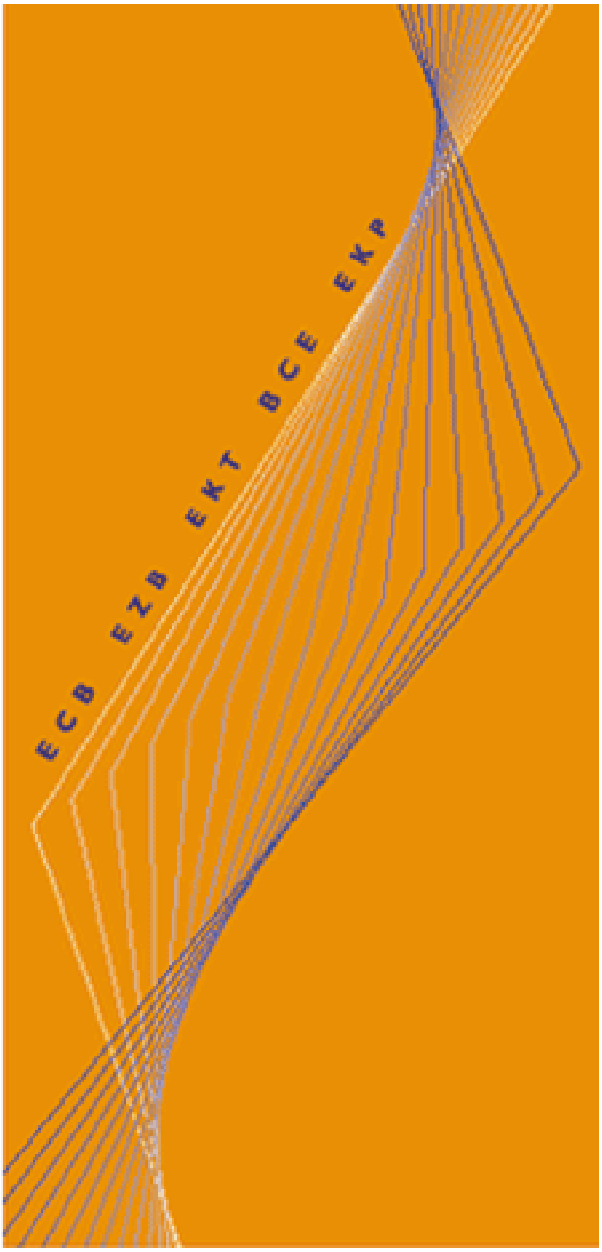
EUROPEAN CENTRAL BANK

WORKING PAPER SERIES



WORKING PAPER NO. 154

THE EURO BLOC, THE DOLLAR BLOC AND THE YEN BLOC: HOW MUCH MONETARY POLICY INDEPENDENCE CAN EXCHANGE RATE FLEXIBILITY BUY IN AN INTERDEPENDENT WORLD?

BY MARCEL FRATZSCHER

June 2002

EUROPEAN CENTRAL BANK

WORKING PAPER SERIES

WORKING PAPER NO. 154

THE EURO BLOC, THE DOLLAR BLOC AND THE YEN BLOC: HOW MUCH MONETARY POLICY INDEPENDENCE CAN EXCHANGE RATE FLEXIBILITY BUY IN AN INTERDEPENDENT WORLD?

BY MARCEL FRATZSCHER*

June 2002

* *Comments are very welcome to the author at: European Central Bank, Kaiserstrasse 29, D-60311 Frankfurt, Germany; marcel.fratzscher@ecb.int* *I would like to thank Gonzalo Camba-Méndez, Michael Ehrmann, Simone Manganelli, John Williamson and a referee for useful suggestions and participants of the CFS/Deutsche Bundesbank/ECB Joint Lunchtime Seminar series and the conference on "Regional Currency Areas" at ECLAC in Santiago, Chile, for comments. The views expressed in this paper are those of the author and do not necessarily represent those of the European Central Bank.*

Address	**Kaiserstrasse 29**
	D-60311 Frankfurt am Main
	Germany
Postal address	**Postfach 16 03 19**
	D-60066 Frankfurt am Main
	Germany
Telephone	**+49 69 1344 0**
Internet	**http://www.ecb.int**
Fax	**+49 69 1344 6000**
Telex	**411 144 ecb d**

ISSN 1561-0810

Contents

Abstract

The paper analyses the trade-off between exchange rate flexibility and monetary policy autonomy. It tests empirically the "Possible Duality" hypothesis, i.e. whether countries with more flexible currency regimes are indeed able to exert more monetary policy autonomy than those with less flexible ones, and whether moving towards exchange rate flexibility allows countries to gain monetary independence. The results for a set of open emerging markets and ERM countries show no systematic link between exchange rate flexibility and monetary independence. It is also found that the Fed is still the dominant force in world capital markets, although the importance of EU monetary policy decisions has been increasing and a Euro bloc has formed in Europe.

