience larger capital account deficits.[17] In the same way, higher levels of FDI inflows and higher levels of domestic investment are associated with larger current account deficits. Countries with higher

[16] See, for example, Giovannini (1985), Atkeson and Ogaki (1991), Rebelo (1992).
[17] See, for example, Clausing and Doranatu (2005).

consumption smoothing are usually characterized by higher levels of private and public savings, thus the effect on the current account balance is expected to be positive. Similarly, high inflation (especially if unanticipated) is likely to increase precautionary saving.[18] Fiscal deficits can be seen as negative public saving, thus we should expect a negative correlation between the current account balance and the deficit-to-GDP ratio.[19] Finally, a high credit-to-GDP ratio can be seen as a proxy for financial development and is expected to positively affect investment.

The relation between exchange rate volatility and the current account balance is measured by the parameter β. From a theoretical point of view, the sign of the effect of exchange rate volatility on the current account balance is *a priori* not clear. On the one hand, a more stable exchange rate could be seen as favoring an environment of macroeconomic stability and thus strengthening incentives for savings and investment decisions. At the same time, a stable exchange rate – especially in small open economies such as the CEE countries – is likely to encourage international capital inflows.

In Table 6 we report the results obtained from estimating equation (7). In the first column we present the results obtained using only country-fixed effects and a robust variance and covariance matrix (*Sandwich Estimator*). All control variables are significant and the associated signs correct. Moreover, the relation between exchange rate volatility and current account imbalances is significant and positive, implying that countries with higher exchange rate stability are characterized by higher current account deficit. These results are also confirmed when we include time-fixed effects (column 2). In particular, while some of the control variables such as consumption smoothing and the fiscal deficit become insignificant, the parameter for exchange rate volatility and its significance level are almost unchanged.

[18] See, for example, Deaton (1977) and Bandiera et al. (2000).
[19] See, for example, Bachmann (1992), Selhattini (1997), Chinn and Prasad (2000), Bussiére et al. (2004).

4. Conclusions

Exchange rate strategies in the CEE differ considerably, from fixed exchange rate to pure floaters. At the beginning of the transition process, most of these countries relied on pegging the exchange rate to a highly stable currency, such as the US dollar or the Deutsche Mark, as a way to import credibility from abroad and reduce inflation. In the course of the 1990s, a number of countries gradually softened their peg and moved towards more monetary policy autonomy and several countries adopted inflation targeting as a monetary policy framework.

When we look at stylized facts regarding the macroeconomic performance of the "hard peg" and "floating" CEE country groups over the period 1995-2006, the evidence is quite mixed. While "hard-pegs" tended to experience faster real GDP growth than "floaters", they also tended to experience relatively larger external imbalances, especially during the last couple of years.

Moving beyond stylized facts, the empirical results of our paper suggest that differences in exchange rate volatility across the CEE countries during the 1995-2006 period are, indeed, associated with differences in key macroeconomic variables. More specifically, our findings suggest that, over this period as a whole, lower exchange rate volatility in the CEE countries was associated with higher growth (for relatively less financially developed economies), higher FDI inflows (for relatively more open economies), higher current account deficits, and a more volatile credit cycle.

Given the limited data available, however, we are not able to investigate possible endogeneity issues to the full. This makes it impossible to firmly conclude on the direction of causality between exchange rate volatility and the above-mentioned variables.

