Measuring exchange rate flexibility in Europe

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Abstract

In official terms, European countries that are not in the EMU have been showing a polarization of monetary policy regimes in the last fifteen years: either Inflation Targeting or fixed exchange rates. I apply several methods recently developed by the literature to measure exchange rate flexibility to these European countries, in order to see whether such polarization has indeed occurred from a *de facto* point of view. Using these approaches, I find that the move to Inflation Targeting did bring about higher exchange rate flexibility, but only up to a level that is not comparable to that of the non-European benchmark floaters. Inflation Targeters in Europe also seem to have put some weight on stabilization of the exchange rate vis à vis the euro, after its introduction; fixed exchange rate arrangements, instead, apart from official policy changes, remained mostly stable throughout the last decade.

JEL Classification: E52, F31, F41
Keywords: Exchange Rate Regimes, Fear of Floating, Inflation Targeting.

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1. Introduction

This paper applies several techniques recently developed by the literature on exchange rate regimes classification to European countries that did not enter the EMU. Since the 1990s, a gradual polarization of exchange rate regimes (either flexible rates, coupled with Inflation Targeting, or strict pegs) characterized the whole international monetary system, with "intermediate" regimes gradually disappearing. Previous works (for example, Frankel [1999] and Levy-Yeyati and Sturzenegger [2005]) showed that, however, from a *de facto* point of view, the majority of countries still lies in the shaded area between these two extremes. A similar *de jure* pattern characterized official exchange rate policies also in Europe, after the collapse of the the Communist Bloc at the end of the 1980s and of the ERM in 1992. Countries that did not enter the EMU in the first wave either moved to Inflation Targeting or to a fixed exchange rate with the euro. In particular, several smaller countries joined the currency union (Slovenia, Cyprus, Malta and Slovakia). The objective of this work is to assess to what extent such a polarization, in Europe, also occurred *de facto*; in particular, whether the exchange rate policies of non-euro countries changed after the introduction of the euro and also whether there is evidence of "Fear of Floating" – in the terminology of Calvo and Reinhart [2002] – episodes in Europe. In other words, I want to assess whether, on the one hand, countries that officially are Inflation Targeting also pursued separate exchange rate objectives, while on the other hand countries that declared a peg to the euro did indeed keep the exchange rate fixed towards the official reference currency. The novelty of this paper is, first of all, in its focus on Europe, trying to draw a line between the pre-euro and the euro era. Second, rather than introducing a new classification scheme, I use different approaches, combining the "de jure vs. de facto flexibility" classification scheme of Calvo and Reinhart [2002] with the approach to estimate currency weights in baskets of Frankel and Wei [2008], in order to understand whether these two approaches lead to consistent conclusions.

I use regime classification methods, rather than estimating the monetary policy reaction function, because the latter approach does not take into account exchange rate objectives in monetary policy when the latter are pursued with instruments different from the setting of the policy interest rate, as discussed in Section 2: actually, as Taylor [2001] and Edwards [2006], point out, if Inflation Targeting central banks took exchange rate movements under control in setting the interest rate, this would require a high variability of the latter, which is not observed in practice: this, however, does not exclude the possibility that they use other instruments like foreign exchange reserves; therefore, I do not focus on interest rate setting.

As it is well known, 16 out of 27 European Union Member States have now joined the Monetary Union (EMU). In official terms, the exchange rate regimes of non-euro countries range from a currency board – actually a fixed parity – in Estonia and Lithuania to freely floating rates in Western and Central European countries that adopted Inflation Targeting.
The results of the paper are quite surprising: while fixed exchange rate arrangements *vis à vis* the euro remained fairly stable and consistent with official policy statements throughout the last decade, Inflation Targeting regimes appear to have brought about higher exchange rate flexibility, but not to a level comparable to that of non-European countries. In particular, I find evidence that they have put some weight on euro exchange rate stabilization. Van Dijk et al. [2006] have shown, using dynamic conditional correlations, that the correlation between the US Dollar exchange rate of the main European non-euro currencies, namely the Swedish Krona, the Swiss Franc, the U.K. Pound and the Norwegian Krone and the euro has increased both after the launch of the euro at the end of 1996 and its formal introduction in 1999. Following this result, the authors state that "*non-euro countries may wish to gain maximum positive spill-over effects by keeping their currencies more in line with the euro*"[1], so that the benefits of lower exchange rate variability are achieved without the drawbacks of joining the Monetary Union (namely the loss of monetary policy independence). In the case of Switzerland, Reynard [2008] has pointed out the stabilization role of the euro, which has reduced the fluctuations of the Swiss Franc against the U.S. Dollar. The results of the present paper confirm those findings and suggest that, since its introduction, the euro has gradually become an informal anchor for most European currencies.

The paper is structured as follows: the issue of the role of the exchange rate in monetary policy rules is introduced in Section 2, using a very simple and stylized model; Section 3 reviews the main approaches to exchange rate regime classification that have been developed in the literature with a focus on those which will be applied in this work; in Section 4 the data are presented. The results are shown in Sections 5-6. Section 7 concludes.

2. The role of the exchange rate in monetary policy rules and the case for limited flexibility.

The relative advantages and disadvantages of flexible and fixed exchange rate regimes are still widely discussed. On one hand, under a peg, the lack of exchange rate adjustments can result in price distortions and misallocation of resources; the need to defend a peg in case of

[1] Van Dijk et al., p. 20.

speculative attacks can result in costly real interest rate spikes (see Calvo [1999]); there is some evidence as well that output volatility is higher and output growth tends to be lower (Levy-Yeyati and Sturzenegger [2003])[2]. On the other hand, by reducing relative price volatility, a peg is likely to stimulate investment and trade, and this can have a positive impact on growth.

For small open economies, since the 1990s the move towards flexible exchange rates was coupled with the adoption of different forms of Inflation Targeting (in U.K., Sweden, Chile, New Zealand, Israel, to name but a few). When we consider inflation targeting – and indeed the majority of the countries in the sample that will be introduced in Section 4 is Inflation Targeting –, due to the pass-through effect of the exchange rate on prices, one might ask whether the Central Bank should control exchange rate movements directly. More precisely, a Central Bank should keep an eye on exchange rate developments if it has the objective of keeping inflation low and stabilize output, because exchange rate movements have an impact on the price of imported goods and on aggregate output. Svensson ([2000] and [1999]), showed within a small open economy model that flexible CPI inflation targeting can in fact reduce the volatility of output and the real exchange rate while keeping inflation under control, a result that is shared with Gali and Monacelli [2005]. Svensson [2003] also acknowledges that it is possible for central banks to engage in exchange rate smoothing, i.e. to use the monetary policy instrument in order to limit the volatility of the exchange rate or stabilize the real exchange rate to some "potential level". In his model, this would mean that deviations of the exchange rate from target are in the loss function of the central bank together with inflation deviation from target and the output gap. However, he also suggests that there should be no reason for central banks in advanced countries to have separate exchange-rate and inflation objectives in setting their monetary policy. Exchange rate smoothing resulting from IT would therefore only be implicit and depending on the degree of exchange rate pass-through and the share of imported final goods. These results are in agreement with Clarida [2001], who states that "*in practice, a monetary policy aimed at achieving only domestic objectives may also serve to stabilize the exchange rate,* […] *and thus be difficult to distinguish from a policy of maintaining the exchange rate within a band*"[3].

We can use a very simple and stylized model, with no dynamics, to describe different attitudes of monetary policy towards exchange rate variability. This model and the following

[2] Levy-Yeyati and Sturzenegger actually find evidence of significantly lower GDP growth in the case of pegs for developing countries, but the same result does not hold for industrial countries.

[3] Clarida [2001], p 15.

discussion applies, in particular, to advanced economies and, in general, countries that are not subject to extreme output, inflation and interest rates variability, as it is the case for Europe[4].

Assume that the evolution of the domestic output gap, *x*, is described by the Aggregate Demand curve:

$$x = \alpha_x x^F - \alpha_r (r - \bar{r}) + \alpha_q q + \vartheta \qquad (1)$$

where the domestic output gap depends on net foreign demand for domestic goods (which, in turn, would depend on the foreign business cycle), the gap between the real interest rate and the target rate, and the change in the real effective exchange rate; ϑ is an "excess demand" shock as in Svensson [2003].

CPI inflation, by definition, depends on domestic inflation and imported inflation:

$$\pi^c = \xi(\pi^F + \delta \Delta q) + (1 - \xi)\pi \qquad (2)$$

where ξ is the share of imported goods in the CPI, δ is the degree of exchange rate pass-through and π is domestic inflation. Domestic inflation depends on the output gap[5]:

$$\pi = \phi_x x + \nu \qquad (3)$$

where ν is a "cost-push shock" as in Svensson [2000, 2003]. Both ν and ϑ are zero-mean with variance respectively equal to σ^2_ν and σ^2_ϑ.

The evolution of CPI inflation can thus be described by an Aggregate Supply curve like:

$$\pi^c = \beta_x x + \xi(\pi^F + \delta \Delta q) + \eta \qquad (4)$$

where $\beta_x = \phi_x \cdot \xi$ and $\eta = \nu \cdot \xi$.

Monetary policy is described by a Forward-Looking Taylor Rule[6]:

$$i = \bar{r} + \bar{\pi} + \gamma_\pi E[(\pi^c - \bar{\pi})|\Omega] + \gamma_x E(x|\Omega) + \gamma_q \Delta q \qquad (5)$$

i.e. the level of the policy rate set by the central bank depends on the target real interest rate, the inflation target (the sum of the two can be interpreted as the "target nominal interest rate") and is higher when inflation is above target and / or there is a positive output gap, or when the effective exchange rate weakens (*q* increases).

By simply projecting the AS and AD curves, which form the Central Bank's information set, in (5), the following result is obtained:

[4] This point might become clearer below, where I introduce the correlation between the domestic policy rate and the target country policy rate as one of the relevant priors for exchange rate regime classification. In practice, it could not be applied to *de facto* "freely falling" regimes and "hyperfloats", as identified by Reinhart and Rogoff [2004].

[5] In a more complete framework, domestic inflation is also affected by past inflation, future expected inflation and the real exchange rate since it affects the price of imported intermediate goods.

[6] The rule (5) is as general as possible in this simple framework, since we have not said anything specific on the monetary policy rule followed by the central bank. Below we will insert the necessary restrictions.

$$i=\bar{r}+\bar{\pi}+\gamma_{\pi}\left[\left((1-\xi)\pi+\xi(\pi^{F}+\delta\Delta q)\right)-\bar{\pi}\right]+\gamma_{x}\left[\alpha_{x}x^{F}-\alpha_{r}(r-\bar{r})+\alpha_{q}\Delta q\right]+\gamma_{q}\Delta q \quad (6)$$

Given this very general rule, we can see that a central bank can react to exchange rate changes *directly*, via the last term in (6), and indirectly, since the exchange rate affects CPI inflation via imported inflation and the output gap via resource utilization. In order to maintain price determinacy it must also be that $\gamma_{\pi} > 0$ (see Woodford [2003]). Notice that Inflation Targeting should focus on the *real* exchange rate, while managed floats, pegs and limited flexibility regimes focus on a target level of *nominal*[7] exchange rate. From this point of view, we can see why a policy in an IT country aimed directly at stabilizing the nominal exchange rate would be evidence of fear of floating.

In particular, we can use (6) to write the policy rules of central banks following different monetary and exchange rate policy strategies. Following the IMF classification, we can identify four broad classes of exchange rate arrangements: Floating, Fixed, Managed Float and Limited Flexibility, where "Limited Flexibility" was used, in general, for European countries with exchange rate arrangements with each other like the ERM. For a country that is in a Fixed, Managed Float or Limited Flexibility regime, the rule becomes:

$$i=\bar{i}+\gamma_{e}\Delta e \quad (7)$$[8]

e is the *nominal* exchange rate vis à vis the reference currency and $\gamma_{e} > 0$. The policy rate is thus equal to the target nominal interest rate, and tends to be higher when the currency weakens and lower otherwise. This policy is clearly described, for example, in the Danmarks Nationalbank's "Introduction to Monetary and Fixed Exchange Rate Policy". Denmark has a fixed exchange rate vis à vis the euro area, and the DNB states that " […] when the foreign-exchange market is calm, the fixed-exchange-rate policy means that Danmarks Nationalbank adjusts its interest rates in step with the ECB's adjustments. In a situation with upward or downward pressure on the krone or a sustained inflow or outflow of foreign currency, Danmarks Nationalbank unilaterally changes its interest rates in order to stabilise the krone."