JEL no. F41, F31, E50.
Keywords: exchange rate regime, monetary policy, international transmission, GARCH, error correction model.

Non-Technical Summary

Economists often emphasize the existence of the "Impossible Trinity", i.e. the inability of a country to have open capital markets, fixed exchange rates *and* an independent monetary policy simultaneously. But it has been assumed that a government can pursue *any two* of these policy objectives; in particular, that an open economy can exert full monetary independence if it only lets its exchange rate float. Examining whether this assumption of the "Possible Duality" really holds is the key motivation for this paper.

More specifically, the paper tests empirically for a broad set of developed countries and emerging markets whether countries with more flexible currency regimes are indeed able to exert more monetary policy autonomy than those with less flexible ones, and whether moving towards exchange rate flexibility allows countries to gain monetary independence.

The trade-off issue implicit in the "Possible Duality" hypothesis has important implications for policy as there has been a tendency in all regions of the world over the past decade to move away from intermediate exchange rate regimes and adopt either irreversibly fixed or freely floating currency regimes. The move towards more flexible exchange rate regimes has been motivated to a large extent by the hope that giving up an explicit exchange rate target would allow policy-makers to exert a greater degree of monetary policy autonomy by focusing its monetary policy decisions on domestic economic objectives.

As its theoretical motivation, the paper builds on the literature of target zone models, which takes as a key assumption an uncovered interest parity condition. Applying this argument to the exchange rate – monetary policy nexus in the context of the paper, interest rates may diverge persistently under a flexible exchange rate regime if the domestic policies are credible and the authority primarily targets domestic variables such as inflation and output. By contrast, a monetary authority may not enjoy much monetary autonomy even under a more flexible exchange rate regime if it lacks credibility or if the economy is highly integrated with a large economy such as the US or the euro area.

For the empirical implementation, the paper applies a dynamic GARCH model and an error correction model (ECM) framework, using daily interest rate data for a set of 12 emerging markets and 16 developed countries. Overall, the analysis finds that adopting a more flexible exchange rate regime has not allowed countries to raise their degree of monetary policy autonomy. All of the analyzed emerging markets that faced a financial crisis in the 1990s experienced a greater dependence on interest rate changes in the US or the euro area following the crisis, and this in spite of switching mostly to more flexible currency regimes.

Moreover, it is found that there has been a polarization of monetary policy dominance in the world. A "Dollar bloc" exists in Latin America and in Asia as interest rates in both regions are dominated strongly by US monetary policy. In contrast, a "Euro bloc" has been forming in Europe as the importance of monetary policy from the euro area has been increasing over time, whereas the relevance of US interest rate changes has declined.

One interpretation of these empirical results is that moving from a fixed to a flexible exchange rate regime alone may not be sufficient to raise the degree of monetary autonomy. What may be required in addition to adopting a flexible exchange rate arrangement are credibility and a track record to establish a reputation in financial markets. An alternative, though partly complementary explanation of the findings is that it has been the rising degree of financial and real integration among economies which has also led to an increased interdependence of interest rate movements. What this may indicate is that in an increasingly interdependent world we are moving from an "Impossible Trinity" to an "Impossible Duality", i.e. even under flexible exchange rate arrangements it becomes ever more difficult for countries to exert independent and truly autonomous monetary policy.

1 Introduction

Economists in recent years have been rather religious about emphasising the existence of the "Impossible Trinity", i.e. the inability of a country to have open capital markets, fixed exchange rates *and* an independent monetary policy simultaneously. At the same time, it is often assumed that the "Possible Duality" holds, i.e. that a government can pursue *any two* of these policy objectives; in particular, that a central bank in an open economy can exert full monetary independence if it only lets its exchange rate float. Examining whether this assumption of the "Possible Duality" really holds is the key motivation for this paper.

