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# The Forex Regime and EMU Expansion

PIETER VAN FOREEST vanforeest@few.eur.nl
Erasmus University Rotterdam and Netherlands Organization for Scientific Research,
P.O. Box 1738, 3000 DR, Rotterdam

CASPER G. DE VRIES cdevries@few.eur.nl
Erasmus University Rotterdam and Tinbergen Institute,
P.O. Box 1738, 3000 DR, Rotterdam

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## *Abstract*

This paper provides evidence that the choice of the foreign exchange regime is not of first order importance for achieving high output growth. It is argued that due to the forward looking nature of the foreign exchange market, exchange rate stability hinges on the current and anticipated coherency of monetary and fiscal policies. We demonstrate this empirically on a panel including potential EMU accession countries. By means of rank regression analysis we uncover the partial links across the regime specifics of the representative country versus the German regime during the 1990s.

To start with our main conclusion, we find that the choice of the foreign exchange (forex) regime is not of first order importance for achieving high real growth. The empirical evidence is that production growth was unrelated to the amount of forex variability, and the type of currency arrangement in place. The fact that real growth is insulated from the forex variability and the forex system, is analogous to the well established relative insensitivity of the trade account to forex uncertainty, see for instance Bacchetta and van Wincoop (2000). Within the monetary theory of exchange rates, this insensitivity can be seen as an implication of the forward looking nature of the international financial markets. Since the spot forex rate is determined by the discounted sum of all future expected fundamentals, the stability of the forex rate hinges on the coherency of current and anticipated monetary and fiscal policies. Seen in this way, a flexible forex system can be very stable, if the monetary and fiscal policies are coherent with the market's forex rate valuation. Conversely, a managed float or fixed forex arrangement can be quite unstable.

The objective of our study is to investigate the importance of the choice of the forex regime for real growth, and in particular regarding the Central and

Eastern European Countries (CEECs) and the members of Europe's Economic and Monetary Union (EMU). To this end Section 1 first investigates what economic theory has to say on this matter. In Section 2 we turn to an empirical analysis of the issue geared towards the transition of the CEECs and the inception of the EMU during the 1990s. Section 3 concludes.

Some recent empirical studies provide weak evidence that the choice of forex regime matters for the behavior of macro-economic fundamentals (see Edwards, 1996, 1998; Ghosh et al., 1997, 2002; Reinhart and Rogoff, 2002). The results are mixed, however, in the sense that there is no agreement on the regime-specific effects. In our view, the weakness and inconsistency of the existing empirical evidence does support the forex regime irrelevance result.

## 1. The choice of forex regime and growth

In this section we investigate what economic theory has to say on the importance of the choice of the forex regime for the behavior of the macro-economic fundamentals, and in particular real growth. We present the monetary model of the forex and discuss how it characterizes different monetary policy regimes. We show that the forex regime irrelevance result follows from the forward solution of the monetary model of the forex rate.

### *1.1. The monetary foreign exchange rate model*

As is well known, the monetary model of the forex rate consists of two building blocks: the quantity equation and the purchasing power parity supposition. Country $i$'s quantity equation at time $t$ in logarithmic format reads

$$m_{i,t} - p_{i,t} = \tau y_{i,t} - \lambda r_{i,t}, \tag{1}$$

where $m_{i,t}$ is log money demand, $p_{i,t}$ is the log price level, $y_{i,t}$ is the log output, and $r_{i,t}$ is the nominal interest rate. Plausible parameter restrictions are a positive income elasticity $\tau > 0$, and a negative interest semi-elasticity $\lambda > 0$. When money demand and supply are balanced, Equation (1) describes money market equilibrium. Then domestic prices are determined by

$$p_{i,t} = \beta m_{i,t} + \lambda r_{i,t} - \tau y_{i,t} + \varepsilon_{i,t}, \tag{2}$$

where we generalized the model by allowing for additive noise $\varepsilon_{i,t}$ and by introducing the elasticity $\beta = \partial p_{i,t}/\partial m_{i,t}$. The quintessence of the monetarist theory is the neutrality hypothesis $\beta = 1$.

The coefficients of the quantity Equation (2) are restricted to be identical across countries. The theoretical reason for this restriction is that the structural model is not country-specific. Another reason is that per country time series estimates usually fail to deliver meaningful results, since countries do not often change their monetary regimes. But across countries, monetary regimes do differ substantially, and hence yield valuable information. A panel with cross country coefficient restrictions can exploit this variation to obtain meaningful parameter estimates. Under the common coefficients assumption, the relative quantity equation of a country vis-a-vis the benchmark country is

$$\tilde{p}_{i,t} = \beta\tilde{m}_{i,t} + \lambda\tilde{r}_{i,t} - \tau\tilde{y}_{i,t} + \tilde{\varepsilon}_{i,t}, \tag{3}$$

where $\tilde{x}_{i,t} \equiv x_{i,t} - x_{\text{Benchmark,t}}$. The international quantity Equation (3) is the first building block of the monetary forex model.