The monetary policy regime that is most common in non-euro Europe is Inflation Targeting. All IT Central Banks follow flexible forms of Inflation Targeting, where some weight in the policy function is attached to output stabilization as well. Ball and Reyes [2008] choose to ignore flexible inflation targeting, stating that they treat IT in their study "[...] *to mean strict and honest IT.* [...] *Interest rate interventions for exchange rate reasons associated with output concerns but not inflation target concerns would be empirical evidence of Fear of*

[7] Not necessarily bilateral: in the case of a basket peg, the focus is on a weighted exchange rate.

[8] By UIP reasoning, the target level of the nominal interest rate is equal to the reference country's target plus a risk premium.

Floating".[9] This is an overly restrictive hypothesis even for a very stylized model, since it has been acknowledged (Svensson [2000], Gali and Monacelli [2005]) that strict CPI Inflation Targeting results in higher output variability, which can be hardly socially acceptable, with respect to flexible IT, and IT Central Banks generally have output stabilization among their declared objectives (for example, in Sweden, the U.K., Australia, just to name a few).

Equation (6) for a country that engages in "honest" flexible CPI inflation targeting has $\gamma_s = 0$, and therefore becomes:

$$i=\bar{r}+\bar{\pi}+\gamma_\pi\left[\left((1-\xi)\pi+\xi(\pi^F+\delta\Delta q)\right)-\bar{\pi}\right]+\gamma_x\left[\alpha_x x^F-\alpha_r(r-\bar{r})+\alpha_q\Delta q\right] \tag{8}$$

From the above rule we can see that indeed a honest inflation targeter might react indirectly to exchange rate changes; in particular, the change in the interest rate following a depreciation in the (trade-weighted) currency is:

$$\frac{\partial i^{IT}}{\partial\Delta q}=\gamma_\pi\xi\delta+\gamma_x\alpha_q>0 \tag{9}$$

The responsiveness of the policy interest rate to (nominal effective) exchange rate movements depends on the weight on inflation in the policy rule, γ_π , the level of openness as described by ξ, the degree of exchange rate pass-through to inflation, δ, and the impact of the exchange rate changes on output.

In this framework, I define an IT country of the "Fear of Floating" type, using Calvo and Reinhart's [2002] terminology, as one that is pursuing exchange rate objectives separate from its official policy targets, as in Ball and Reyes [2008], with $\gamma_q > 0$ and therefore

$$\frac{\partial i^{FF}}{\partial\Delta q}=\gamma_\pi\xi\delta+\gamma_x\alpha_q+\gamma_q>\frac{\partial i^{IT}}{\partial\Delta q} \tag{10}$$

Interest rates variability is therefore higher than in honest IT; it must be noted, however, that one other element characterizes FF episodes: if the (implicit) target value of the currency is defined in *nominal* terms of one reference currency rather than a basket or a trade-weighted index, then the *bilateral* exchange rate should enter the policy function, and the central banks would react to changes in the *bilateral* exchange rate, which makes the policy more similar to that of an exchange rate targeter.

For a strict floater, monetary policy can be described here by a standard forward-looking Taylor Rule with weight placed on domestic inflation, as measured by the GDP price deflator as in the original Taylor Rule, and therefore (6) becomes:

$$i=\bar{r}+\bar{\pi}+\gamma_\pi[\pi-\bar{\pi}]+\gamma_x\left[\alpha_x x^F-\alpha_r(r-\bar{r})+\alpha_q\Delta q\right] \tag{11}$$

[9] Ball, Reyes [2008], p. 313.

and thus, even in the case of the most committed floaters, the interest rate responds to changes in the exchange rate, because of its role in influencing the output gap:

$$\frac{\partial i^F}{\partial \Delta q} = \gamma_x \alpha_q < \frac{\partial i^{IT}}{\partial \Delta q} \qquad (12)$$

Foreign exchange intervention to defend the exchange rate, however, need not come only through the policy interest rate channel. Central Banks use foreign exchange reserves, as well as other "hidden" channels like credit lines to maintain the desired value of the currency with respect to one or more reference currencies. In theory, foreign exchange reserves should never change in case of committed floaters, and variability should be higher the less flexible the exchange rate and in particular in situations of financial turbulence (for example, speculative attacks). In reality, this is not the case: reserves change even for the most committed floaters, and also for reasons other than exchange rate stabilization[10]. Indeed, Taylor [2001] and Edwards [2006] claim that if the Central Bank took exchange rate movements into account in setting the policy interest rate, this would result in excessive interest variability, which is not observed in practice.

If a Central Bank is actually pursuing an IT strategy but also has a separate exchange rate smoothing objective, therefore, it is likely to use instruments different from the policy interest rate to that end.

Considering a simple model of exchange rate determination, the reason is clear. The value of a currency depends, as for any asset, on supply and demand of the currency itself. The level of interest rates will influence demand through international financial inflows/outflows. Central Banks can, however, use foreign exchange reserves to affect supply and demand of the domestic currency. Consider a very simple, undergaduate-course-flavoured monetary approach model of exchange rate determination where you only have two countries, a domestic (h) and a foreign (f) country.

Total demand for real-money holdings in each country is determined by the private sector demand. Private sector demand is determined by: i) transaction purposes, where, for simplicity, only home country goods are demanded; ii) investment / speculative purposes, depending on the level of domestic interest rates, while uncovered interest parity is supposed to hold:

$$\frac{M_D}{P} = k\,Y_h^a e^{bi}$$

[10] See Section 5 below for a discussion on the role of foreign exchange reserves as a measure of commitment towards flexible exchange rates.

Table 1. Classification of Exchange Rate Regimes according to theoretical priors

	σ^2_e	σ^2_R	σ^2_i	corr(i,i*)	corr(r,π)	corr(r, e)
Fixed	Nil / Low	High	High	High	Low	High
Managed Float / Limited Flexibility	Low	High	High	High	Low	High
Fear of Floating	Low	High		High	Interm.	Interm.
Inflation Targeting	Interm.	Low	Low	Low	High	Low
Float	High	Low	Low	Low	High	Low

σ^2_e = variance of the (bilateral of effective) exchange rate; σ^2_R = variance of reserves; σ^2_i = variance of the policy rate; i* = foreign (reference country) policy rate; e = bilateral or effective ER.

Assuming purchasing power parity holds, and thus $P_f = S\ P_d$, and taking logs, we can define the exchange rate as clearing the differences in relative demand and supply of domestic and foreign currency:

$$s = a\left(y_f - y_h\right) + \left[\ln\left(k_f\right) - \ln\left(k_h\right)\right] + b\left(i_f - i_h\right) + \left(m_f - m_h\right) \quad (13)$$

Equation (13) states the well-known result of the monetary approach, that the level of the exchange rate tends to fall (the currency appreciates) when domestic interest rates are higher than foreign rates, when there is an expansion in domestic monetary base relative to foreign monetary base, and it also depends on relative output and money velocity.

If a central bank is targeting the exchange rate, when it sees an undesired change in the exchange rate (for example, an increase), it can either change the interest rate to a level higher than the target country's, or reduce the monetary base by increasing its foreign exchange reserves. By using monetary instruments, the Central Bank can manage, at least in the short run, to keep the exchange rate stable while maintaining an independent interest rate policy.

The model outlined in this section, albeit very stylized, allows us to order monetary policy regimes according to some priors, similar to Levy-Yeyati and Sturzenegger [2005], Calvo and Reinhart [2002] and Ball and Reyes [2008]. Out of these priors, we will focus on those related to the exchange rate and reserves. Table 1 summarizes these conclusions, where “high”, “low” and “intermediate” are in relative terms.

3. Review of the Literature on Exchange Rates Regimes Classification

It has been discussed in the literature why a central bank would pursue an exchange rate policy that is different from what is officially declared. One reason is that an exchange rate band or a peg is prone to speculative attacks when the markets perceive that the commitment of the central bank to maintain the parity is no longer credible; in order to defend the peg, the Central Bank may thus be forced to engage in costly interest rate spikes.

Such speculative attacks can occur even when there is no credibility problem on the Central Bank's side, making the prophecy of the abandonment of the parity self-fulfilling.

In recent years, there has been a growing empirical literature, on which the present paper draws, aimed at estimating the degree of exchange rate flexibility, and thus distinguishing *de facto* exchange rate regimes from *de jure* regimes. Indeed, many countries that announce the intention to float actually informally manage the exchange rate in order to avoid excessive volatility: research on exchange rate flexibility is based on the idea that, rather than the official label of the regime, what countries do can be better described by movements in asset prices and foreign exchange reserves.

To be precise, exchange rate regimes can be classified according to a *de jure* or *de facto* scheme: the former says what countries claim that they are doing, the latter is based on empirical analysis of the behaviour of exchange rates, reserves, money supply and so on.

According to the IMF classification, there are four exchange rate arrangements: Floating, Fixed, Managed Float and Limited Flexibility. Until 1997, the IMF's *Annual Report on Exchange Rate Arrangements and Exchange Restrictions* was completed asking each country to self-report their exchange rate regime: this is the *de jure* classification scheme. Such classification method was upgraded in 1997 and the *Report* now follows a new approach that is closer to the *de facto* classification schemes presented below.

Table 2 presents the *de jure* classification of current exchange rate arrangements in Europe, where we also include Inflation Targeting as a separate regime.

Reinhart and Rogoff [2004] reclassified exchange rate arrangements for 153 countries from the end of World War II to 2001, finding that in the large majority of the cases the *de facto*, exchange rate regime was different from the *de jure* regime. All of the countries in our sample were also in Reinhart and Rogoff's. In particular, they use use monthly observations of the absolute percentage change in the bilateral exchange rate *vis à vis* a reference currency calculating the probability that the exchange rate remains within a one, two or 5 percent band. A country is classified as a peg if it is officially pegging and a dominant reference currency can be identified. If inflation is larger than 40%, we have "*freely falling*" or "*hyperfloat*" cases. When inflation is lower than 40%, the de facto classification depends on the probability that the absolute percent change in market exchange rates (*e*) remains within some pre-specified band over a rolling 5-year (or 2-year) period.

Table 2. De jure exchange rate regimes in Europe

Floating	EMU	**Inflation Targeting**	Hungary United Kingdom Czech Republic Poland Sweden Romania Iceland Norway Switzerland
Limited Flexibility	Denmark Lithuania Latvia		
Peg	Estonia Bulgaria		
Managed Floating	Russia		

Being ε the absolute percentage change in the exchange rate, if $P(\varepsilon < 1\%)$ is 80% or larger, the regime is classified as a *de facto* peg, crawling peg or moving peg. If $P(\varepsilon < 2\%)$ is 80% or larger (the threshold is 5% if the official band is larger), the regime is classified as a de facto *narrow*, *narrow crawling* or *narrow moving band*. In order to distinguish between *managed float* and *freely floating*, they calculate the degree of exchange rate flexibility as $e / P(\varepsilon < 1\%)$. If, for some country, the estimated ratio falls in the 99% confidence interval of the “committed floaters' group”, then the country is classified as freely floating. Managed Floating cases are therefore residual episodes.

The classification scheme set up by Reinhart and Rogoff is thus much richer than the original IMF de jure classification, and is more appropriate if one wants to study the real merits of exchange rate policies.

The view that the world is moving towards a polarization of exchange rate regimes (i.e. either strict pegs/currency unions or freely floating) has been proved to be not correct, among others, by Calvo and Reinhart [2002] and Ball and Reyes [2008]. Many countries actually lie in between; the fact that countries put in place an exchange rate policy that is different from what they officially claim has been labeled “Fear of Floating” by Calvo and Reinhart (henceforth CR); Levy-Yeyati and Sturzenegger [2007], however, proved that in most of the cases it is a fear of *appreciation.* The motivation of such exchange rate management in disguise would be the view of a depreciated exchange rate as a means of protection for domestic industries.