The 1990s experienced a trend away from intermediate exchange rate regimes (pegs, crawls and bands) and towards the two extremes of the currency regime spectrum. Fixed but adjustable exchange rate regimes were widely seen as a culprit behind the Asian financial crisis, where most of the affected countries had such intermediate regimes. In essence, the main critique of intermediate currency regimes is that they do not provide a sufficiently credible and sustainable nominal anchor. Not only do intermediate regimes leave little or no room for domestic monetary policy, but they constitute a target for speculative attacks. It has also been argued that these types of regimes tend to worsen financial sector fragility by encouraging foreign borrowing and capital inflows that leave the domestic financial sector exposed and vulnerable to external shocks (e.g. Mishkin 1999).

Partly as a result of the various emerging market crises of the 1990s, many developing countries moved to either extreme of the currency regime spectrum. A number of countries adopted a currency board regime or even dollarized their economy with the hope that "tying one's own hands" would allow them to gain sufficient credibility to tie down inflation expectations. This, in turn, was hoped to lower country and currency risk premia in order to reduce domestic inflation and enable the domestic economy to gain access to foreign capital at affordable rates.

The success of irrevocably fixed regimes, however, has been mixed at best. Even countries under currency board arrangements, such as Argentina and Hong Kong, were not spared from speculative attacks and significant economic downturns in the 1990s. For Argentina, the currency board system may even have been one of the key factors behind the severe recession and eventual financial collapse in 2002. A key drawback of irreversibly fixed exchange rates is that they leave economies strongly exposed to external shocks and give governments virtually no ability to adjust monetary policy to domestic needs. A second disadvantage can be the irreversibility: "locking oneself into a cell" can provide substantial benefits through increased credibility and lower financing costs. But currency board regimes are also tantamount to "throwing away the key of the cell", making it difficult and very costly to change the nominal anchor once this becomes appropriate, as in the recent case of Argentina.

On the other extreme, the adoption of floating exchange rate regimes by several emerging markets in recent years seems to have been a more popular alternative. This move towards flexible currency arrangements can in part be understood as an attempt by policy-makers to gain more autonomy and flexibility in directing monetary policy towards domestic policy goals. After floating their currencies in the 1990s, Brazil, Chile, Colombia, Mexico in Latin America and Poland and the Czech Republic in Europe adopted inflation targeting frameworks to provide a clearly visible nominal anchor.[1] Many of the Asian economies have also formally adopted a floating currency regime since the Asian financial crisis but many do not quantify their policy targets.

The central question analysed in this paper is whether adopting floating exchange rate regimes has really allowed countries to gain monetary autonomy. Both on theoretical and on empirical grounds, it is not clear whether countries can indeed gain a substantial degree of monetary independence by switching from fixed to floating exchange rate arrangements. On the theoretical side, the extent to which a country may gain monetary policy autonomy crucially depends on factors like the credibility and capability of its policy-makers and institutions, external factors such as the confidence of international investors in global financial markets, and the degree of real and financial integration with large, dominant markets such as the US, the euro area or Japan.

There has also been no compelling evidence on the empirical side to support the assertion of a link between exchange rate flexibility and monetary autonomy. Hausman et al. (1999) find that interest rates in countries with floating exchange rate regimes are as dependent on and responsive to US monetary policy shocks as are those countries with fixed currency regimes. Using daily data for 1998-99, they for instance show that Mexico's interest rate reaction to US shocks was stronger than that of other Latin American countries with far less exchange rate flexibility.

Frankel (1999) and Frankel et al. (2000) look at a broad sample of markets for 1970-2000 and also fail to detect a strong link between exchange rate flexibility and interest rate autonomy for the 1990s. Although they do find some connection between interest rate insularity and exchange rate flexibility for the 1970s and 1980s, these results are not conclusive as they include countries with very different degrees of market openness. Finally, Borensztein, Zettelmeyer and Philippon (2001) show that Singapore's Monetary Authority has enjoyed more independence in determining domestic interest rates than Hong Kong under its currency board system. But they also detect no evidence that Mexico was any more autonomous in setting domestic monetary policy than Argentina under its currency board system.

There are two possible reasons for a lack of evidence for a currency regime – monetary independence nexus. The first one is that such a causal link may not exist for countries whose policies lack credibility and are closely interdependent with a large and dominant economy like the US or the euro area. Alternatively, the lack of empirical evidence for such a link may be explained by the fact that regimes that are officially classified as "floating" may in fact not be as flexible. This could be due to policy-makers' "fear of floating", i.e. their reluctance to float their exchange rate freely because of their concern for the effect of a depreciation on foreign exchange liabilities and exchange rate pass-through (Calvo and Reinhart 2000, Hausman et al. 1999). The analysis in this paper here will try to avoid this specification problem by looking at a small sample of countries that are relatively transparent about their policy regimes.