The second building block is the purchasing power parity (PPP) assumption. In absolute form, PPP postulates that goods sell for the same price in two countries. Formally, let $s_{i,t}$ denote the log nominal exchange rate (units of local currency per unit foreign currency), then absolute PPP holds if $s_{i,t} = \tilde{p}_{i,t}$. In our empirical study, we allow for (persistent) deviations from absolute PPP by postulating that $s_{i,t} = \tilde{p}_{i,t} + \tilde{\eta}_{i,t}$, where $\tilde{\eta}_{i,t}$ is the deviation from absolute PPP. Substitution into (2) and rearranging renders the monetary model of the (flexible) forex rate

$$s_{i,t} = \beta\tilde{m}_{i,t} + \lambda\tilde{r}_{i,t} - \tau\tilde{y}_{i,t} + \tilde{\varepsilon}^*_{i,t}, \tag{4}$$

where $\tilde{\varepsilon}^*_{i,t} = \tilde{\varepsilon}_{i,t} + \tilde{\eta}_{i,t}$. The model predicts that the forex $s_{i,t}$ is related to three fundamental economic factors, respectively the relative money supply $\tilde{m}_{i,t}$, the interest rate differential $\tilde{r}_{i,t}$, and the output differential $\tilde{y}_{i,t}$. The (composite) residual $\tilde{\varepsilon}^*_{i,t}$ captures the omitted variables like transportation costs, etc.

### *1.2. The regime characteristics*

The monetary forex model (4) describes the stance of monetary policy of a particular country $i$ vis-a-vis the benchmark country at a particular time $t$. In order to characterize empirically the different monetary policy regimes and the trade-offs represented by the different regimes, we assume that each country in the sample has essentially operated one particular regime. Under the assumption of stable monetary regimes, the salient features of a monetary regime are captured by the mean vector and covariance matrix of the growth rates of the three fundamental macro economic factors.

The cross-section provides the overview of the alternative regimes. To demonstrate this concisely, we define the 'financial' variable $f_{i,t} \equiv \beta\tilde{m}_{i,t} + \lambda\tilde{r}_{i,t}$ and the 'real' variable $g_{i,t} \equiv \tau\tilde{y}_{i,t}$, so that, in first differences, the monetary currency model (4) reads

$$\Delta s_{i,t} = \Delta f_{i,t} - \Delta g_{i,t} + \Delta\tilde{\varepsilon}^*_{i,t}, \tag{5}$$

where $\Delta x_{i,t} \equiv x_{i,t} - x_{i,t-1}$. In addition, we introduce shorthands for the unconditional moments, the expected value $\mu_{x,i} \equiv \mathbb{E}\{\Delta x_{i,t}\}$, the variance $\sigma^2_{x,i} \equiv \text{var}\{\Delta x_{i,t}\}$, and the covariance $\sigma_{xu,i} \equiv \mathrm{cov}\{\Delta x_{i,t}, \Delta u_{i,t}\}$. Model (5) imposes the following structure on the unconditional moments of the forex changes

$$\mu_{s,i} = \mu_{f,i} - \mu_{g,i} + \mathcal{E}_i \tag{6a}$$
$$\sigma_{s,i}^2 = \sigma_{f,i}^2 + \sigma_{g,i}^2 - 2\sigma_{fg,i} + \mathcal{U}_i. \tag{6b}$$

Since the monetary forex rate model (5) contains an unobserved residual $\Delta\tilde{\varepsilon}_{i,t}^*$, the moment decompositions (6) contain the unidentified components $\mathcal{E}_i$ and $\mathcal{U}_i$. In the empirical analysis, $\mathcal{E}_i$ and $\mathcal{U}_i$ are just residuals.

The variance decomposition (6b) highlights that country $i$'s forex volatility $(\sigma_{s,i}^2)$ need not depend on the level of one of its volatility components, such as the financial volatility $(\sigma_{f,i}^2)$ or the real volatility $(\sigma_{g,i}^2)$. For instance, it may happen that $\sigma_{s,i}^2$ itself is low (high), while both $\sigma_{f,i}^2$ and $\sigma_{s,i}^2$ are high (low). One extreme possibility is that the financial and real variable move in lockstep (i.e. $\Delta f_{i,t} = \Delta g_{i,t}$ for all $t$, so that $\sigma_{f,i}^2 + \sigma_{g,i}^2 - 2\sigma_{fg,i} = 0$) and the omitted factors are constant (i.e. $\Delta\tilde{\varepsilon}_{i,t}^* = 0$ for all $t$, so that $\mathcal{E}_i = \mathcal{U}_i = 0$). Then it follows that $\Delta s_{i,t} = 0$ for all $t$, such that $\sigma_{s,i}^2 = 0$. This particular currency system can be classified as a 'hard float' or 'fear of floating' regime, in which the *de facto* regime is 'fixed', while the *de jure* regime is "flexible" (see Calvo and Reinhart, 2000). In fact, the fear of floating is exactly what the Growth and Stability Pact is all about. This pact should ensure that each member country $i$ follows a fiscal policy that yields a real growth $\Delta g_{i,t}$, which is consistent with the single monetary policy yielding financial growth $\Delta f_{i,t}$.

### 1.3. *The forward looking solution*

We investigate the relation between the domestic regime specifics and the forex regime characteristics by solving the model forward. Suppose that the uncovered interest parity (UIP) holds

$$\tilde{r}_{i,t} = \mathbb{E}_t\{s_{i,t+1} - s_{i,t}\}, \tag{7}$$

where $\mathbb{E}_t\{s_{i,t+1}\}$ is country $i$'s time $t$ expected forex rate for time $t+1$. For simplicity we assume that $\tilde{\varepsilon}_{i,t}^* = 0$, and for notational convenience we define the forex rate's fundamental value $z_{i,t} \equiv \beta\tilde{m}_{i,t} - \tau\tilde{y}_{i,t}$. The monetary forex model (4) simplifies to

$$s_{i,t} = \frac{1}{(1+\lambda)} z_{i,t} + \frac{\lambda}{(1+\lambda)} \mathbb{E}_t\{s_{i,t+1}\}.$$

When this equation is solved forward, one obtains[1]

$$s_{i,t} = \frac{1}{(1+\lambda)} \sum_{j=0}^{\infty} \frac{\mathbb{E}_t\{z_{i,t+j}\}}{(1+1/\lambda)^j}. \tag{8}$$

The forward solution (8) states that the current forex rate $s_{i,t}$ is proportional to the expected discounted value of the fundamental process $\{z_{i,t+j}\}$. This forward looking solution of the monetary forex model forms the basis of the asset view on the forex rate determination. All the available information about future changes in the fundamental process $\{z_{i,t+j}\}$ is directly and completely incorporated in the current rate $s_{i,t}$.