CR use priors and a classification scheme which are quite dirrerent from Reinhart and Rogoff's. As they argue, from an *official* point of view, there are four types of exchange rate regimes: peg, limited flexibility, managed floating and freely floating. Limited flexibility includes exchange rate arrangements in Europe during the ERM era, while a peg is a stricter commitment towards fixed rates. In reality, the regimes can be collapsed to pegs, floats and “fear of floating” (FF). Ball and Reyes [2008] (henceforth BR) include also Inflation

Targeting (IT) as a regime which is different both from free float and a peg but closer to the former, arguing that IT regimes can determine, as a side effect, a reduction in the volatility of the exchange rate, as we have also seen in Section 2, but should be identified separately from the others. The pattern of asset prices, reserves and inflation in different exchange rate regimes is described, by CR and BR, using several theoretical priors. Merging the priors presented by CR and BR, taking a threshold x for the monthly change in a particular variable, then the following priors should hold:

- lower exchange rate variability in fear of floating episodes and pegs with respect to free floats and inflation targeting:

$$P(\Delta e<x|Peg, FF)>P(\Delta e<x|Float, IT) \quad (14)$$

- higher reserve variability in fear of floating episodes and pegs with respect to free floats and inflation targeting:

$$P(\Delta F<x|Peg, FF)<P(\Delta F<x|Float, IT) \quad (15)$$

- higher inflation variability in fear of floating episodes and pegs with respect to free floats and inflation targeting:

$$P(\Delta \pi>x|Peg, FF)>P(\Delta \pi>x|Float, IT) \quad (16)$$

- higher correlation (in absolute value) between inflation and the real interest rate than between rean interest rate and exchange rate in inflation targeting regimes:

$$corr(\pi, \Delta r|IT)>|corr(\Delta r, \Delta e|IT)| \quad (17)$$

- higher real interest rates variability in fear of floating episodes and pegs with respect to free floats and inflation targeting:

$$P(\Delta r>x|Peg, FF)>P(\Delta r>x|Float, IT) \quad (18)$$

What (14) says is that the probability that the monthly percentage change (in absolute value) in the exchange rate is lower than some threshold (for example, 2.5% in CR) in case of a peg or fear of floating is lower than the probability that the change in the exchange rate lies within such narrow bands in the case of a floating regime or IT. In other words, exchange rate variability is higher in various kinds of floating regimes than in de facto pegs and managed floats.

Inequality (15) states that the probability that the monthly percentage change (in absolute value) in the foreign exchange reserves is lower than some threshold (for example 2.5%) in case of a peg or fear of floating is higher than the probability that the change in the foreign exchange reserves lies within such narrow bands in the case of a floating regime. The reason is that if a country is trying to manage the exchange rate in order to reduce its volatility using foreign reserves, then we should observe a high volatility in the latter.

Inequality (16) states that inflation variability is higher in pegs, fear of floating and managed floats in general than it is in IT and floats. This prior, as the above, is in line with the predictions of Svensson [2000] and Gali and Monacelli [2005] that were cited above regarding flexible inflation targeting as opposed to a strict peg.

Prior (17) states that, in IT, (the absolute value of) the correlation between the inflation rate and changes in the real interest rate[11] should be higher than the correlation between changes in the the real interest rate and in the exchange rate, while the opposite should hold for fixed. Since the nominal interest rate is the policy instrument, the Central Bank is expected to raise it when inflation is above target in order to reduce the inflationary pressure; the responsiveness to movements in the inflation rate should be higher than that to movements in the exchange rate. On the other hand, in a fixed exchange rate regime, the central bank uses the interest rate to stabilize the exchange rate, and the correlation between changes in real interest rates and in the exchange rate should be higher, in absolute terms, than the correlation between the inflation rate and changes in *r*. Finally, prior (18) states that real interest rates are more volatile in pegs and managed floats than they are in IT and free floats.

Both CR and BR also use a prior similar to (13) and (14) for the interest rate, using a 4% (400 basis points) threshold. Such prior, in the present analysis, would not be informative since interest rate variability is much lower than that in the CR sample, and it will therefore not be employed in section 5[12].

As discussed by CR, the use of these priors in place of descriptive statistics such as mean absolute deviation, since the the former avoid the problem of outliers, which give excessive weight to observations corresponding to large devaluations[13].

Descriptive statistics are, however, used by Levy-Yeyati and Sturzenegger ([2003], [2005] and [2007]): the classification criteria they employed are in fact based on three variables: "exchange rate volatility", measured as the average of absolute monthly percentage change in the nominal exchange rate relative to the relevant anchor currency; "volatility of exchange rate changes", measured as the standard deviation of monthly percentage changes in the

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[11] The real interest rate is calculated as: $r_t = 100 \times \left[(1 + i_t) \frac{P_t}{P_{t+1}} - 1 \right]$ where *P* is the consumer price index.

[12] The only occasion when the change in the interest rate was higher than 4% within a month was in september/ october 1992, during the speculative attacks that led to the collapse of the ERM.

[13] Calvo, Reinhart (2002), p. 384.

exchange rate; “volatility of reserves”, that is the average of the absolute monthly change in dollar-denominated foreign exchange reserves relative to the monetary base.

The strand of literature that has been discussed so far is aimed at estimating the degree of exchange rate flexibility when we know the relevant – or possible – anchor currency for the country that is being studied. The limit of these approaches is therefore that, on one hand, if a country is officially a floater or IT, the choice of the bilateral exchange rate to take into account is, to some extent, arbitrary; on the other hand, the results may be misleading if the real regime is in fact a (strict or flexible) basket peg.

A different approach has been set up by Frankel and Wei (1994) to estimate the weights in a currency basket: when a country adopts a basket peg, it seldom announces which currencies are included in the basket and their weights. If we regress the change in the value of a currency (expressed as its SDR exchange rate[14]) on the change in the value of some international reserve currencies, we can derive the weights in the basket. In case of a strict peg, OLS is especially appropriate since the model is linear and yields an almost perfect fit. However, it is less on firm grounds and potentially not correctly specified if the basket peg allows for some flexibility (for example, it has a band or moving band). Therefore, it could not be used to disentangle Fear of Floating episodes. In order to merge the techniques to infer exchange rate flexibility and those to estimate the weights in a currency basket, Frankel [2008] and Frankel and Wei [2008] (henceforth FW) extended their original approach. They run the following regression to estimate both the weights in a currency basket and the degree of exchange rate flexibility:

$$\Delta e_t = c + \sum_{i=1}^{N} \omega_i \Delta X_i + \delta(\Delta emp_t) + u_t \qquad (19)$$

where e is the (log) value of a currency (number of units of domestic currency per SDR); X is the value of the N currencies that form the (potential) basket, and Δemp is the percentage change in the “exchange market pressure index” where the latter is defined as:

$$\Delta emp_t = \Delta e_t + \Delta F_t \qquad (20)$$

and *Res* is the (log) value of Foreign Exchange Reserves, appropriately corrected in order to take valuation changes and interest rate earnings into account.

The ω coefficients capture the de facto weights on the constituent currencies (after we restrict their sum to 1), and the market pressure index is defined so that we should have $\delta = 0$ when there is a strict peg, $\delta = 1$ in the case of a pure float. However, as it is acknowledged by the authors, this correspondence would be perfect if countries used foreign exchange reserves

[14] See Frankel and Wei [2008] for a discussion on the choice of the SDR as definition of 'value of a currency'.

only to intervene on the exchange market and therefore the stock of reserves did not change otherwise. Unfortunately, this is not the case, and therefore countries will all lie in the [0,1] interval with the more committed floaters showing a higher coefficient. Countries with a higher degree of flexibility will also show lower R^2.

A caveat regarding the main limit of regime classification literature is necessary. These approaches are not structural analyses of the determinants of exchange rate movements; rather, they detect empirical regularities that allow one to distinguish between “pure floaters” and different levels of exchange rate management or pegging, regardless of how the exchange arrangement is officially classified. From this point of view, if we have two groups of “benchmark floaters” and “benchmark peggers” we can use the above classification schemes to infer to which group a specific country is closer.

4. The Data

This work applies the regime classification schemes outlined in the previous section in order to observe the evolution of European monetary integration and to show the extent to which such classification schemes provide consistent results. The dataset is monthly and composed of 23 countries and 53 exchange rate regimes over 1980:01 – 2009:03. It includes 18 European countries and 5 non-European “benchmark floaters”. The former group is quite heterogeneous as far as official monetary policy and attitude towards the EMU and EU: three countries are not EU members (Norway, Iceland, Switzerland), four are EU members that have recently adopted the euro (Malta, Cyprus, Slovenia and Slovakia), three are ERM members (Latvia, Lithuania and Denmark, and the latter has opted out of EMU), two have a currency board[15] (Estonia and Bulgaria) and the remaining six are EU members that are Inflation Targeters (Sweden, United Kingdom, Czech Republic, Poland, Hungary, Romania); out of these, the UK has opted out of EMU.

The set of “benchmark floaters” is made up of New Zealand, Australia, United States, Canada and Japan. Australia, Canada and New Zealand are Inflation Targeters.

More specifically, the procedure will be applied over the whole 1980-2008 period, dividing the latter in three subperiods: the ERM era (from 1980 to october 1992), the post-ERM era (november 1992 to 1998), and the Euro era (1999 to present). Data come from IFS of the International Monetary Fund and national Central Banks.

Actual reference subperiods for the single countries may be different from the above, in order to avoid mixing data with different exchange rate regimes.

[15] Lithuania, which is listed among the ERM II members, also have a currency board arrangement with the euro.

As far as Central and Eastern European (CEEC) countries are concerned, due to data availability the analysis is performed only from 1993 on, and the exact starting year is different from country to country.

On the above data I apply the CR and FW approaches. The bilateral exchange rate taken into consideration for the CR approach is against the euro (German Mark) for the European countries and the United States since (until) 1999, and the US dollar for non-European countries, as in CR[16]. During the ERM era, the parities were defined with respect to the European Currency Unit (ECU); however, it was the Bundesbank which had the leading role in the system, and the Mark was the main reserve currency in the region and also had the largest weight in the ECU basket.

5. The Calvo-Reinhart Approach

As discussed in Section 3, in an exchange rate arrangement different from a free float, the volatility of the exchange rate should be low. As pointed out by prior (13), the probability that the monthly percentage change in the exchange rate is lower, in absolute terms, than some threshold x should be higher when there is some form of limited flexibility with respect to a pure float. Such probability is estimated here using 2-year rolling windows.

In this Section the empirical distribution of the monthly percentage change in the bilateral exchange rate, Δe, is observed, with two thresholds: 1%, as in CR and Ball and Reyes [2008] and 2.25%, as in the ERM. The 1% threshold is also used by Reinhart and Rogoff to identify *de facto pegs* or *crawling pegs*. Tables 3-5 present the results of the Calvo-Reinhart approach on exchange rate volatility over the three subperiods introduced in section 4; tables6-8 concentrate on foreign exchange reserves volatility. Table 3 shows the relevant figures for the countries in the sample during the ERM era; for each of them, the time period considered is also indicated. Since the objective is to highlight the differences in exchange rate volatility due to different exchange rate arrangements, the criterion for the choice of the time span is membership of the ERM for the European countries, and the date when a floating regime was adopted for the benchmark floaters. Norway was not a member of the ERM over the period, it had a basket peg instead. The Norwegian Krone was pegged to the ECU in 1990, and the peg was abandoned in december 1992 following the turbulence of the previous months.

[16] Actually, CR use only the bilateral exchange rate against the DM for European countries because their dataset is entirely pre-euro, while BR use first the DM and then the euro.

Table 3. Exchange Rate Volatility during the ERM years

De jure regime	Country	Period	Probability that the monthly % change in nominal exchange rate falls within	
			± 1% band	± 2.25% band
Floaters	*Australia*[17]	Jan 1984 – Dec 1992	*32.4%*	*67.3%*
	Japan	Jan 1980 – Oct 1992	*30.5%*	*59.3%*
	New Zealand[18]	Mar 1985 – Dec 1989	*35.9%*	*70.7%*
	United States	Jan 1980 – Oct 1992	*18.4%*	*53.5%*
	Canada	Jan 1980 – Dec 1990	*79.6%*	*98.9%*
Limited Flexibility	Sweden[19]	Jun 1985 – Oct 1992	74.2%	99.4%
	United Kingdom[20]	Oct 1990 – Sep 1992	58.3%	95.8%
	Norway	Jan 1980 – Dec 1992	56.5%	90.1%
	Denmark	Jan 1980 – Oct 1992	93.4%	98.6%
	Switzerland [21]	Jan 1980 – Oct 1992	64.3%	94.2%

The results in Table 3 confirm prior (14); countries with a floating regime systematically exhibit higher bilateral exchange rate volatility, except for Canada, with respect to countries that adopted a managed float. Later in this section, tests on the difference of the means are performed in order to test whether such difference is statistically significant.