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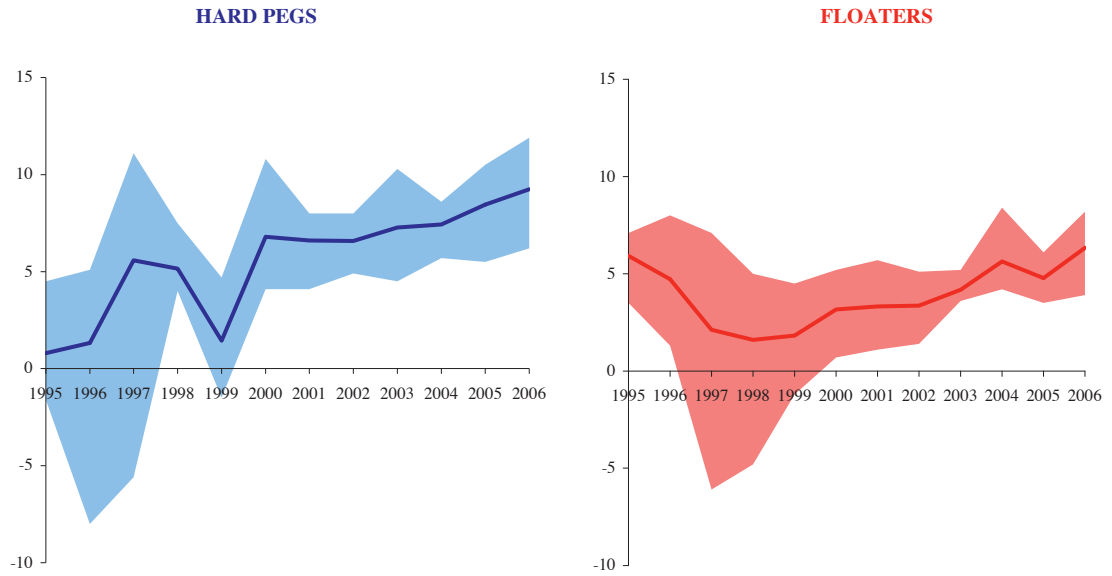
ANNEX

Table 1. Official monetary policy strategies of CEE countries

Official monetary policy strategies of Central and Eastern European EU Member States			
	Monetary policy strategy	**Currency**	**Features**
Bulgaria	Exchange rate target	Bulgarian lev	Exchange rate target: peg to the euro at 1.95583 lev per euro within the framework of a currency board arrangement.
Czech Republic	Inflation target	Czech koruna	Target: 3% ±1 percentage point until end- 2009; thereafter 2% ±1 percentage point. Managed floating exchange rate.
Estonia	Exchange rate target	Estonian kroon	Participates in ERM II with a ±15% fluctuation band around central rate of EEK 15.6466 per euro. Estonia continues with its currency board arrangement as a unilateral commitment.
Latvia	Exchange rate target	Latvian lats	Participates in ERM II with a ±15% fluctuation band around central rate of LVL 0.702804 per euro. Latvia continues with a fluctuation band of ±1% as a unilateral commitment.
Lithuania	Exchange rate target	Lithuanian litas	Participates in ERM II with a ±15% fluctuation band around central rate of LTL 3.45280 per euro. Lithuania continues with its currency board arrangement as a unilateral commitment.
Hungary	Inflation target	Hungarian forint	Inflation target: 3% (±1 p.p.) medium term target since 2007.
Poland	Inflation target	Polish zloty	Inflation target: 2.5%, with ±1 percentage point (12-month increase in the CPI). Free floating exchange rate.
Romania	Inflation target	Romanian leu	Inflation target: 4%, 3.8% and 3.5%, with ±1 percentage point for end-2007, 2008 and 2009, respectively. Managed floating exchange rate.
Slovakia	Inflation targeting in the conditions of ERM II	Slovak koruna	Participates in ERM II with a ±15% fluctuation band around central rate of Slovak koruna 30.1260 per euro. The inflation target is set below 2% at end-2007 and at end-2008.