To provide a simple demonstration of the asset view on the forex rate determination, suppose that the fundamental follows a *driftless* random walk

$$z_{i,t+1} = z_{i,t} + \xi_{i,t+1}, \tag{9}$$

where $\xi_{i,t+1}$ is white noise with variance $\sigma^2_{\xi,i} > 0$. Under this random walk assumption, all the information about the future fundamental values is fully incorporated in the current fundamental value, that is $\mathbb{E}_t\{z_{i,t+j}\} = z_{i,t}$ for all $j$, with moment restrictions $\mathbb{E}_t\{\Delta z_{i,t+j}\} = 0$ for all $j$, and $\mathrm{var}\{\Delta z_{i,t}\} = \sigma^2_{\xi,i}$. So that $s_i, t = z_i, t$.

The driftless random walk model (9) has the counterfactual implication that the interest differential is always zero $\tilde{r}_{i,t} = \mathbb{E}_t\{\Delta s_{i,t+1}\} = \mathbb{E}_t\{\Delta z_{i,t+1} = 0$ for all $t$.[2] Nevertheless, it is also part of the folk wisdom on exchange rate economics that the forex rates approximately follow random walks. Anyway, the result below does not depend critically on the random walk assumption.

**Proposition.** *Under the assumption that the fundamental $z_{i,t}$ follows the driftless random walk* (9), *the fundamental shock $\xi_{i,t}$ is transferred one for one to the forex rate $s_{i,t}$. For this reason the volatility of the forex rate $s_{i,t}$ equals the volatility of the composite fundamental $z_{i,t}$, that is*

$$\mathrm{var}\{\Delta s_{i,t}\} = \mathrm{var}\{\Delta z_{i,t}\} = \sigma^2_{\xi,i}.$$

But since $z_{i,t} \equiv \beta\tilde{m}_{i,t} - \tau\tilde{y}_{i,t}$ we have $\mathrm{var}\{\Delta z_{i,t}\} = \beta^2\sigma^2_{m,i} + \tau^2\sigma^2_{y,i} - \beta\tau\sigma_{my,i}$, so that as before we conclude that growth and fluctuations in the financial and real sector are to a first-order unrelated to the adoption of a particular forex regime. Due to the forward looking nature of the forex market, the forex rate stability hinges on the coherency of the current and anticipated behavior of the fiscal authorities (partially) controlling the output differential $(\tilde{y}_{i,t})$ and monetary authorities (partially) controlling the relative money stock $(\tilde{m}_{i,t})$.

As, for example, Switzerland and The Netherlands have shown, the official flexible forex regime can be very stable ("fear of floating") when monetary and fiscal policies are coherent. Conversely, officially announced managed floats, crawling bands, or fixed rate systems can be very unstable, a phenomenon called 'fear of pegging' by von Hagen and Zhou (2002). This 'fear of pegging' behavior is illustrated by the lively history of the United Kingdom. For a thorough theoretical evaluation of the link between the sustainability of pegs and the fiscal discipline, see Canzoneri et al. (2001) and references therein. For a detailed discussion of the trade-offs involving the selection of the forex regime, see Frankel (1999).

## 2. The forex regime and transitional growth

The international monetary theory presented above implies that the choice of forex regime can be more or less unrelated to the growth and fluctuations in the financial and real sector; what matters is the coherency of the current and anticipated fiscal and monetary policies. What do the data have to say on this matter? To this end, Section 2.1 first estimates the monetary model of the exchange rate using data for 40 countries during the 1990s. Section 2.2 characterizes the regime specifics by estimating the sample moments of the per-country variables. Finally, in order to disentangle the cross-sectional variation in regime specifics of the fundamentals in relation to the forex (regime), Section 2.3 analyzes the links across the country-specific moment estimates.

We focus on the cases of the CEEC transition and the EMU inception during the 1990s. For this reason we choose Germany as the benchmark country. Our panel data set covers 40 countries over the period 1993:4 1999:3 (24 quarterly observations per country).[3] We subdivide the panel into four groups: CEEC, EMU, WEST, and REST. The exact composition of the country groupings is given in Table 1. Clearly, the CEEC group contains the Central and Eastern European Countries, while EMU comprises all current EMU members (with exception of the benchmark Germany). The WEST panel contains Western industrialized non-EMU countries, while the REST panel contains other (less) industrialized non-EMU countries. Table 1 also reports Reinhart and Rogoff's de facto classification of each country's currency regime versus Germany at the beginning of the 1990s.[4]

*Table 1*. Countries in panel.