Table 4 summarizes the results for the 1992:11-1998:12 period. After the crisis in the autumn 1992, Sweden, Norway and the United Kingdom abandoned the limited flexibility arrangement. While Sweden and the UK never went back to limited flexibility, and rather moved to Inflation Targeting, Norway left its currency free to float only until the end of 1994, and a managed float versus a basket of currencies was adopted from january 1995.

Again, the prediction of prior (14) is fulfilled, although a test on the means will be needed to state the significance of the differences. Countries that were listed as in a pure float or Inflation Targeting exhibit a higher volatility of the nominal exchange rate.

We now turn to the exchange rates developments after the introduction of the euro.

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[17] Australia adopted a floating exchange rate in December 1983, therefore it can be included in the group of benchmark floaters only from 1984 on.

[18] New Zealand adopted a floating exchange rate regime in february 1985.

[19] Sweden joined the ERM in june 1985; as a term of comparison during the period 1980:1 – 1985:6, the figures were 60% and 90.8% respectively.

[20] As previously said, the United Kingdom was member of the ERM only in the period 1990:10-1992:9; during 1980:1-1989:12, the figures were 40.8% and 73.3% respectively.

[21] Switzerland was not a member of ERM. However, empirical work has proved that, in the period under consideration, the Swiss National Bank did stabilize the CHF/DM and the CHF/FF exchange rate (see Von Ungern-Sternberg, 1987).

Table 4. Exchange Rate Volatility after the collapse of ERM

De jure Regime	Country	Period	Probability that the monthly percent change in nominal exchange rate falls within		Official Anchor Currency
			± 1% band	± 2.25% band	
Floaters	*Japan*	Nov 1992 – Dec 1998	*32.9%*	*62.7%*	
	United States	Nov 1992 – Dec 1998	*38.5%*	*72.0%*	
Inflation Targeters	Canada	Jan 1991 – Dec 1998	69.8%	96.1%	
	Australia	Jan 1993 – Dec 1998	39.5%	78.9%	
	New Zealand	Jan 1990 – Dec 1998	48.6%	81.1%	
	Sweden	Jan 1993 – Dec 1998	40.5%	78.4%	
	Un. Kingdom	Nov 1992 – Dec 1998	43.2%	83.8%	
Managed Floating and Limited Flexibility	Norway	Nov 1992 – Feb 2001	77.4%	97.3%	Basket
	Denmark	Nov 1992 – Dec 1998	90.5%	98.6%	DM
	Switzerland	Nov 1992 – Dec 1998	64.9%	98.6%	DM
	Bulgaria	Jan 1997 – Dec 1998	75.0%	75.0%	DM
	Czech Rep.	Jan 1993 – May 1997	65.8%	97.3%	DM
	Hungary	Jan 1993 – Dec 1998	45.8%	78.7%	DM
	Latvia	Feb 1994 – Dec 2004	96.5%	100.0%	SDR
	Lithuania	Apr 1994 – Dec 2000	96.1%	96.1%	USD
	Poland	Jan 1993 – Dec 1998	47.0%	84.2%	DM, USD
	Slovak Rep.	Jan 1993 – Dec 1998	53.8%	88.5%	DM
Peg	Estonia	Jan 1993 – Dec 1998	100.0%	100.0%	DM

The story shown in Table 5 is quite puzzling. The figures for Pegs, Managed Floatings and Limited Flexibility arrangement are quite similar to each other, as expected. As far as inflation targeters are concerned, we notice that during the ten years after the introduction of the euro, bilateral exchange rates vis à vis the euro have exhibited remarkable stability. European Inflation Targeters, except for Poland and Romania, present figures that are closer to those of peggers than to other IT countries. This is true in particular for Sweden, Switzerland and the Czech Republic. The case of Norway is interesting: after the basket peg (de facto, a strict peg to the Euro) was abandoned in march 2001, the euro exchange rate of the kroner became more volatile, but still remained within the range of what Reinhart and Rogoff would classify as a "de facto narrow band". While this is not enough to state that the countries under consideration have adopted some sort of exchange rate management, and further analyses are necessary, still the volatility is much lower than for the group of floaters.

Table 5. Exchange Rate Volatility after the introduction of the Euro

De jure regime	Country	Period	Probability that the % change in nominal exchange rate is within ± 1% band	± 2.25% band	Official Anchor Currency
Floaters	Japan	Jan 1999 - Mar 2009	*35.0%*	*66.2%*	
	United States	Jan 1999 - Mar 2009	*29.6%*	*66.6%*	
Inflation Targeters	Australia	Jan 1999 - Mar 2009	27.5%	61.8%	
	New Zealand	Jan 1999 - Mar 2009	27.2%	61.4%	
	Canada	Jan 1999 – Mar 2009	37.8%	82.1%	
	Sweden	Jan 1999 – Mar 2009	68.0%	97.3%	
	Un. Kingdom	Jan 1999 – Mar 2009	56.6%	88.2%	
	Norway	Mar 2001 – Mar 2009	51.5%	84.2%	
	Switzerland	Jan 1999 – Mar 2009	80.5%	98.4%	
	Czech Rep.	Jan 1999 - Mar 2009	59.0%	94.8%	
	Poland	Jan 1999 - Mar 2009	35.8%	66.4%	
	Hungary	Aug 2001 – Mar 2009	54.0%	87.0%	
	Romania	Jan 2005 – Mar 2009	44.5%	74.9%	
	Iceland	Jan 2001 – Mar 2009	38.6%	69.4%	
Peg	Bulgaria	Jan 1999 - Mar 2009	91.3%	91.3%	Euro
	Estonia	Jan 1999 - Mar 2009	100.0%	100.0%	Euro
Managed Floating	Malta	Jan 1999 – Jan 2005	71.4%	97.9%	Euro
	Romania	Jan 1999 – Dec 2004	32.2%	66.6%	Euro
	Slovak Rep.	Jan 1999 – Nov 2005	66.5%	91.0%	Euro
	Hungary	Jan 1999 – Jul 2001	87.0%	96.9%	Euro
	Norway	Jan 1999 – Feb 2001	71.9%	99.0%	Basket
Limited Flexibility	Lithuania	Feb 2002 – Mar 2009	100.0%	100.0%	Euro (ERM II members)
	Latvia	Jan 2005 – Mar 2009	96.4%	100.0%	
	Denmark	Jan 1999 – Mar 2009	100.0%	100.0%	
	Malta	Feb 2005 – Dec 2007	100.0%	100.0%	
	Slovak Rep.	Nov 2005 – Dec 2008	39.6%	83.3%	

We now move to the analysis of foreign exchange reserves volatility, that is prior (15) above. Interpreting the path of foreign exchange interventions is, however, less easy. In theory, in a pure float the change in foreign exchange reserves should be zero. However, this is not the case in reality. First of all, foreign exchange reserves vary due to valuation changes and interest earnings. Second, they are not only used for exchange rate stabilization purposes, as pointed out also by CR. This is true, in particular, for New Zealand, which in our case is especially interesting since it moved from managed float to a free float in 1985, and to

Inflation Targeting in 1990. In the case of New Zealand, reserves fluctuate due to the Treasury's management of its overseas currency debt rather than foreign exchange market intervention[22].

Third, in order to manage the exchange rate, countries also engage in hidden foreign exchange transactions: credit lines were widely used by ERM countries during speculative attacks. Finally, countries may rely a lot on interest rate interventions as it was the case during the ERM crisis in 1992 or in the managed float of Norway which started in 1995.

Nevertheless, the path of foreign exchange reserves can be a good indicator, although not the only one, of the actual exchange rate policy that is being pursued and is taken into consideration in most of the exchange rate regime classification literature.

Tables 6-8 show the results of prior (15) in our dataset, divided by country and over the three subperiods introduced above. In this case, the prediction of prior (15) is not sistematically fulfilled: during the first period (see Table 6) there is no clear difference between reserves volatility in floating countries and in ERM countries.

In the second and third period, however, reserves volatility is systematically lower in the "benchmark floater" countries, Japan and the US, as well as Canada, while it is still higher for New Zealand and Australia. Besides, for countries that went through a regime switch and moved toward higher flexibility, reserve volatility has indeed fallen, although it remained at a level higher than benchmark floaters, and more precise statistical analysis would be needed.

On average, however, prior (15) holds: official floaters have the most stable foreign reserves (i.e. the highest probabilities), IT countries have a quite higher reserves volatility, then come limited flexibility, pegs and managed floating arrangements.

So far, we have found several empirical regularities that can be summarized as follows: 1. during the ERM era, volatility of exchange rates in Europe was lower than that exhibited by countries listed as "benchmark floaters", as we expected a priori; 2. after the collapse of the ERM, while Denmark remained in a limited flexibility arrangement, joining ERM II, the other western European countries moved, with different timing, to Inflation Targeting, while the CEEC went through a period of exchange rate instability, which appears in our approach as massive foreign exchange reserves intervention that was, however, not successful in keeping the exchange rate stable, as it is shown in tables 2 and 5 above. 3. Starting 1999, a growing number of European countries moved to Inflation Targeting, while we see, in tables 5 and 8, a remarkable stabilization of euro exchange rates and a relative increase in reserves volatility with respect to benchmark floaters. The United Kingdom and, in particular, Sweden

[22] See also Calvo, Reinhart [2002] p. 388.

and Switzerland present values on exchange rate volatility that are closer to those of a *de facto* pegger as Denmark than to other IT countries. Similar conclusions can be drawn by looking at the variability of foreign exchange reserves, when the benchmark country is Japan or the United States. When the benchmark is Australia or New Zealand, however, data on foreign exchange reserves volatility do not seem informative. However, we notice that, in most of the cases, adoption of inflation targeting was associated with a fall in both exchange rate and reserves volatility.

Figure 1 shows the results of this approach, by exchange rate regime, within our dataset. In theory pegs, MF and LF should be lying up and to the left, while floats and IT should be down and to the right. IT shows up as being an intermediate regime as far as exchange rate and reserves variability are concerned.

In order to see whether such empirical regularities are also statistically significant I then move to hypothesis testing. Table 9 shows the results of the tests that were run: first of all, as far as exchange rates variability is concerned, t-tests on the equality of means of the prior (14) are presented. Second, for foreign exchange reserves, F tests on the equality of variances are presented. I ran F-tests instead of tests on prior (15) because in the case of reserves, unlike exchange rates, the variance is a good measure of variability since it is less affected by periodic devaluations[23].

We start from the tests on the mean value of the probability that the exchange rate change is lower than 2.25% in absolute value. As I stated above, our prior expectation is that this probability is highest for limited flexibility regimes and managed floating, lowest for free floaters, with inflation targeters in the middle.

Table 9 shows the results divided by subperiod. We compare the probabilities of prior (14) for each European country to those of the non-european benchmark floaters, and then group the results according to the official regime. This is interesting because it allows us to see whether european IT regimes are similar, from the point of view of exchange rate volatility, to non-european floating and IT regimes.

First of all, as we expected, MF and LF regimes are significantly different from free floats (USA and Japan), as far as exchange rate variability is concerned. Moreover, they are significantly different from the benchmark IT regimes, Australia, Canada and New Zealand, although the figures are less clear cut than in the previous case. This proves that IT regimes are characterized by a lower exchange rate variability than free floats, and counting them as benchmark floaters might be misleading, as Ball and Reyes [2008] point out.

[23] See Calvo and Reinhart (2002), p. 400.