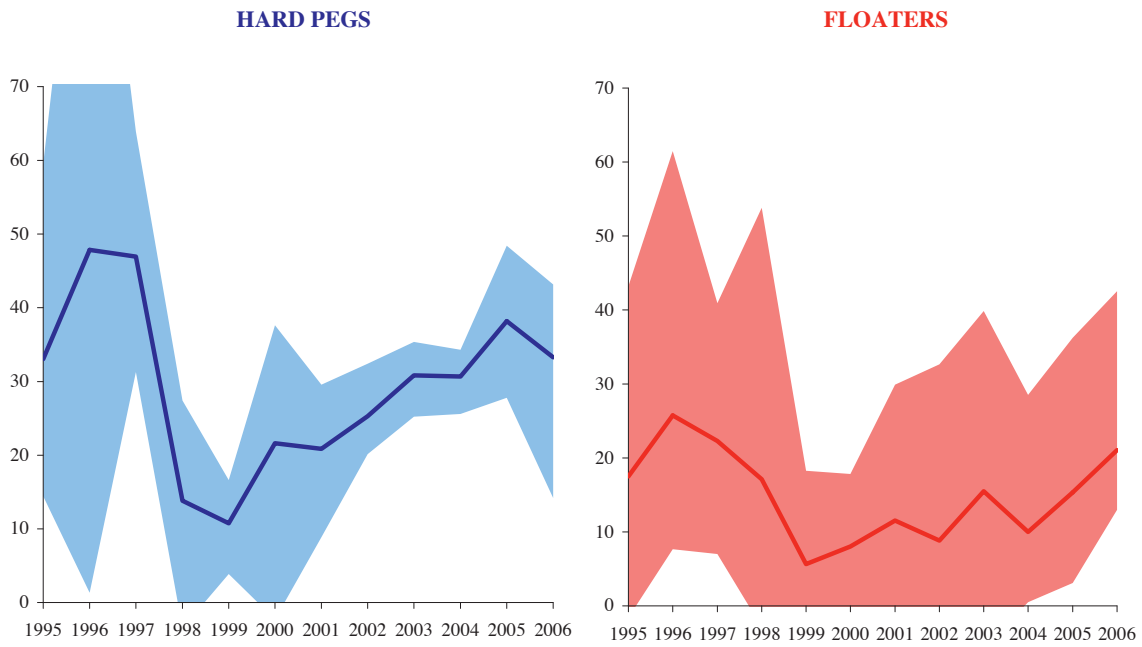
Sources: ESCB.

Figure 1. Real GDP Growth (in %)



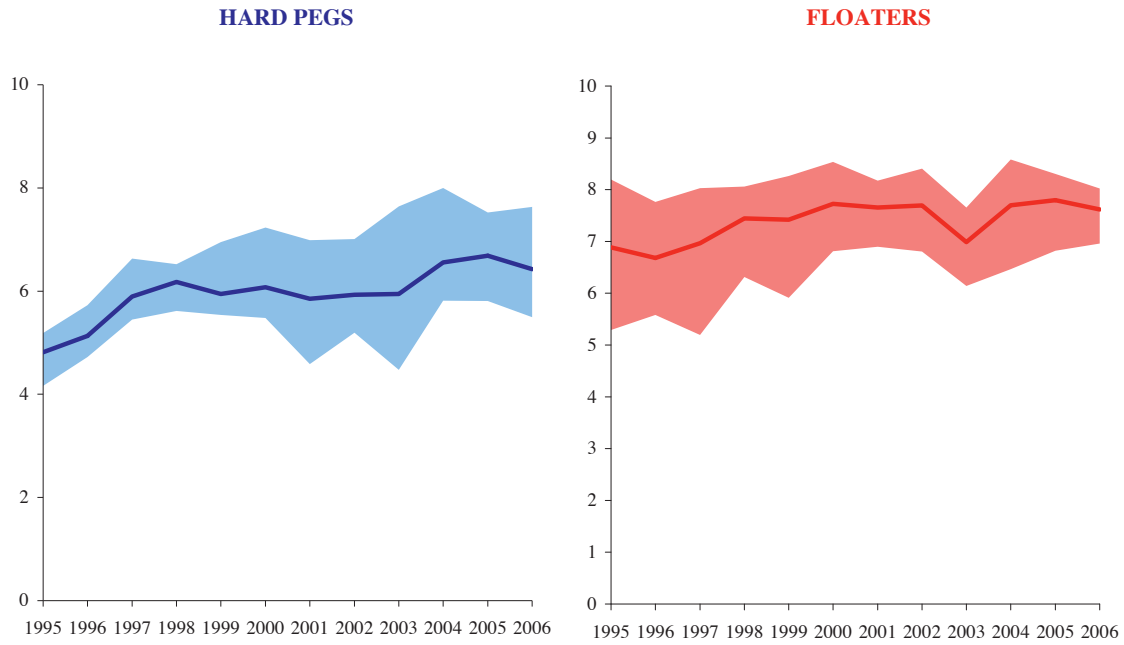
Source: Eurostat. Shaded area corresponds to maximum and minimum values, Lines to unweighted average.