| EMU | CEEC | WEST | REST |
|---|---|---|---|
| (at) Austria[a] | (bg) Bulgaria[b] | (au) Australia[d] | (in) India[d] |
| (be) Belgium[a] | (cz) Czech Rep[c] | (ca) Canada[d] | (is) Israel[d] |
| (fi) Finland[a] | (es) Estonia[a] | (dk) Denmark[a] | (jp) Japan[d] |
| (fr) France[a] | (hg) Hungary[c] | (gr) Greece[a] | (ko) Korea[d] |
| (it) Italy[a] | (la) Latvia[b] | (no) New Sealand[d] | (ma) Malaysia[d] |
| (ir) Ireland[a] | (li) Lithuania[b] | (ns) Norway[d] | (mx) Mexico[d] |
| (lx) Luxemburg[a] | (pl) Poland[c] | (se) Sweden[d] | (ph) Philippines[d] |
| (nl) Netherlands[a] | (rm) Romania[b] | (sw) Switserland[c] | (sg) Singapore[d] |
| (pt) Portugal[a] | (sk) Slovak Rep[c] | (uk) UK[d] | (th) Thailand[d] |
| (sp) Spain[a] | (sn) Slovenia[c] | (us) US[d] | (tk) Turkey[b] |

*Source*: Reinhart and Rogoff (2002).
[a](de facto) peg to DM.
[b](de facto) freely falling to DM.
[c](de facto) crawling or moving band around DM.
[d](de facto) managed or freely floating to DM.

### *2.1. The international monetary structure*

We first estimate the coefficients of model (4). The nonstationarity of the variables permits estimation in levels, but in order to obtain standard errors, we employ the panel version of the Stock and Watson's dynamic OLS (DOLS) procedure.[5] The standard DOLS procedure involves a regression of the level of the endogenous variable on the levels of the explanatory variables, the leads and lags of the first differences of the exogenous variables, and a constant.

Accordingly, the empirical counterpart of model (4) is

$$\begin{aligned} s_{i,t} &= c + \beta \tilde{m}_{i,t} + \lambda \tilde{r}_{i,t} - \tau \tilde{y}_{i,t} + a_{i,1}\Delta\tilde{m}_{i,t-1} + a_{i,2}\Delta\tilde{y}_{i,t-1} + a_{i,3}\Delta\tilde{r}_{i,t-1} \\ &\quad + a_{i,4}\Delta\tilde{m}_{i,t+1} + a_{i,5}\Delta\tilde{y}_{i,t+1} + a_{i,6}\Delta\tilde{r}_{i,t+1} + \epsilon_{i,t}, \end{aligned} \tag{10}$$

for $i = 1, \ldots, N$, $t = 1, \ldots, T$. By including the leads and lags of the first differences of the per-country explanatory variables, the empirical specification accounts for cross-country differences in (transitional) short-run dynamics. In addition, the data for $s$, $\tilde{m}$, and $\tilde{y}$ are taken in deviation from their mean, so that the empirical model (10) indirectly accounts for fixed country effects. To allow for deterministic drift and seasonal components and cross-sectional heteroskedasticity in the panel residual $\epsilon_{i,t}$, we work with the following decomposition

$$\epsilon_{i,t} = d_{a,t} + d_{q,t} + e_{i,t},$$

with year dummy $d_{a,t}$ (equal to unity in year $a$), seasonal quarter dummy $d_{q,t}$ (equal to unity in quarter $q$), and we assume that $e_{i,t} = \sigma_i \zeta_{i,t}$, with $\zeta_{i,t}$ being Gaussian noise. To compute heteroskedasticity-consistent standard errors, we estimate (10) by means of GLS.

An important issue is whether the estimated model is structural, in the sense of Lucas (1976). The model is unlikely to be structural when panel estimates are very different for different data sets, or when the cointegrating vector does not apply to the panel. To examine the robustness of the panel estimates, we repeat the estimation procedure for various groups of countries and we conduct the panel cointegration tests. Our main interest lies in the long-run coefficients, $\beta, \tau$, and $\lambda$. To save space we do not report the coefficients on the seasonal dummies, nor the coefficients on the leads and lags. The long-run coefficient estimates and cointegration test results are reported in Table 2.

The monetary homogeneity hypothesis $\beta = 1$ holds up quite well in the different panels, except when the data are restricted to the EMU countries. But this is not so surprising, since convergence between these countries in the 1994–1999 period in anticipation of the monetary unification gives insufficient variation in the money stock data to get a reliable estimate. Per contrast, the monetary hyper expansions in the transition countries, such as in Bulgaria during the years 1996–1997, are very conducive for producing a reliable estimate of $\beta$. The estimates for the other two long-run coefficients, $\lambda$ and $\tau$, are also quite plausible. Across the board, the estimates for the interest semi-elasticity $\lambda$ are positive, and those for the income elasticity $\tau$ are negative.

*Table 2*. Panel dynamic OLS regressions.

| | $c$ | $\beta$ | $\lambda$ | $\tau$ | AEG |
|---|---|---|---|---|---|
| ALL | 0.018 | 0.765 | 0.921 | −0.667 | −0.178 |
| (862 observations) | (0.005) | (0.027) | (0.318) | (0.055) | (0.041) |
| | (3.513) | (28.589) | (2.896) | (−12.170) | (−4.365) |
| WEST + REST | 0.023 | 0.779 | 1.451 | −0.595 | −0.315 |
| (437 observations) | (0.011) | (0.018) | (0.273) | (0.060) | (0.055) |
| | (2.014) | (42.845) | (5.316) | (−9.994) | (−5.775) |
| CEEC | 0.029 | 0.996 | 0.542 | −1.177 | −0.176 |
| (218 observations) | (0.040) | (0.043) | (1.135) | (0.180) | (0.086) |
| | (0.723) | (23.397) | (0.477) | (−6.523) | (−2.050) |
| EMU | 0.051 | −0.100 | 2.904 | −0.039 | −0.216 |
| (207 observations) | (0.007) | (0.022) | (0.332) | (0.042) | (0.035) |
| | (7.391) | (−4.529) | (8.739) | (−0.923) | (−6.192) |

Numeraire: Germany; Period: 1994:II–1999:III; Cointegration model (10); Pooled cointegration test (11); In parenthesis: Standard errors (first row) and $t$-statistics (second row).