Table 6. Foreign Exchange Reserves Volatility during the ERM years

De jure regime	Country	Period	Probability that the monthly percentage change in foreign exchange reserves is ≤ ± 2.5%
Floaters	Australia	Jan 1984 – Dec 1992	39.9%
	Japan	Jan 1980 – Oct 1992	78.2%
	New Zealand	Mar 1985 – Dec 1989	19.8%
	Canada	Jan 1980 – Dec 1991	16.4%
	United States	Jan 1980 – Oct 1992	33.3%
Limited Flexibility	Sweden	Jun 1985 – Oct 1992	35.1%
	United Kingdom	Jan 1990 – Sep 1992	70.8%
	Norway	Jan 1980 – Dec 1992	31.9%
	Denmark	Jan 1980 – Dec 1992	27.3%
	Switzerland	Jan 1980 – Dec 1992	31.8%

Table 7. Foreign Exchange Reserves Volatility after the collapse of ERM

De jure regime	Country	Period	Probability that the monthly percentage change in foreign exchange reserves ≤ ± 2.5%
Floaters	United States	Nov 1992 – Dec 1998	66.5%
	Japan	Nov 1992 – Dec 1998	79.7%
	Switzerland	Nov 92 – Dec 1998	37.8%
Inflation Targeters	Australia	Jan 1993 – Dec 1998	57.9%
	New Zealand	Nov 1992 – Dec 1998	32.5%
	Canada	Nov 1992 – Dec 1998	34.0%
	Sweden	Nov 92 – Dec 1998	32.4%
	United Kingdom	Nov 92 – Dec 1998	71.6%
Managed Floaters and Limited Flexibility	Norway	Nov 92 – Feb 2001	40.6%
	Denmark	Nov 92 – Dec 1998	37.8%
	Latvia	Jan 93 – Dec 2004	46.3%
	Hungary	Jan 93 – Dec 1998	28.2%
	Lithuania	Jan 93 – Jan 2002	28.8%
	Czech Rep.	Jan 93 – Dec 1998	29.4%
	Slovak Rep.	Jan 93 – Dec 1998	39.4%
	Poland	Jan 93 – Dec 1998	59.3%
	Bulgaria/1	Jan 94 – Dec 1996	17.3%
	Bulgaria/2	Jan 1997 – Dec 1998	29.2%
Peg	Estonia	Jan 93 – Dec 1998	37.8%

Table 8. Foreign Exchange Reserves Volatility after the introduction of the Euro

De jure regime	Country	Period	Probability that the monthly percentage change in foreign exchange reserves is within ± 2.5% range
Floaters	United States	Jan 1999 – Mar 2009	74.9%
	Japan	Jan 1999 – Mar 2009	87.1%
Inflation Targeters	New Zealand	Jan 1999 – Mar 2009	22.9%
	Canada	Jan 1999 – Mar 2009	71.3%
	Australia	Jan 1999 – Mar 2009	30.4%
	Sweden	Jan 1999 – Mar 2009	45.8%
	United Kingdom	Jan 1999 – Mar 2009	42.3%
	Norway	Mar 2001 – Mar 2009	47.0%
	Romania	Jan 2005 – Mar 2009	65.5%
	Switzerland	Jan 1999 – Mar 2009	68.0%
	Czech Rep.	Jan 1999 – Mar 2009	74.7%
	Poland	Jan 1999 – Mar 2009	56.1%
	Iceland	Apr 2001 – Mar 2009	43.6%
	Hungary	Jan 1999 – Mar 2009	54.5%
Managed Floaters	Iceland	Jan 1999 – Mar 2001	37.5%
	Slovakia	Jan 1999 – Oct 2005	43.2%
	Romania	Jan 1999 – Dec 2004	39.7%
	Malta	Jan 1999 – Dec 2004	56.7%
Limited Flexibility, Peg	Latvia	Jan 2005 – Mar 2009	45.8%
	Lithuania	Feb 02 – Mar 2009	38.3%
	Malta	Jan 2005 – Dec 2007	68.5%
	Slovakia	Nov 05 – Dec 2008	72.0%
	Denmark	Jan 1999 – Mar 2009	47.7%
	Estonia	Jan 1999 – Mar 2009	34.8%
	Bulgaria	Jan 1999 – Mar 2009	34.4%

European IT regimes present a significantly lower exchange rate variability than benchmark floaters, and, interestingly, in most of the cases (23 out of 27) exchange rate variability is significantly lower than that of the benchmark IT countries. The only European IT that presented exchange rate variability during the last 10 years comparable with that of the benchmark are Poland, Romania and Iceland.

Table 9. T-tests. Proportion of cases where P(ε< |2.25%|) is higher than the benchmark

	1980-1992 **Official Regime**	1993-1998 **Official Regime of the European country**		1999-2009 **Official Regime of the European country**	
Benchmark	**MF/LF**	**MF/LF**	**IT**	**MF/LF**	**IT**
USA	100.0%	90.0%	100.0%	85.7%	66.7%
Japan	100.0%	100.0%	100.0%	100.0%	66.7%
Australia		77.8%	0.0%	100.0%	77.8%
New Zealand		80.0%	100.0%	100.0%	100.0%
Canada		40.0%	0.0%	80.0%	77.8%
No. of cases	4	10	2	10	9

As I already stated, all of European Inflation Targeters have moved from a limited flexibility regime to IT during the period under analysis; in the third period, while in 28 out of 30 cases MF/LF regimes are significantly different from benchmark inflation targeters, the figures for European IT after they left the LF/MF regimes have not changed significantly, or exchange rates became even more stable, with the exception of Iceland and Norway, and the UK and Sweden only for the 1993-1998 period.

The conclusions of the previous section are therefore confirmed: European currencies, regardless of the monetary policy regime, exhibited lower exchange rate volatility than non-European currencies; the Euro era, which was characterized by a move towards greater de jure flexibility[24] actually shows a stabilization of exchange rates.

The increased stability of exchange rates might be the result of more synchronized business cycles, rather than active exchange rate policy. In order to get some insight on this point, I conducted F tests of the null hypothesis of the equality of variances of the monthly absolute percentage change in foreign exchange reserves. The tests were run for each single country and (official) exchange rate arrangement with the above specified subperiods. Therefore, in each test, the null hypothesis is that the variance for a non-benchmark floater (European countries), σ^2_{EU}, is equal to that of the non-European floating or IT country, σ^2_F, while the alternative hypothesis is that the European country is not a committed floater/inflation targeter, and therefore $\sigma^2_{EU} > \sigma^2_F$.

When the benchmark is the US or Japan, which are free floaters, the null hypothesis is rejected for all European countries and subperiods, with the exception of UK, where the null of equal variances is rejected only for the 1999-2008 period and not during ERM membership, and this result is contrary to our a priori expectation.

[24] Seven Countries abandoned regimes of managed floating to adopt Inflation Targeting, while none which was previously float / IT moved to managed float or entered the EMU.

Therefore, regardless of the official monetary policy strategy, European countries intervene on foreign exchange markets more than committed floaters.

We consider Canada as a benchmark only from 1991 on, since in that year Canada adopted Inflation Targeting. During 1992-1998, the null of equal variances cannot be rejected for 12 out of 16 cases: only Bulgaria, Slovakia and Romania exhibited a significantly higher variability of reserves. During the Euro era the situation is reversed: while most European countries in the sample moved to more flexible regimes, the null of equal variances is rejected in 15 cases out of 16; it is marginally accepted for the Czech Republic (which is Inflation Targeter as Canada); foreign exchange intervention in other countries appears to have been significantly larger.

When the benchmark is Australia or New Zealand, the tests on equal variances do not offer a clear distinction between IT regimes and managed floating/limited flexibility: for New Zealand, the null of equal variances cannot be rejected in 11 out of 16 cases in 1992-1998 and in 13 out of 16 cases in 1999-2009; for Australia, the null cannot be rejected in 6 out of 16 and 14 out of 16 cases.

The tests therefore confirm that the variability of exchange rates and reserves of committed floaters is significantly different from that of European countries and inflation targeters in general, and in most of the cases this result is confirmed over all subperiods. This result is stronger for the period after the adoption of the euro. With the exception of Canada, which – from this simple perspective - seems to be the most committed inflation targeter, at least from the point of view of reserves variability, IT regimes do not appear significantly different from managed floats while they intervene significantly more than floaters. When reserves do not vary for other reasons, as it is the case for New Zealand (see above), this might be a proof of active foreign exchange intervention that can result from Fear of Floating.

6. The Frankel and Wei Approach

One of the limits of the CR approach is that the choice of the currency vis à vis which the bilateral exchange rate is calculated in order to assess episodes of Fear of Floating is, in some sense, arbitrary. Besides, these approaches do not fit well situations where a basket peg (official or in disguise) is in place. I therefore present the results obtained using a different approach developed by Frankel and Wei [2008] and outlined in Section 3 above, over the three subperiods I have defined.

As it was stated in section 3, the FW approach consists of the OLS regression:

$$\Delta e_t = c + \sum_{i=1}^{N} \omega_i \Delta X_i + \delta(\Delta emp_t) + u_t$$

where the variables have been defined above. In order to reduce as much as possible the problem of parameter instability, the exact dates sample for the regressions changes from country to country, to take into account regime shifts, as declared by the central banks, and to exclude periods of "freely falling" exchange rates as detected by Reinhart and Rogoff [2004]. The expression for *emp* is given in (20); as noted by FW, however, the percentage change in reserves might not be a good indicator of central bank intervention when a country holds a relatively low *level* of reserves, since a change that is small in absolute terms may show up like a large intervention in percentage terms: therefore, when needed, I will also estimate equation (19) with *emp* defined as[25]:

$$emp = \frac{Res_t - Res_{t-1}}{MB_{t-1}} \qquad (21)$$

The vector X of foreign currencies includes the U.S. Dollar, the Japanese Yen, the U.K. Pound, the German Mark and the French Franc (until 1998), the euro and, in some cases, the Russian Ruble. Since several countries in the dataset until 1998 actually had exchange rate arrangements using the ECU as reference basket instead of single currencies, I also performed the regression with the ECU/SDR exchange rate in place of FFR and DEM.

In order to constrain the sum of the weights ω_i to 1, I rewrite equation (18) as:

$$\Delta e_t - \Delta UKP_t = c + \sum_{i=1}^{N} \omega_i (\Delta X_i - \Delta UKP_t) + \delta(\Delta emp_t) + u_t \qquad (22)$$

[26]

and the weight of the UK Pound can be recovered subtracting the sum of the weights on other countries from 1.

Table 10 and Table 11 present the results when emp is defined respectively as (20) or (21) above. The ECU (XEU) appears in place of FFR or DEM when the former regression presented better results in terms of model specification, R^2 and precision of the coefficients.

Table 8 shows the results when *emp* is defined as in (20). It is interesting to see that no country, even the committed floaters, gets a coefficient for EMP close to 1: the currencies that are indicated as most freely floating only get as high as 0.2-0.6. This is due to the problem that we already cited related to uses of reserves different from exchange rate management. We notice, however, a positive trend in δ for the US, Japan and Canada. Benchmark floaters, in general, have a δ coefficient that is statistically different from zero, except from Australia in 1984-1992 and New Zealand in 1986-1998. Australia, New Zealand

[25] See Frankel and Wei [2008], p. 396.

[26] In the case of the U.K., I used the Swiss Franc to constrain the sum to 1.

and Canada seem to have also intervened on the USD exchange rate. However, they are among the countries for which measuring the change in reserves in percentage terms might not be appropriate.

In Europe, all ERM countries in the first subperiod did put a 100% weight on the ECU, except for Sweden and Norway, which seemed to intervene also on the USD exchange rate. Switzerland as well shows a strict peg to the ECU. In the case of Iceland, which officially had a basket peg, the table shows an increase in the weight of the ECU that occurred during the period. But while Denmark is a member of ERM and officially pursuing a policy of exchange rate targeting, and Slovakia was member of ERM during the last 2 years of the sample, the same cannot be said for Switzerland and the Czech Republic. In the second subperiod, the sample also includes some CEEC. The U.K. shows a clear move toward a more flexible regime, confirming the results of Section 5, while also Switzerland has a positive and significant – though small – *emp* coefficient.

The official basket peg of Norway was actually a peg to the DEM with some weight also attached to the dollar. Most of CEEC countries officially had managed floating regimes with the DEM as a reference currency. Table 10.b actually shows that a large weight was also put on the Dollar (between .3 and .5). The exceptions were the Latvian Lats, which was pegged to the SDR, the Lithuanian Litas, which was pegged to the USD and the Estonian Kroon with a currency board to DEM. In these cases, our results are in accordance with the official policy.