Figure 2. Credit Growth (in %)



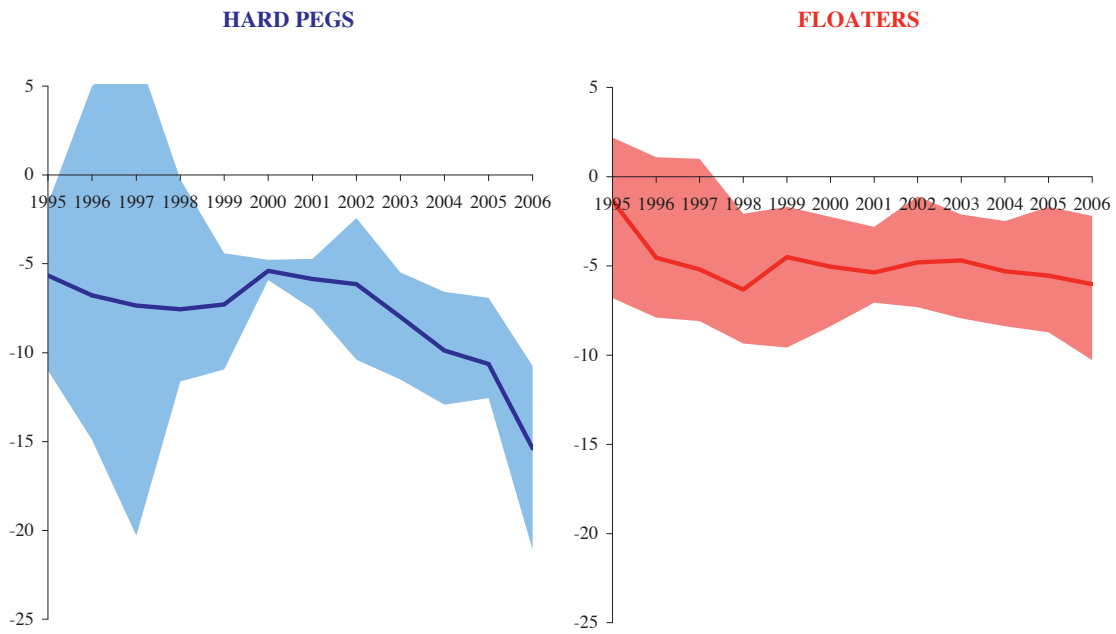
Source: Eurostat. Shaded area corresponds to maximum and minimum values, Lines to unweighted average.

Figure 3. FDI Inflow (Real terms, log of Millions of $)



Source: UNCTADD. Shaded area corresponds to maximum and minimum values, Lines to unweighted average.

Figure 4. Current account balance (% of GDP)



Source: Eurostat. Shaded area corresponds to maximum and minimum values, Lines to unweighted average.