To see whether the cointegrating vector applies to a panel, we run the pooled Augmented Engle-Granger (AEG) test regression for panel residuals[6]

$$\Delta e_{i,t} = \gamma e_{i,t-1} + \gamma_1 \Delta e_{i,t-1} + \gamma_2 \Delta e_{i,t-2} + u_{i,t}, \tag{11}$$

for $i = 1, \ldots, N, t = 1, \ldots, T$. We assume that the residual $u_{i,t}$ is independently and identically distributed over time and across countries with zero mean and bounded variance. The null is a unit root $H_0 : e_{i,t} \sim I(1)$, which corresponds to parameter restriction $\gamma = 0$. Under conventional conditions, the asymptotic critical *t*-value equals $-3.74$ at the 5% level.[7] The last column in Table 2 gives the pooled cointegration test results. Convincing evidence for cointegration is found in all panels, except for the CEEC panel. This result actually confirms that the CEECs have been in transition (i.e. their policies were not structural).

### *2.2. The characterization of monetary policy regimes*

In order to characterize the regime specifics empirically, we estimate the monetary forex model's moment decomposition (6). We use the long-run coefficient estimates from the total panel of 40 countries (see first row Table 2). On the basis of the empirical variance decomposition, we compute the fundamentals' sample correlation coefficient $\sigma_{fg,i} = \sigma_{fg,i}\sigma_{f,i}^{-1}\sigma_{g,i}^{-1}$. As the number of countries is large, it is impracticable to report all the per-country estimates. We decided to summarize the results for the various country groupings by reporting the cross-sectional mean and standard deviation of each of the per-country estimates in Table 3.

There are pronounced differences between the various regions. In general, the mean and the variance estimates are remarkably low in the EMU group (see

*Table 3*. Cross-sectional averages.

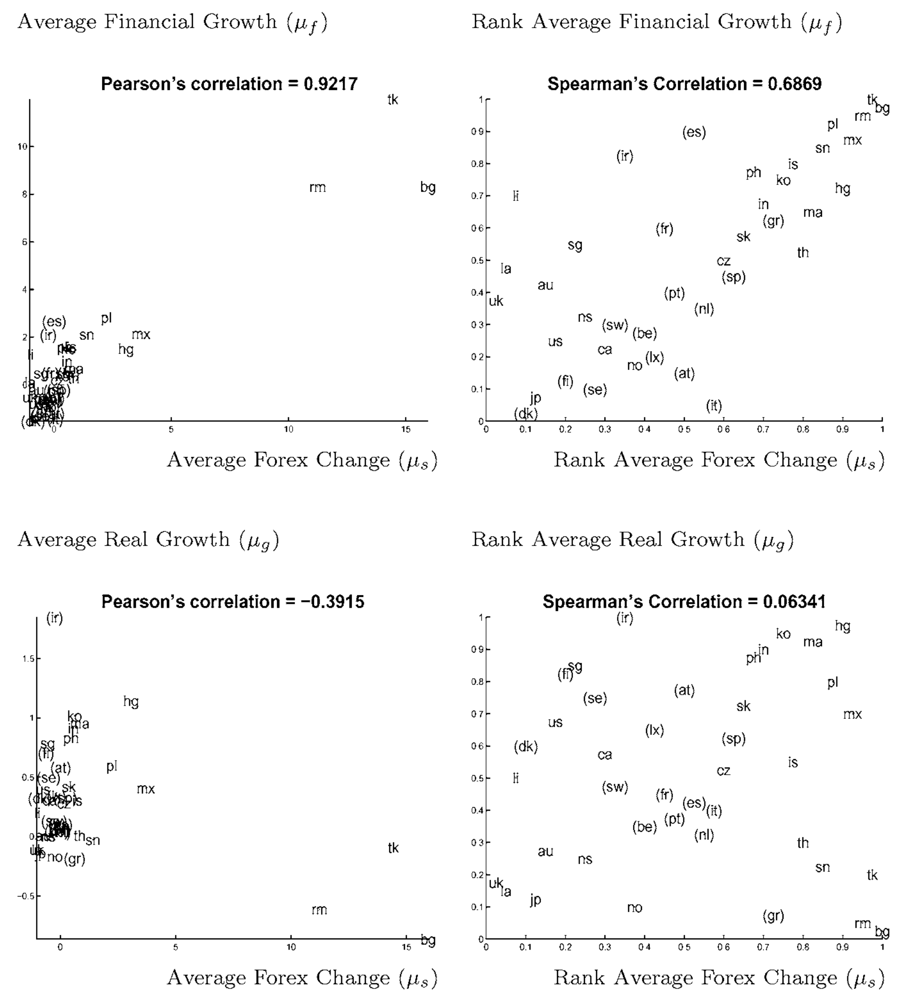
| | ALL | WEST + REST | CEEC | EMU |
|---|---|---|---|---|
| $\mu_s$ | 1.18 | 0.80 | 3.24 | −0.11 |
| | (3.84) | (3.39) | (5.72) | (0.23) |
| $\mu_f$ | 0.92 | 0.65 | 2.78 | −0.38 |
| | (2.80) | (2.89) | (3.07) | (1.05) |
| $\mu_g$ | 0.29 | 0.31 | 0.11 | 0.41 |
| | (0.49) | (0.41) | (0.57) | (0.56) |
| $\mathcal{E}$ | −0.03 | − 0.17 | 0.34 | −0.14 |
| | (1.95) | (1.13) | (3.34) | (1.53) |
| $\sigma_s^2$ | 56.49 | 53.01 | 116.27 | 3.64 |
| | (150.36) | (55.49) | (290.41) | (4.89) |
| $\sigma_f^2$ | 33.48 | 30.49 | 52.29 | 20.65 |
| | (31.13) | (10.03) | (55.97) | (16.07) |
| $\sigma_g^2$ | 5.09 | 3.28 | 10.57 | 3.21 |
| | (7.17) | (3.13) | (12.17) | (3.09) |
| $\sigma_{fg}$ | −1.24 | −1.30 | −3.70 | 1.33 |
| | (14.64) | (5.15) | (29.18) | (2.82) |
| $\mathcal{U}$ | 19.16 | 20.54 | 57.11 | −21.54 |
| | (130.51) | (54.00) | (252.48) | (21.57) |
| $\rho_{fg}$ | 0.02 | −0.04 | 0.12 | 0.04 |
| | (0.22) | (0.21) | (0.24) | (0.21) |