We now move to the results of the approach during the 1999-2009 period, presented in panel c of Table 10. Except for Denmark, strictly pegged to the euro, Western European countries all have positive and significant coefficients on *emp*. Except for Norway after 2001 (when it adopted Inflation Targeting) these coefficients are quite low, always below 0.15; the coefficient on the euro is always positive and significant at all levels, which might be suggestive of central bank intervention to stabilize the euro exchange rate. In the case of the U.K., the central bank seems to have been managing the exchange rate with the dollar as well as the euro. Looking at the CEEC countries instead, the policy change in Lithuania (since 2002) and Latvia (since 2005) when they pegged to the euro is clear in table 10.c, as well as Cyprus, Malta, Slovenia and Slovakia, especially during the period of preparation to EMU, and Bulgaria and Estonia, which have a currency board.

As far as the eastern European inflation targeters are concerned, instead, Poland and the Czech Republic have positive and significant coefficients for *emp* while the weight attached to the euro has been large as well. Romania and Hungary do not seem to have moved do greater flexibility after the adoption of inflation targeting: δ is not significant and the weight on the euro has actually increased.

Table 11 presents the results when *emp* is defined as in (21). The results in general are consistent with the previous discussion. We notice however that δ is larger for New Zealand and Canada (for the latter, in the last subperiod it is not significantly different from 1), and it is now significant for Romania and Hungary after the adoption of Inflation Targeting, while it is marginally significant for Sweden (at 10%) and Switzerland (at 5%).

The approach when the change in reserves is scaled by the monetary base also yields better results in terms of R^2, while in general the equations are all correctly specified.[27]

Summing up, we found that: (1) benchmark floaters tend to have the largest δ coefficients in each subperiod; (2) in the case of peggers, the de facto policies were generally consistent with the official labels; (3) as far as the inflation targeters are concerned, the results of the Calvo-Reinhart approach are mostly confirmed: while moving to a greater flexibility since the beginning of the 1990s, European countries seem to have been intervening actively to manage the euro exchange rate.

Frankel and Wei also adapt their model in order to look for particular "trends" in the composition of the baskets. For example, in the case of China, they verify whether the weight on the dollar actually decreased after the move to a basket peg in 2005 by augmenting the regression, including t^*X for all explanatory variables.

To check for possible trends in the weight of the euro in the policies of European countries, I instead ran the same regression over 5-year rolling windows. This approach is preferable for a number of reasons: first of all, we save on degrees of freedom; second, the trend is not necessarily linear, and therefore using a linear trend might yield no results; third, since in most of the cases we do not have official regime shifts, this can allow us to detect policy changes at specific times. Figure (2) shows the estimates of the *emp* coefficient and the weight on the euro for the European countries that are inflation targeting which, among other things, are also those for which we have the least clear answer.

Sweden shows a fairly stable δ coefficient while there has been a clear increase in the "weight" of the euro during the period, except for the last few windows, which are affected by the instability of the end of 2008; however, a recursive test of structural break shows no evidence of breaks. A note on the last few observations in the sample is necessary. Instability

[27] Results of specification tests are available on request.

was common to all countries in our sample and, in general, to small open economies: as it was acknowledged by the Sveriges Riksbank in its Monetary Policy Report of October 23rd 2008: "*It is unclear exactly what this weakening is due to, but in times of great anxiety, small countries' currencies are usually regarded as uncertain and they weaken. The krona weakened, for instance, after the crises in 1997-98 and* (…) *in September 2001. This is clear, for instance, from the krona's position against the euro* (…).".

The U.K. seems to have moved towards greater exchange rate flexibility since 2003 while the weight on the euro remained fairly stable. Norway adopted inflation targeting in 2001, but has been increasing exchange rate flexibility throughout the period; the weight on the euro also was increasing for most of the sample.

Iceland is a peculiar case. It moved to IT in 2001, an indeed the *emp* coefficient is stable and close to zero before that, and then trending upward. The second half of 2008 was characterized by financial instability, that ended up in a weakening of the krona and the collapse of the financial system, so that convertibility of the krona was also suspended. The figures show a gradual move towards greater flexibility (coupled with a declining weight on the euro) for most of the sample and a peak in the euro weight in the last few windows.

The estimates for Switzerland present a fall in δ since 2000, while it remained fairly stable and significant for the rest of the period, around the value of 0.03. The weight on the euro has been slightly trending upwards until 2007-2008, reaching 1.0.

The Czech Republic adopted IT in 1998. Throughout the period the δ coefficient has been increasing, while the weight on the euro remained stable around 1.0, which makes it, as for Switzerland, interpretable as an informal reference currency. The same holds for Hungary from 2001 on, when it adopted IT. However, at the end of the sample, δ has been falling, which might be interpreted as a sign of the central bank intervening actively to defend the forint due to the weakening in the second half of 2008.

Confirming the results of the CR approach and the regressions, Poland, where inflation targeting has been introduced at the end of 1998[28] shows the highest and most stable δ coefficient among its fellow eastern European partners, the weight on euro does not show a clear trend and is significantly lower, around .4-.5.

Finally, Romania adopted inflation targeting in 2005. In this case the weight on the euro is increasing over the whole period, reaching 0.8 in the final part, while δ is slightly increasing.

[28] A crawling band actually remained in place until april 2000, but it had been widened to ±15% in march 1999, which made the band practically irrelevant (see also Golinelli, Rovelli [2004])

Table 10 - Frankel Approach with EMP = Δln(Res)

a. Period 1 - 1980-1992

	US	**Japan**	**Australia**	**New Zealand**	**Canada**
c	0.000	-0.006***	0.002	-0.002	0.000
	(0.002)	(0.002)	(0.003)	(0.005)	(0.001)
xeu	0.308**	0.480***	-0.217	-0.120	0.039
	(0.128)	(0.112)	(0.199)	(0.261)	(0.055)
usd		0.412***	0.818***	0.604***	0.921***
		(0.064)	(0.119)	(0.185)	(0.040)
jpy	0.507***		0.031	0.084	-0.026
	(0.100)		(0.144)	(0.224)	(0.037)
emp	0.112**	0.247***	0.084	0.036	-0.026***
	(0.046)	(0.073)	(0.051)	(0.041)	(0.006)
R^2	*0.372*	*0.510*	*0.505*	*0.249*	*0.895*
N	154	154	106	58	130

	Sweden	**Norway**	**Denmark**	**Switzerland**	**U.K.**	**Malta**	**Iceland**	
					1990-1992		*1983-1986*	*1987-1992*
c	-0.000		0.000	-0.002	0.004	-0.001**	0.011***	0.005***
	(0.001)		(0.001)	(0.001)	(0.003)	(0.000)	(0.003)	(0.001)
xeu	0.589***	0.586***	1.032***	0.949***	1.539***	0.439***		0.512***
	(0.090)	(0.073)	(0.081)	(0.094)	(0.371)	(0.034)		(0.124)
dem							1.742**	
							(0.864)	
ffr							-1.441	
							(0.862)	
usd	0.194***	0.155***	0.007	-0.066	0.115	0.285***	0.572***	0.245***
	(0.030)	(0.034)	(0.199)	(0.042)	(0.174)	(0.018)	(0.103)	(0.059)
jpy	0.030	0.073*	0.046	0.174***	-0.063	0.065***	-0.115	0.025
	(0.039)	(0.038)	(0.038)	(0.060)	(0.129)	(0.019)	(0.127)	(0.076)
emp	0.001	0.033**	0.002	0.020	0.194	0.038	0.112	0.044
	(0.012)	(0.013)	(0.009)	(0.015)	(0.119)	(0.026)	(0.072)	(0.032)
R^2	*0.824*	*0.714*	*0.888*	*0.712*	*0.793*	*0.921*	*0.681*	*0.539*
N	89	152	154	154	25	154	38	74

*** Statistically significant at 1%; ** statistically significant at 5%; * statistically significant at 10%.
Robust Standard Errors in parenthesis.

b. Period 2 - 1993-1998

	US	Japan	Australia	New Zealand	Canada	Sweden	Norway	Denmark
c	0.001	-0.010	0.001	0.000	0.003**	0.001	0.001	0.000
	(0.001)	(0.004)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
dem		1.043***					0.775***	
		(0.416)					(0.227)	
ffr		-0.649					0.110	
		(0.427)					(0.246)	
xeu	0.377***		-167	0.127	-0.061	0.860		1.131***
	(0.097)		(0.149)	(0.137)	(0.095)	(0.166)		(0.055)
usd		0.492**	0.834***	0.758***	1.000	0.215	0.250*	-0.009
		(0.192)	(0.135)	(0.076)	(0.052)	(0.133)	(0.136)	(0.049)
jpy	0.241***		0.107	0.177***	-0.009	0.004	-0.081	0.058
	(0.062)		(0.083)	(0.032)	(0.045)	(0.054)	(0.043)	(0.025)
emp	0.354***	0.546***	0.177***	0.032	-0.059	0.022	-0.007	-0.009
	(0.102)	(0.118)	(0.053)	(0.023)	(0.018)	(0.025)	(0.025)	(0.012)
R^2	*0.538*	*0.556*	*0.558*	*0.654*	*0.854*	*0.547*	*0.745*	*0.859*
N	*72*	*72*	*72*	*96*	*84*	*74*	*48*	*72*

	Czech Rep.	Cyprus	Malta		Hungary	Switzerland	U.K.	Iceland
	1993-1997		1993-1995	1996-1998				
c	0.002	0.000	0.000	0.001	0.011***	-0.001	-0.001	0.001
	(0.003)	(0.001)	(0.001)	(0.006)	(0.001)	(0.001)	(0.001)	(0.002)
dem	0.848***	0.528***	0.464***	-0.719		0.679***		
	(0.217)	(0.166)	(0.129)	(0.687)		(0.197)		
ffr	-0.076	0.205	0.071	1.077		0.343		
	(0.222)	(0.153)	(0.180)	(0.684)		(0.210)		
xeu					0.646***		0.812***	0.744***
					(0.077)		(0.185)	(0.190)
usd	0.407***	0.111***	0.235***	0.269	0.489***	-0.096	0.294***	0.203
	(0.093)	(0.033)	(0.055)	(0.282)	(0.094)	(0.079)	(0.087)	(0.125)
jpy	-0.079	0.012	-0.018	-0.123	-0.046	0.104	0.033	0.021
	(0.119)	(0.019)	(0.036)	(0.269)	(0.068)	(0.036)	(0.042)	(0.050)
emp	0.009	0.003	0.014	0.565*	0.088**	0.060**	0.227***	0.004
	(0.021)	(0.009)	(0.017)	(0.285)	(0.037)	(0.030)	(0.059)	(0.008)
R^2	*0.677*	*0.919*	*0.808*	*0.411*	*0.629*	*0.843*	*0.776*	*0.556*
N	*60*	*72*	*36*	*36*	*72*	*72*	*74*	*72*

b. Period 2 (continued)

	Poland	**Romania**	**Latvia**	**Lithuania**	**Slovak Rep.**	**Estonia**	**Slovenia**
c	-0.003	0.026***	0.000	-0.000	0.002	0.000	0.004***
	(0.005)	(0.006)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
dem			0.310***	0.005		1.175***	
			(0.098)	(0.009)		(0.150)	
ffr			-0.037	-0.006		-0.206	
			(0.098)	(0.009)		(0.149)	
xeu	0.678***	0.860*			0.895***		1.164***
	(0.164)	(0.445)			(0.148)		(0.080)
usd	0.389***	0.049	0.446***	0.995***	0.380***	-0.011	-0.142*
	(0.134)	(0.578)	(0.024)	(0.004)	(0.099)	(0.046)	(0.076)
jpy	0.042	-0.166	0.168***	1	-0.044	0.097	0.090**
	(0.075)	(0.141)	(0.000)	(0.001)	(0.052)	(0.175)	(0.037)
emp	0.241*	0.278***	0.010	0.000	0.023	-0.017	-0.010
	(0.121)	(0.081)	(0.010)	(0.001)	(0.015)	(0.013)	(0.019)
R^2	*0.613*	*0.277*	*0.951*	*1.000*	*0.671*	*0.939*	*0.827*
N	*42*	*71*	*48*	*48*	*72*	*72*	*72*

c. Period 3 - 1999-2009

	US	Japan	Australia	New Zealand	Canada	Sweden
c	0.000	-0.008***	-0.001	-0.000	-0.003**	0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)
eur	0.359***	0.180**	0.613***	0.580***	0.208**	0.783***
	(0.074)	(0.073)	(0.110)	(0.131)	(0.082)	-85
usd		0.728***	0.108	0.052	0.659***	-0.132
		(0.091)	(0.128)	(0.112)	(0.090)	(0.091)
jpy	0.454***		-0.057	-0.037	-0.018	0.074
	(0.028)		(0.099)	(0.085)	(0.079)	(0.082)
emp	0.687***	0.633***	0.049*	0.071**	0.377***	0.073***
	(0.141)	(0.100)	(0.025)	(0.035)	(0.072)	(0.027)
R^2	*0.829*	*0.715*	*0.270*	*0.246*	*910*	*0.639*
N	*122*	*122*	*122*	*122*	*122*	*122*