Figure 5a. The Credit Cycle in "hard-peg" countries 1995-2006

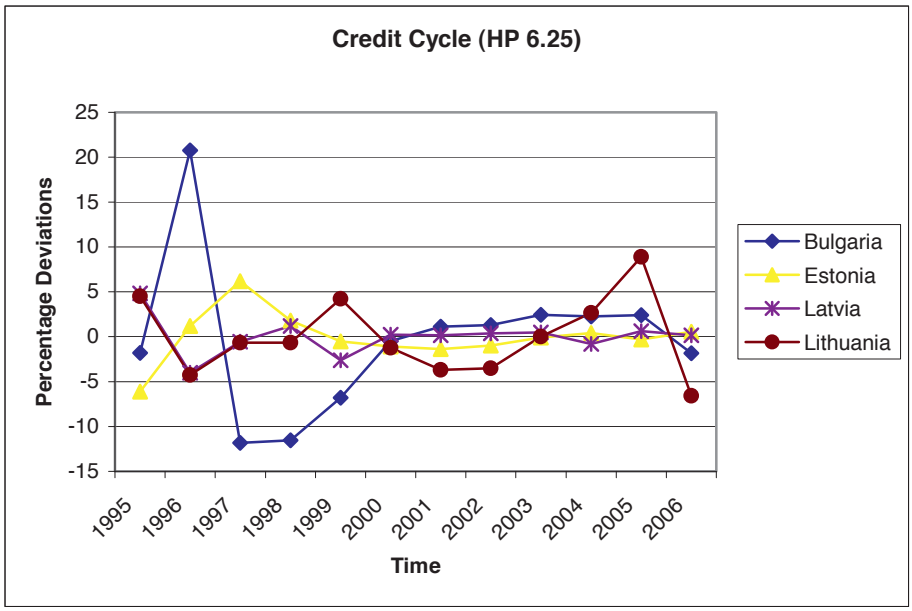


Figure 5b. The Credit Cycle in "soft-peg" countries 1995-2006

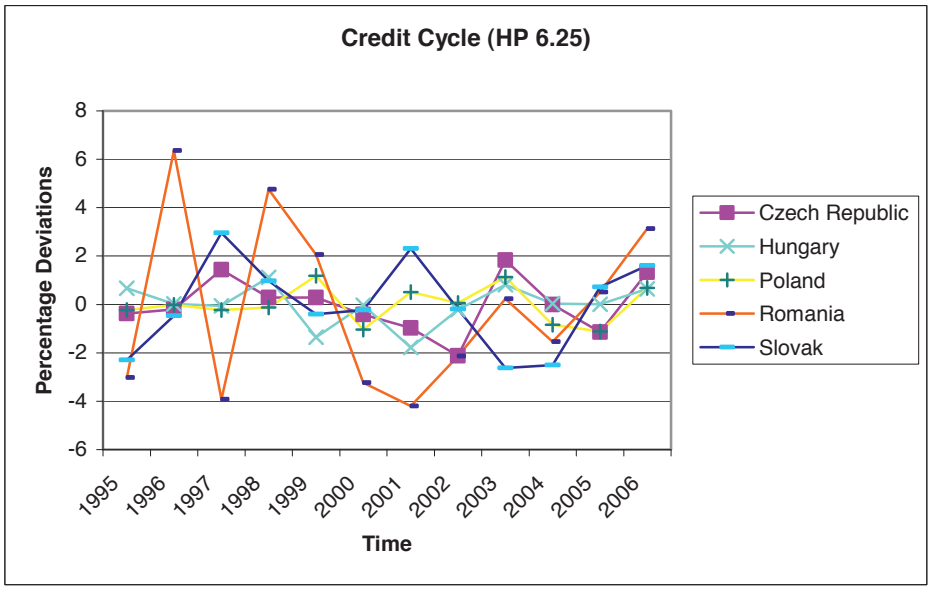


Table 2. Growth and Exchange Rate Volatility

		(1)	(2)	(3)	(4)
ER	Z-scores	0.089	-0.805	-0.831	-0.759
		(0.80)	(-2.07)**	(-1.78)*	(-1.94)*
	Interaction		0.012	0.011	0.011
			(2.41)**	(1.87)*	(2.27)**
Controls	Investment	0.308	0.309	0.370	0.309
		(5.36)***	(5.40)***	(4.58)***	(5.39)***
	Defcit	0.039	0.029	0.008	0.029
		(0.27)	(0.20)	(0.07)	(0.20)
	Openess	1.745	2.350	2.568	2.325
		(1.20)	(1.49)	(2.20)**	(1.48)
	FDI inflow	0.054	0.054	0.292	-0.059
		(0.12)	(0.12)	(0.64)	(-0.13)
	Dummy 98	-0.707	-0.481	-3.347	-0.494
		(-0.82)	(-0.54)	(-1.71)*	(-0.55)
	Observations	104	104	104	104
	R^2-within	0.45	0.46	0.57	0.46
	R^2-between	0.12	0.16	0.06	0.16
	R^2-overall	0.30	0.30	0.21	0.30

Robust standard errors; t-statistics in parenthesis;
*,**,*** respectively significant at 10%,5% and 1%.

Table 3. Growth and Exchange Rate Volatility (controlling for endogeneity)

		(1)	(2)	(3)
ER	Z-scores	-2.838	-0.729	-0.795
		(-1.13)	(-0.66)	(-1.11)
	Interaction	0.041	0.014	0.012
		(1.15)	(0.67)	(1.06)
Controls	Investment	0.207	0.310	0.153
		(2.09)**	(1.95)**	(3.48)***
	Defcit	-0.082	0.091	0.084
		(-0.10)	(0.78)	(1.06)
	Openess	7.557	-0.274	1.589
		(2.25)	(-1.17)	(2.25)**
	FDI inflow	-1.434	0.152	-0.177
		(-0.77)	(0.37)	(-0.68)
	Dummy 98	0.318	-2.847	-0.644
		(0.24)	(-2.33)**	(-1.03)
	Observations	96	96	96
	Wald *p-value*	0.00	0.00	0.00

Robust standard errors; t-statistics in parenthesis
*,**,*** respectively significant at 10%,5% and 1%.