Numeraire: Germany; Period: 1994:III–1999:III; Moment decompositions (6); Cross-sectional standard deviations in parenthesis.

last column of Table 3), while they are substantial in the CEEC group (see third column of Table 3). In general the WEST + REST group takes a middle position. As the numbers in parenthesis show, the cross-sectional standard deviations of the monetary components are very low in the EMU group, while they are very high in the CEEC group. This finding is important for the cross-sectional analysis of policy regimes. High cross-sectional variation is conducive for producing a reliable characterization of policy regimes.

### *2.3. The links across policy specifics*

How are the characteristics of the domestic policy regime related to the specifics of the forex regime in place, and vice versa? To provide an answer to this question we run a multiple rank regression (MRR) analysis across the country-specific moment estimates. To emphasize that we study (two-way) relationships, we repeat the MRR for each of the country-specific moment estimates. In this way, we uncover the partial links across the regime specifics of the representative country versus Germany during the 1990s. To determine whether particular regime specifics are affected by the choice of forex regime, we include a ‘fixed’ regime dummy in the MRR analysis.




Numeraire: Germany; Period: 1994:III-1999:III; The identifiers of the countries are given by Table 1. In parenthesis: Countries that peg to the DM (or euro).

*Figure 1.* Scatter plot averages.

We decide to analyze the links across the rank-ordered moments instead of using the raw moments. To underpin our choice of the ordinal above the cardinal association measure, we present in Figure 1 the cross-country scatter plots for raw and rank-ordered fundamental average values $\mu_{f,i}$, and $\mu_{g,i}$ vis-a-vis the mean forex return $\mu_{s,i}$. At the top of each of the scatter plots we report the respective correlation estimate. It can be seen that the choice of the metric underlying the association measure is of major importance for the outcomes. For example, take a look at the top panels in Figure 1. Pearson's sample correlation for the pair $[\mu_{s,i}, \mu_{f,i}]$ is seen to be a substantial 0.92. In contrast, when the data is rank-ordered first (see right top panel), the rank correlation estimate is lower, namely 0.69. Nonetheless, both the ordinal and cardinal association measures point at a clear positive association between $\mu_{s,i}$ and $\mu_{f,i}$. But it can happen that the association measure switches sign. From the lower panels in Figure 1 it can be seen that for the pair $[\mu_{s,i}, \mu_{g,i}]$ the Pearson's sample correlation is significantly negative $-0.39$, while the Spearman's sample correlation has an insignificant positive value of 0.06. Overall, we observe that Pearson's sample correlation is very sensitive to the few 'hyper inflation' or 'freely falling' episodes in our sample, while Spearman's sample correlation is not. Rather than use the cardinal scales and excluding the 'freely falling' episodes from the cross-country analysis (as is proposed by e.g. Reinhart and Rogoff, 2002), we decide to include these outstanding episodes in the cross-country analysis and to change the scales from cardinal to ordinal.

To run the MRR, we stack the expected values $(\mu_{s,i}, \mu_{f,i}, \mu_{g,i})$, the variances $(\sigma^2_{s,i}, \sigma^2_{f,i}, \sigma^2_{g,i})$, and the correlation coefficient $(\rho_{fg,i})$ into an $(N \times 7)$ matrix $\mathbf{Q}$. Then the matrix $\mathbf{Q}$ is rank ordered column for column, giving an $(N \times 7)$ rank-ordered matrix $\mathbf{Q}^r$. Let $q_{i,j}$ and $q^r_{i,j}$ be the typical elements of the matrices $\mathbf{Q}$ and $\mathbf{Q}^r$, respectively. If $q_{i,j}$ is the smallest element in the column $j$ of the matrix $\mathbf{Q}$, then $q^r_{i,j} = 1$; if $q_{i,j}$ is the second smallest value in column $j$ of the matrix $\mathbf{Q}$, then $q^r_{i,j} = 2$; etc. The MRR analysis involves OLS regressions of a specific column of $\mathbf{Q}^r$ on all other columns of $\mathbf{Q}^r$, a constant $a_j$, and a 'fixed' forex regime dummy $\mathcal{D}^{\text{fix}}_i$, that is

$$q^r_{i,j} = a_j + b_j \mathcal{D}^{\text{fix}}_i + \sum_{k}^{6} \alpha_{j,k} q^r_{i,k} + \phi_{i,j}, \tag{12}$$

for $k \neq j$, $i = 1, \ldots, N$, and $j = 1, \ldots, 7$. We assume that the residual $\phi_{i,j}$ is white noise. We test the null hypotheses that the partial relations between columns $j$ and $k$ of the matrix $\mathbf{Q}^r$ are absent, $H_0 : \alpha_{j,k} = 0$, and that there is no 'fixed' regime effect, $H_0 : b_j = 0$.