	Czech R.	Norway		Denmark	Switzerland	Iceland	U.K.
		1999-2000	2001-2009				
c	-0.004***	-0.001	0.000	0.0000	-0.000	0.002	0.001
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.004)	(0.001)
eur	0.842***	0.503***	0.668***	1.035***	0.917***	0.582*	0.650***
	(0.097)	(0.075)	(0.068)	(0.024)	(0.075)	(0.336)	(0.220)
usd	-0.030	0.305***	0.291***	-0.016	0.028	0.425**	0.487***
	(0.095)	(0.102)	(0.058)	(0.010)	(0.058)	(0.207)	(0.100)
jpy	-0.013	0.041	-0.017	0.004	0.156***	-0.613***	0.030
	(0.051)	(0.066)	(0.041)	(0.011)	(0.054)	(0.204)	(0.040)
emp	0.261**	0.347***	0.653***	0.003	0.086**	0.083**	0.130***
	(0.113)	(0.062)	(0.058)	(0.005)	(0.043)	(0.039)	(0.040)
R^2	*0.693*	*0.866*	*0.828*	*0.985*	*0.840*	*0.225*	*0.593*
N	*122*	*25*	*97*	*122*	*122*	*122*	*122*

c. Period 3 (continued)

	Poland		**Romania**		**Hungary**		**Cyprus**	**Malta**	
	99-00	01-09	99-05	05-09	99-01	01/09/09	1999-2007	99-04	05-07
c	-0.005	-0.003	0.014***		-0.002	0.002	0.000	0.000	-0.000
	(0.004)	(0.002)	(0.003)		(0.003)	(0.002)	(0.001)	(0.000)	(0.000)
eur	0.510***	0.369***	0.436**	0.801***	0.919***	1.215***	0.907***	0.545***	0.971***
	(0.163)	(0.090)	(0.182)	(0.214)	(0.094)	(0.182)	(0.029)	(0.023)	(0.050)
rur	0.299**	0.378***							
	(0.135)	(0.076)							
usd	0.203	-0.053	0.361**	0.042	0.214	-0.171*	-0.005	0.174***	-0.029
	(0.316)	(0.102)	(0.178)	(0.128)	(0.148)	(0.095)	(0.026)	(0.028)	(0.026)
jpy	-0.147	-0.021	-0.008	-0.092	-0.028	-0.134	0.004	0.011	0.019
	(0.136)	(0.079)	(0.100)	(0.126)	(0.115)	(0.092)	(0.014)	(0.017)	(0.027)
emp	0.475	0.529***	0.014	0.344	0.119	0.141	-0.001	-0.015	0.001
	(0.097)	(0.064)	(0.042)	(0.105)	(0.078)	(0.053)	(0.005)	(0.020)	(0.008)
R^2	*0.768*	*0.715*	*0.193*	*0.614*	*0.779*	*0.619*	*0.939*	*0.921*	*0.940*
N	*24*	*98*	*71*	*51*	*29*	*92*	*108*	*72*	*36*

	Latvia		**Lithuania**		**Slovak Rep.**		**Estonia**	**Bulgaria**	**Slovenia**
	1999-2005	2005-2009	1999-2002	2002-2009	1999-2005	2005-2008			1999-2006
c	-0.000	0.000	-0.000	-0.001	-0.001	-0.007**	0.000	-0.000	0.002
	(0.000)	(0.001)	(0.000)	(0.001)	(0.002)	(0.003)	(0.000)	(0.001)	(0.001)
eur	0.203***	0.885***	0.002	0.849***	0.697***	0.959***	1.025***	1.026***	0.887***
	(0.022)	(0.067)	(0.002)	(0.069)	(0.096)	(0.061)	(0.016)	(0.035)	(0.053)
rur	0.069*	0.040							
	(0.037)	(0.036)							
usd	0.383***	-0.041	1.002***	-0.045	-0.008	0.025	-0.024	-0.015	-0.019
	(0.039)	(0.068)	(0.004)	(0.052)	(0.088)	(0.119)	(0.016)	(0.017)	(0.054)
jpy	0.107***	0.122***	-0.002	0.087**	0.010	-0.016	0.001	-0.007	0.004
	(0.023)	(0.042)	(0.002)	(0.042)	(0.056)	(0.088)	(0.004)	(0.012)	(0.036)
emp	0.003	-0.013	0.002	0.010	0.000	0.050	0.001	0.011	0.031
	(0.008)	(0.020)	(0.001)	(0.015)	(0.016)	(0.093)	(0.004)	(0.011)	(0.026)
R^2	*0.915*	*0.896*	*1.000*	*0.879*	*0.500*	*0.720*	*0.939*	*0.952*	*0.816*
N	*71*	*51*	*37*	*85*	*81*	*38*	*122*	*122*	*84*

*** Statistically significant at 1%; ** statistically significant at 5%; * statistically significant at 10%. Robust Standard Errors in parenthesis.

Table 11. Frankel Approach with EMP = Δ Res / MB

a. Period 1 - 1980-1992

	Australia	**New Zealand**	**Canada**	**U.K.**	**Norway**	**Switzerland**
c	0.001	-0.003	0.001	0.004	-0.001	-0.000
	(0.003)	(0.005)	(0.001)	(0.003)	(0.001)	(0.001)
dem						0.948***
						(0.120)
ffr						-0.056
						(0.127)
xeu	-0.231	-0.100	0.284***	1.069***	0.443***	
	(0.194)	(0.254)	(0.063)	(0.215)	(0.060)	
usd	0.789***	0.599***	0.531***	0.110	0.263***	-0.050
	(0.115)	(0.187)	(0.055)	(0.146)	(0.026)	(0.044)
jpy	0.055	0.089	0.107***		0.103***	0.120**
	(0.138)	(0.230)	(0.038)		(0.032)	(0.048)
emp	0.211***	0.065	0.645***	0.085	0.419***	0.024
	(0.076)	(0.049)	(0.086)	(0.123)	(0.069)	(0.015)
R^2	*0.545*	*0.262*	*0.916*	*0.815*	*0.814*	*0.787*
N	*106*	*58*	*130*	*25*	*152*	*154*

*** Statistically significant at 1%; ** statistically significant at 5%; * statistically significant at 10%. Robust Standard Errors in parenthesis.

b. Period 2 – 1993-1998

	Australia	**New Zealand**	**Canada**	**U.K.**	**Sweden**	**Switzerland**	**Norway**	**Poland**
c	0.001	0.001	0.000	-0.001	0.001	-0.001	0.001	-0.008
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.006)
dem						0.694***		
						(0.201)		
ffr						0.343		
						(0.214)		
xeu	-0.078	0.125	0.180***	0.652***	0.826***		0.999***	0.742***
	(0.133)	(0.133)	(0.066)	(0.078)	(0.168)		(0.102)	(0.241)
usd	0.757***	0.752***	0.606***	0.323***	0.236*	-0.110	0.153	0.300
	(0.120)	(0.076)	(0.062)	(0.071)	(0.133)	(0.077)	(0.093)	(0.206)
jpy	0.122*	0.180***	0.100***		0.006	0.102***	-0.011	0.040
	(0.069)	(0.051)	(0.030)		(0.054)	(0.036)	(0.037)	(0.081)
emp	0.310***	0.092**	0.697***	0.269***	0.003	0.029	0.167*	0.378**
	(0.079)	(0.041)	(0.077)	(0.058)	(0.017)	(0.021)	(0.093)	(0.175)
R^2	*0.642*	*0.668*	*0.909*	*0.897*	*0.542*	*0.839*	*0.744*	*0.654*
N	*72*	*96*	*84*	*74*	*74*	*74*	*48*	*42*

*** Statistically significant at 1%; ** statistically significant at 5%; * statistically significant at 10%. Robust Standard Errors in parenthesis.

c. Period 3 – 1999-2009

	Australia	**New Zealand**	**Canada**	**Sweden**	**Norway**		**Czech Rep.**
					1999-2000	2001-2009	
c	-0.001	-0.001	-0.001**	0.001	-0.001	-0.000	-0.004
	(0.002)	(0.002)	(0.000)	(0.001)	(0.002)	(0.001)	(0.002)
eur	0.615***	0.462***	0.296***	0.810	0.503***	0.668***	0.910***
	(0.110)	(0.117)	(0.027)	(0.086)	(0.075)	(0.058)	(0.151)
usd	0.112	0.055	0.440***	-0.155	0.305***	0.291***	-0.143
	(0.128)	(0.103)	(0.020)	(0.095)	(0.102)	(0.058)	(0.087)
jpy	-0.065	0.010	0.137***	0.067	0.041	-0.017	-0.048
	(0.100)	(0.077)	(0.017)	(0.084)	(0.066)	(0.041)	(0.076)
emp	0.046*	0.247***	0.985***	0.029*	0.347***	0.653	0.050
	(0.024)	(0.079)	(0.020)	(0.016)	(0.062)	(0.058)	(0.044)
R^2	*0.270*	*0.363*	*0.975*	*0.623*	*0.866*	*0.828*	*0.598*
N	*122*	*122*	*122*	*122*	*25*	*97*	*122*

	Hungary		**Poland**		**Romania**		**U.K.**	**Switzerland**
	1999-2001	2001-2009	1999-2000	2001-2009	1999-2005	2005-2009		
c	-0.000	0.002	-0.005	-0.003	0.014***	-0.006**	-0.001	-0.000
	(0.003)	(0.003)	(0.004)	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)
eur	0.932***	1.263***	0.510***	0.369***	0.436**	0.801***	0.458***	0.929***
	(0.086)	(0.200)	(0.163)	(0.090)	(0.182)	(0.214)	(0.065)	(0.077)
rur			0.299**	0.378***				
			(0.135)	(0.076)				
usd	0.137	-0.186*	0.203	-0.052	0.361**	0.042	0.410***	0.011
	(0.134)	(0.099)	(0.316)	(0.102)	(0.177)	(0.128)	(0.069)	(0.057)
jpy	-0.021	-0.162	-0.147	-0.021	-0.008	-0.093		0.160***
	(0.118)	(0.099)	(0.136)	(0.079)	(0.100)	(0.105)		(0.055)
emp	0.016	0.078**	0.475***	0.529***	0.014	0.344***	0.267***	0.060**
	(0.036)	(0.032)	(0.097)	(0.064)	(0.042)	(0.105)	(0.079)	(0.029)
R^2	*0.757*	*0.590*	*0.768*	*0.491*	*0.193*	*0.615*	*0.775*	*0.834*
N	*29*	*92*	*24*	*98*	*71*	*51*	*122*	*122*

*** Statistically significant at 1%; ** statistically significant at 5%; * statistically significant at 10%. Robust Standard Errors in parenthesis.

7. Conclusions

This paper discussed the issue of exchange rate flexibility in European countries than are not in the EMU using two approaches recently developed by the literature on exchange rate regime classification, namely Calvo and Reinhart [2002] and Frankel and Wei [2008]. The starting point was the observation that official regimes, from the point of view of exchange rate management, are moving towards a polarization: either free floats, coupled with Inflation Targeting, or pegs. However, empirical works cited in this paper proved that the official label of the regime is not always an accurate description of what countries do in practice. I wanted to see whether this is the case also in Europe, especially since the creation of a large, neighbouring currency union might provide, for this group of small open economies, a natural anchor.

The results obtained by the CR and the FW approaches in this paper are generally consistent, and the conclusions are quite mixed.