Table 4. Credit Cycle and Exchange rate volatility

		(1)	(2)	(3)
ER	Z-scores	-0.225 (-2.03)**	-0.216 (-2.00)**	-0.214 (-2.06)**
Controls	Inflation	0.083 (2.89)***	0.064 (1.90)*	0.049 (2.15)**
	GDP	-0.369 (-1.41)	-0.358 (-1.47)	-0.392 (-1.54)
	Credit Share	-0.038 (-3.01)***	-0.043 (-3.04)***	-0.035 (-3.10)***
	Investment	0.102 (1.58)	0.109 (1.64)*	0.109 (1.72)*
	Debt	0.048 (1.86)*	0.053 (2.20)**	0.053 (2.20)**
	Real Interest Rate	-0.019 (-0.28)	-0.032 (-0.37)	-0.029 (-0.53)
	OPEN	0.577 (1.02)*	0.541 (0.92)	0.445 (0.87)
	Capital Control	- -	- -	0.037 (0.59)
	Observations	85	85	85
	R^2-within	0.08	0.20	0.09
	R^2-between	0.94	0.95	0.91
	R^2-overall	0.33	0.43	0.34

Robust standard errors; t-statistics in parenthesis;
*,**,*** respectively significant at 10%,5% and 1%.

Table 5. FDI and Exchange Rate Volatility

		(1)	(2)	(3)
ER	z-scores	0.007	0.028	0.040
		(0.39)	(1.63)	(1.99)*
	Interaction		-0.108	-0.100
			(-4.31)***	(-3.57)***
Controls	GDP	1.361	1.582	0.675
		(2.30)**	(2.78)***	(1.28)
	GDP per capita	0.213	0.006	-0.009
		(0.87)	(0.02)	(-0.03)
	OPEN	1.781	1.877	0.8
		(4.15)***	(4.60)***	(1.99)*
	Barrriers	-1.593	-0.99	-0.04
		(-2.26)**	(-1.44)	(-0.09)
	ANN1	0.467	0.45	0.008
		(3.81)***	(4.17)***	(0.87)
	ANN2	0.412	0.397	-
		(4.00)***	(4.00)***	-
	Corporate tax	-0.200	-0.168	-0.143
		(-4.59)***	(-4.17)***	(-5.44)***
	Unit Labor Cost	0.005	0.005	0.004
		(0.79)	(0.74)	(0.97)
	Observations	97	97	97
	R^2-within	0.90	0.91	0.96
	R^2-between	0.89	0.88	0.84
	R^2-overall	0.89	0.88	0.83

Robust standard errors; t-statistics in parenthesis;
*,**,*** respectively significant at 10%,5% and 1%.

Table 6. Current account and Exchange Rate Volatility

		(1)	(2)
ER	Z-scores	0.898 (3.21)***	0.791 (3.05)***
Controls	FDI inflow	-2.158 (-3.33)***	-1.847 (-3.45)***
	Investment	-1.141 (-12.78)***	-1.123 (-12.24)***
	Relative GDP	0.744 (7.94)***	0.936 (8.78)***
	OPEN	-4.693 (-2.96)***	-3.267 (-2.19)***
	CS	-0.708 (-1.64)*	-0.38 (-0.89)
	Deficit	-0.349 (-2.18)**	-0.020 (-0.13)
	Creditshare	0..061 (1.84)*	0.080 (2.93)***
	Inflation	0.009 (3.79)***	0.007 (3.70)***
	Observations	99	99
	R^2-within	0.61	0.75
	R^2-between	0.90	0.94
	R^2-overall	0.76	0.84

Robust standard errors; t-statistics in parenthesis;
*,**,*** respectively significant at 10%,5% and 1%.

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