We add the volatilities to the mean regressions in order to control for the premiums associated with these risk factors. Similarly, the variance regressions are augmented with mean values in order to control for possible feedback from the premiums to the risk factors. This type of mean-variance regression procedure is theoretically consistent when the gross discrete growth rates of the fundamentals are lognormal distributed and the representative agent has a power utility function, see e.g. Hodrick (1989). We include the forex regime dummy in order to measure a level effect of the 'fixed' regime. Accordingly, the dummy $\mathcal{D}^{\text{fix}}_i$ equals unity if country $i$ has a de facto peg to the Deutsche mark (DM), otherwise it equals zero. We rely on Reinhart and Rogoff's de facto classification of forex regimes at the beginning of the 1990s (see Table 1), except that we reclassified Sweden and Switzerland as having de facto pegs to DM. Eventually, the 'fixed' regime is assigned to 15 countries: the 10 initial members of the EMU plus Estonia, Denmark, Greece, Sweden, and Switzerland.

*Table 4*. Multiple rank regressions across moments.

| | $\mu_s$ | $\mu_f$ | $\mu_g$ | $\sigma_s^2$ | $\sigma_f^2$ | $\sigma_g^2$ | $\rho_{fg}$ |
|---|---|---|---|---|---|---|---|
| $\mu_s$ | – | **0.55** | −0.03 | 0.12 | −0.24 | 0.11 | −0.02 |
| | – | (0.10) | (0.24) | (0.13) | (0.11) | (0.23) | (0.17) |
| $\mu_f$ | **0.75** | – | 0.15 | −0.09 | **0.38** | 0.29 | −0.04 |
| | (0.19) | – | (0.21) | (0.12) | (0.15) | (0.25) | (0.23) |
| $\mu_g$ | −0.02 | 0.06 | – | 0.09 | −0.22 | 0.11 | 0.23 |
| | (0.13) | (0.09) | – | (0.11) | (0.11) | (0.09) | (0.14) |
| $\sigma_s^2$ | 0.16 | −0.09 | 0.20 | – | 0.10 | 0.12 | **−0.55** |
| | (0.19) | (0.11) | (0.25) | – | (0.14) | (0.16) | (0.25) |
| $\sigma_f^2$ | −0.22 | **0.26** | −0.37 | 0.08 | – | **0.39** | 0.29 |
| | (0.12) | (0.11) | (0.24) | (0.11) | – | (0.13) | (0.15) |
| $\sigma_g^2$ | 0.09 | 0.16 | 0.16 | 0.07 | **0.32** | – | −0.05 |
| | (0.17) | (0.12) | (0.13) | (0.11) | (0.14) | – | (0.17) |
| $\rho_{fg}$ | −0.01 | −0.02 | 0.26 | **−0.26** | 0.19 | −0.04 | – |
| | (0.10) | (0.10) | (0.17) | (0.10) | (0.12) | (0.14) | – |
| $\mathcal{D}^{\text{fix}}$ | 3.12 | −5.24 | 3.20 | **−16.78** | −4.78 | 5.22 | −7.14 |
| | (3.84) | (2.76) | (6.18) | (2.28) | (4.34) | (4.87) | (5.21) |
| Intercept | 4.11 | 3.55 | 11.84 | **26.76** | **11.17** | −1.53 | **25.86** |
| | (6.70) | (5.06) | (12.05) | (3.13) | (6.23) | (8.08) | (7.67) |

Numeraire: Germany; Period: 1994:III–1999:III; Multiple rank regression model (12); Standard errors in parenthesis. Bold faced values are significant at 5% level.

The MRR analysis shows that the partial effects between nominal mean values, $\mu_{s,i}$ and $\mu_{f,i}$, are quite substantial, namely 0.75 and 0.55, see the first and second column in Table 4. These highly significant values indicate that countries with low (high) average financial growth tended to experience small (sizeable) depreciations, and the other way around. The regression for $\mu_{f,i}$ also shows that there are (weakly) significant positive mean-variance effects in the financial process. Countries with unstable markets were more likely to have high financial growth rates than countries with stable markets, and vice versa.

The third column of Table 4 presents the regression results for the average real growth rate. Interestingly, none of the slope coefficients is significant. The average real growth rates are independent of the financial and forex changes, and vice versa. We do find evidence for a link between the real and financial volatility. In particular, we obtained significant estimates of 0.32 for the coefficient on $\sigma_g^2$ in the regression for $\sigma_f^2$, as well as a significant estimate of 0.39 for the coefficient on $\sigma_f^2$ in the regression for $\sigma_g^2$ (see fifth and sixth column of Table 4). Economies with the more (un)stable output market had a greater probability of having (un)stable financial markets, and the other way around.

Probably the most striking result of our empirical study is the flip side of the above results. Influences of the forex rate variables on the real growth rate are apparently absent. The 'fixed' regime dummy ($\mathcal{D}_i^{\text{fix}}$), the average forex return ($\mu_s$), as well as the forex volatility ($\sigma_s^2$) do not contribute significantly to the explanation of the variation in the averages and variances of real growth rate ($\mu_g$ and $\mu_g^2$) across countries (see Table 4 third and sixth column).