Fixed exchange rate arrangements have shown substantial stability across countries and, in particular, during the euro era. In some cases, however, when the euro is the formal anchor, we can see that indeed some weight on the US Dollar or the Yen is present (for example, in Latvia and Lithuania after they joined the ERMII).

Inflation Targeting regimes in Europe appear to have brought about an increase in exchange rate flexibility, although generally not to a level comparable to that of the benchmark floaters; however, some weight on euro exchange rate stabilization seems to have remained in place: first of all, bilateral exchange rate volatility is much lower than that which has been observed for benchmark floaters and for non-European IT regimes. This is true, in particular, for Sweden, Switzerland and the Czech Republic. Second, European IT countries all made extensive use of foreign exchange reserves, more than both free floaters like the USA and Japan, and also more than an Inflation Targeter as Canada. Only Australia and New Zealand, among our set of non-European countries, showed substantial reserves volatility, but for reasons different from those that would be implied by exchange rate management[29]. The shift from fixed exchange rates to IT brought about lower reserve volatility but still not to a level comparable with that of benchmark floaters. As it is not clear why the Central Bank of an IT country would make such extensive use of foreign exchange reserves, the interpretation of this result should be further explored.

The FW approach in Section 6 showed that some weight on exchange rate stabilization might indeed have been put by all Inflation Targeting Central Banks. This result apparently contradicts the statement (see Svensson [2003], Taylor [2001] and Ball and Reyes[2008], for example) that Inflation Targeting regimes should not, and do not, have exchange rate objectives separate from that of inflation control.

In order to observe the evolution of both exchange rate flexibility and the weights given to foreign currencies when structural breaks are not present, I also estimated the FW regressions for IT countries using 5-year rolling windows. As far as Europe is concerned, the results show both a low exchange rate flexibility index and a high weight on the euro which, in most

[29] See above (p. 18).

of the cases, was not statistically different from unity. Towards the end of the sample, when the financial instability that characterized the last months of 2008 increased the pressure on small currencies, this showed up as a drop in the "weight" of the euro and – except for Hungary – a stable or even higher flexibility coefficient, showing that exchange rate stabilization was not a primary concern of Central Banks in this context. Rather, as it appears from the Sveriges Riksbank's bulletin cited in section 7, they might have enjoyed the benefits of having a weaker currency in a period of economic crisis.

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APPENDIX A – The composition of the SDR from 1980 to 2009

The SDR (Special Drawing Rights) is an international reserve asset created by the IMF in the 1969 that is composed as a basket of the major international currencies. The weights are updated every 5 years. The following table summarizes the SDR composition during 1980-2009.

	1981-85	1986-90	1991-95	1996-98	1999-00	2001-05	2006-10
U.S. Dollar	0.42	0.42	0.40	0.39	0.39	0.45	0.45
Euro					0.32	0.29	0.34
German Mark	0.19	0.19	0.21	0.21			
French Franc	0.13	0.12	0.11	0.11			
Japanese Yen	0.13	0.15	0.17	0.18	0.18	0.15	0.11
U.K. Pound	0.13	0.11	0.11	0.11	0.11	0.11	0.11

Figure 1. The Calvo – Reinhart Approach

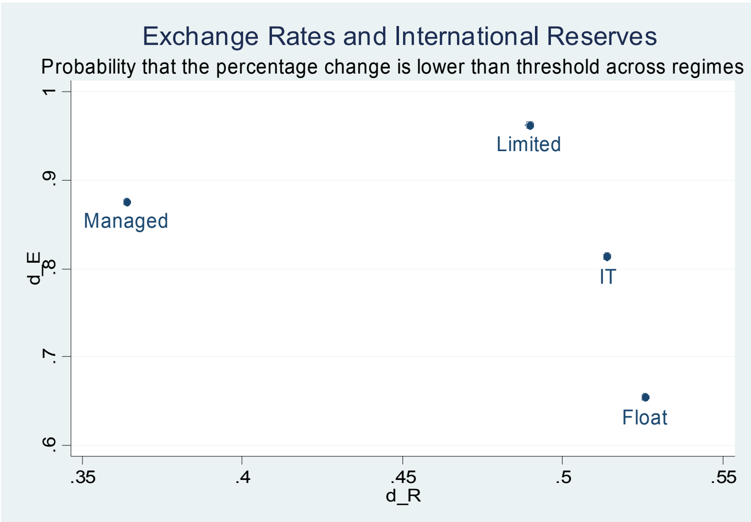
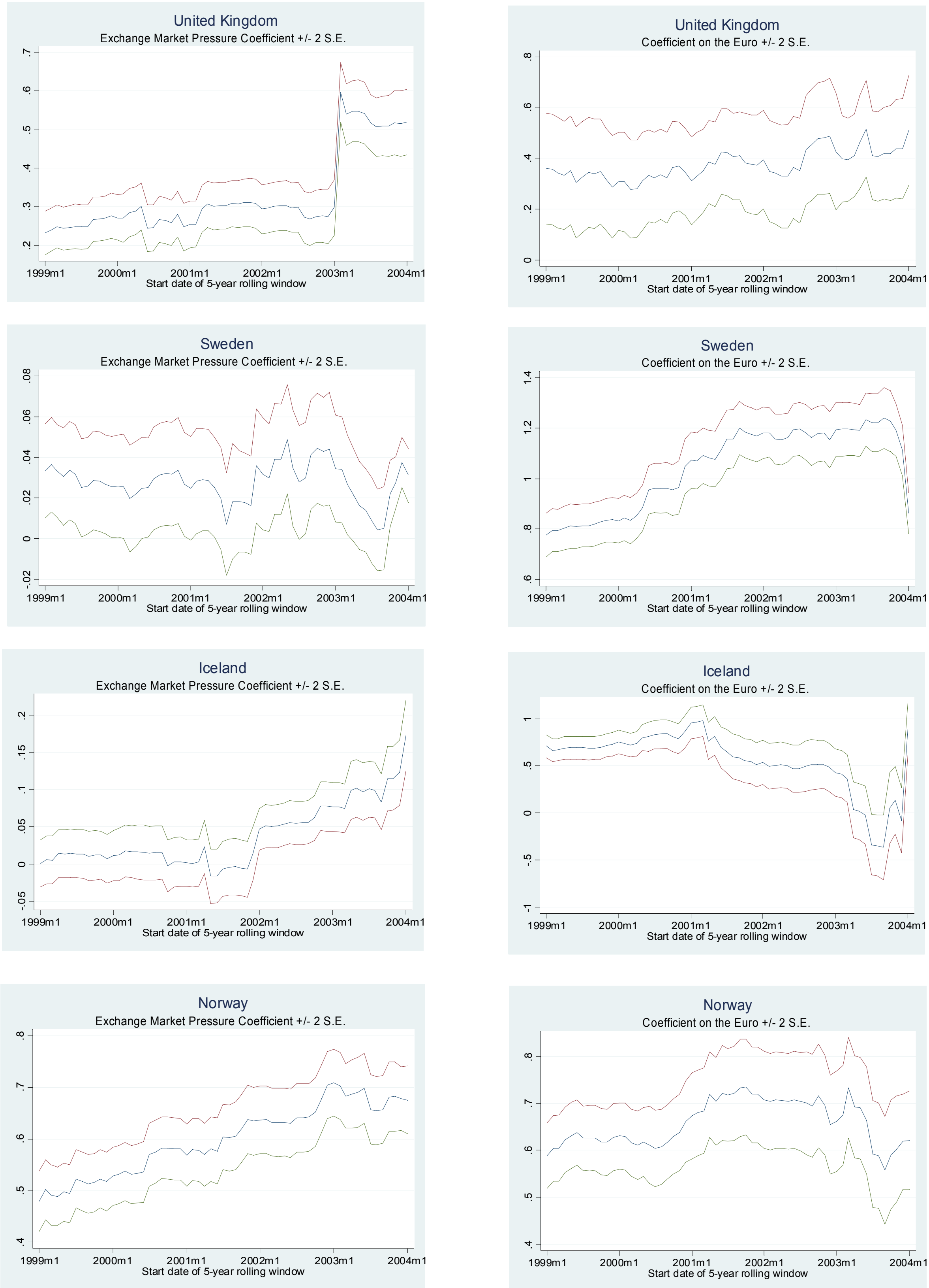
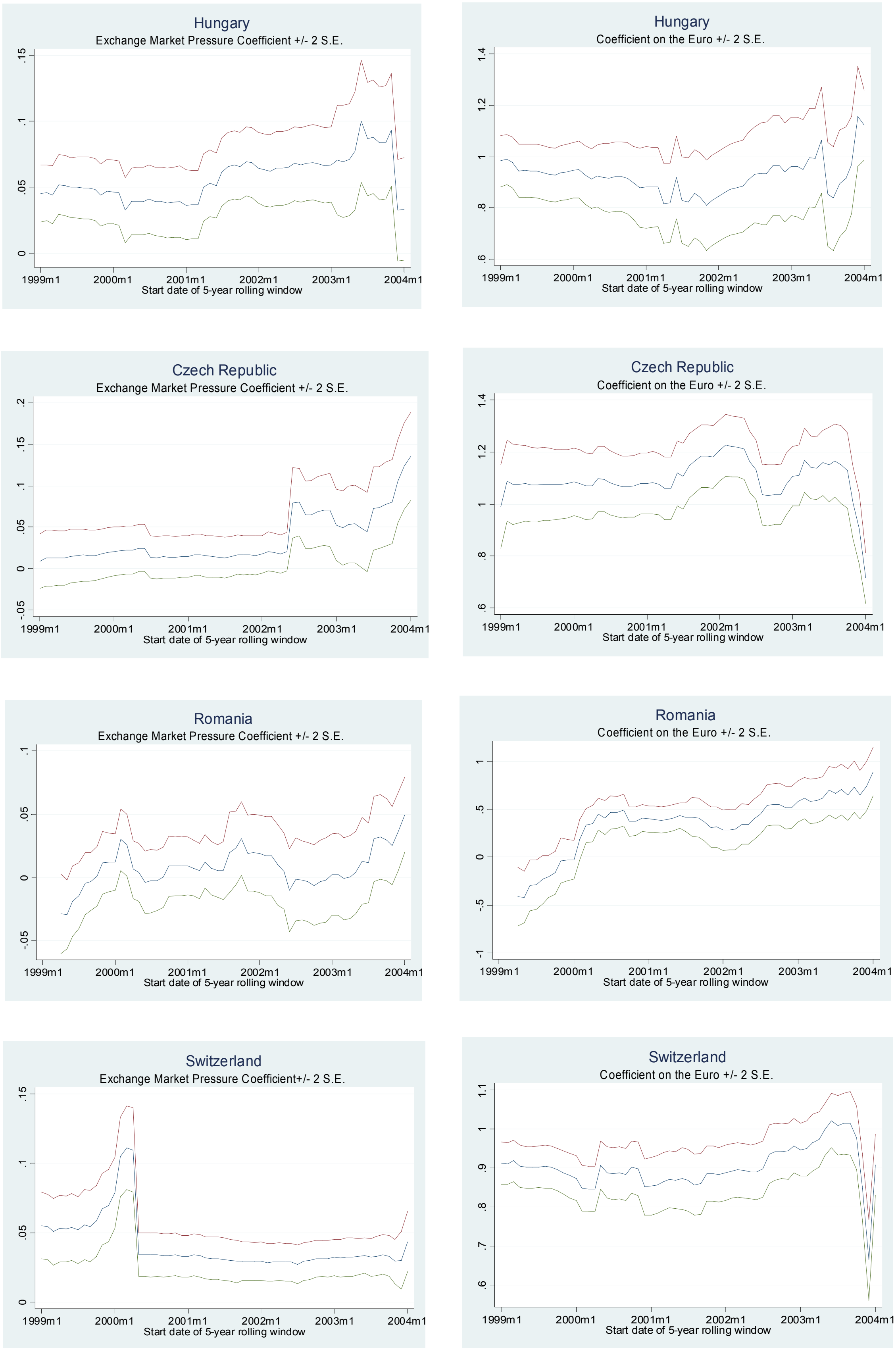


Figure 2. The Frankel and Wei approach using Rolling windows regression



(Figure 2 - continued)



(Figure 2 - continued)