The adoption of a peg to the DM has a significant negative level effect on the forex volatility, see fourth column Table 4. Thus, as must be true almost by definition, we find that countries with de facto pegs to the DM tended to have more stable forex rates. In the regression for $\sigma_s^2$ we obtained insignificant estimates for the coefficients on $\sigma_{f,i}^2$ and $\sigma_{g,i}^2$, while we obtained a significant estimate of $-0.55$ for the coefficient on $\rho_{fg,i}$. This result is consistent with the theory on forex set out in the previous section. It supports the view that the forex rate stability hinges on the coherency of the current and anticipated fiscal and monetary policies.

## 3. Summary and concluding remarks

This paper claims that the choice of forex regime is not of first order importance for achieving high real growth. This claim is based on empirical evidence that the forex return does not help explain economic growth, nor does a de facto ‘fixed’ regime dummy. A priori, the monetary forex model allows for both possibilities. The model certainly does not imply that the choice of regime is important for economic growth. The result that economic growth is insulated from the exchange rate variable carries a very positive message for policy makers supporting the view that the choice of forex regime is irrelevant. Policy can focus on providing coherent fiscal and monetary policy, since it is this coherency that may be conducive to growth stability.

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## Notes

1. We do not necessarily rule out the bubble solution. The bubble component does not affect our results qualitatively.
2. To break away from this implication, suppose that a non-zero risk premium enters the UIP condition (7). Generally, the risk premium is a function of the fundamentals, such that the qualitative results carry over.

3. Most of these data were obtained from International Financial Statistics (IFS). The forex rate $S$ is the *National Currency per US Dollar* (lines *AE* and *AG*). Deutsche mark exchange rates are derived using the triangle arbitrage rule. The output $Y$ is *Industrial Production* (line 66), with exception of the CEECs. For Hungary, Poland, Romania, and Slovenia, we use GDP in historic market prices, while for the other CEECs we deflated GDP in current market prices by the *Consumer Price Index* (line 64). Money $M$ equals *Money* plus *Quasi-Money* (lines 34 and 35), when unavailable the money data were obtained from the national bank. The Interest $R$ is *Lending Rate* (line 60*P*), or when unavailable the *Deposit Rate* (line 60*L*).
4. See Reinhart and Rogoff (2002). For alternative de facto classifications of forex regimes, see von Hagen and Zhou (2002) and Ghosh et al. (2002).
5. See Stock and Watson (1993).
6. See Engle and Granger (1987).
7. The choice of critical values is determined by six factors, for which we assume the following: (i) There are 3 non-stationary regressors; (ii) The residual is stationary; (iii) The number of countries is fixed; (iv) Time expands forever; (v) Non-stochastic regressors are excluded; and (vi) The residuals are perfectly correlated across countries. Under these assumptions, the asymptotic critical values are those reported in Table 20.2 in Davidson and MacKinnon (1993).

## References


Bacchetta, P. and E. van Wincoop (2000) "Does Exchange-Rate Stability Increase Trade and Welfare?" *American Economic Review* 90:1093–1109.

Calvo, G.A. and C.M. Reinhart (2000) "Fear of Floating." NBER Working Paper 7993.

Canzoneri, M.B., R.E. Cumby, and B.T. Diba (2001) "Fiscal Discipline and Exchange Rate Systems." *The Economic Journal* 111:667–690.

Davidson, R. and J.G. MacKinnon (1993) *Estimation and Inference in Econometrics*, New York: Oxford University Press.

Edwards, S. (1996) "The Determinants of the Choice Between Fixed and Flexible Exchange-Rate Regimes." NBER Working Paper 5756.

Edwards, S. (1998) "Exchange Rate Anchors and Inflation: A Political Economy Approach." In S. Eijffinger and H. Huizinga (eds.), *Positive Political Economy: Theory and Evidence*, Cambridge, UK: Cambridge University Press, pp. 187–212.

Engle, R.F. and C.W.J. Granger (1987) "Co-Integration and Error Correction: Representation, Estimation and Testing." *Econometrica* 55:251–276.

Frankel, J.A. (1999) "No Single Currency Regime is Right for all Countries at all Times." *Essays in International Finance* 215.

Ghosh, A.R., A.M. Gulde, and H.C. Wolf (2002) "Exchange Rate Regimes: Classification and Consequences." In A. Ghosh, A. Gulde, and H. Wolf (eds.), *Exchange Rate Regimes, Choices and Consequences*, MIT Press.

Ghosh, A.R., A.M. Gulde, J.D. Ostry, and H.C. Wolf (1997) "Does the Nominal Exchange Rate Regime Matter?" NBER Working Paper 5874.

Hodrick, R.J. (1989) "Risk, Uncertainty, and Exchange Rates." *Journal of Monetary Economics* 23:433–459.

Lucas, Jr., R.E. (1976) "Econometric Policy Evaluation: A Critique." *Carnegie-Rochester Conference Series on Public Policy* 1:59–46.

Reinhart, C.M. and K.S. Rogoff (2002) "The Modern History of Exchange Rate Arrangements: A Reinterpretation." *National Bureau of Economic Research*, Working Paper 8963:104.

Stock, J.H. and M.W. Watson (1993) "A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems." *Econometrica* 61:783–820.

von Hagen, J. and J. Zhou (2002) "De Facto and Official Exchange Rate Regimes in Transition Economies." *ZEI Working Paper* B02-13:28.