[1] See for instance Bernanke et al. (1999) and Mishkin and Savastano (2000) for a discussion and international review of the limitations and dangers of inflation targeting under floating exchange rates.

The contribution this paper aims to make to the existing literature is twofold. First, the paper distinguishes the effects of monetary policy in the USA from those of monetary policy changes originating in the euro area and in Japan. It tests explicitly whether the spheres of monetary policy dominance in the world can be separated into a "Euro bloc", a "Dollar bloc" and a "Yen bloc". The second objective of the paper is to propose a more appropriate empirical methodology, based on generalised autoregressive conditional heteroskedasticity (GARCH) model and error correction model (ECM) frameworks with daily data, to investigate the monetary autonomy – exchange rate regime nexus.

As its theoretical motivation, the paper builds on the literature of target zone models (Bertola and Svensson, 1993; Svensson, 1994), which takes as a key assumption an uncovered interest parity condition. The central argument of target zone models is that a target zone allows for a temporary deviation of domestic from foreign interest rates, if the target zone is credible. Applying this argument to the exchange rate – monetary policy nexus in the context of the paper, interest rates may diverge persistently under a flexible exchange rate regime if the domestic policies are credible and the authority primarily targets domestic variables such as inflation and output. By contrast, a monetary authority may not enjoy much monetary autonomy even under a more flexible exchange rate regime if it lacks credibility or if the economy is highly integrated with a large economy such as the US or the euro area.

Turning to the empirical implementation, it is imperative to take into account the specific characteristics of interest rate data, in particular issues relating to nonstationarity, heteroskedasticity and serial correlation. Many papers on the currency regime – monetary autonomy link ignore these issues, making their results questionable. To address these econometric issues and also to better capture the dynamics of the transmission of interest rates shocks, the paper applies a dynamic GARCH model and an error correction model (ECM) framework, using daily interest rate data for a set of 12 emerging markets and 16 developed countries.

The model is specified in a way that not only US monetary shocks but also euro area and Japanese monetary shocks may influence interest rates in individual countries. This specification allows to analyse the question of whether one can identify different regions of influence: a "Dollar bloc", a "Euro bloc" and a "Yen bloc", referring to the regions where monetary policy decisions by the different central banks are dominant in determining monetary policy and market interest rates. Using GARCH and ECM methodologies with daily data over a longer period allows testing whether such spheres of influence exist and whether they have changed over time. The findings have implications both for the adoption of monetary regimes in emerging markets and accession countries as well as for monitoring and evaluation of such developments at the European Central Bank, the Federal Reserve and the Bank of Japan.

The following section of the paper introduces the analytical framework used for the empirical estimation. It presents the basic theoretical motivation and formulates various hypotheses to determine the degree of monetary policy independence. Data characteristics and the empirical methodology are discussed subsequently. Section 3 outlines the results of the empirical estimations. Particular emphasis is given to the question of how the degree of monetary autonomy differs across currency regimes and how it has changed over time for countries that switched from fixed to flexible regimes. Conclusions and policy implications follow in section 4.

2 Theoretical motivation and empirical methodology

2.1 Defining monetary policy autonomy

The question of what defines the degree of monetary policy autonomy has been approached in several different ways in the literature. One strand of the literature identifies domestic monetary policy reaction functions with the goal to then test whether monetary policy primarily targets domestic variables or whether domestic interest rates are mainly influenced by foreign monetary policy decisions. For instance, Clarida, Gali and Gertler (1998, 2000) and Ball (1999, 2000) use monetary policy reaction functions for which they test for OECD countries whether domestic interest rates are driven by domestic output gaps and expected deviations from optimal inflation, or if they are influenced by foreign monetary policy decisions.

The advantage of using an approach based on a monetary policy reaction function is that it encompasses different monetary policy strategies and allows testing which strategy is pursued under which environment. In other words, the approach allows measuring directly the degree of monetary policy autonomy by analysing to what extent monetary policy pursues domestic or foreign targets. However, the drawback of this approach is that data for macroeconomic variables, such as inflation and output gaps, are available at most on a monthly basis, whereas interest rate shocks tend to be transmitted across markets within hours or at most a few days.

To better capture the dynamics of the transmission of interest rates shocks, the paper therefore follows a different strand of the literature, one that developed in the 1990s focusing on target zone models (Bertola and Svensson, 1993; Svensson, 1994). These models use as a central assumption the uncovered interest parity (UIP) condition

$$r_t = r_t^f + E\left[\Delta e_t^{t+l} \middle| \Omega_t\right] \tag{1}$$

with r as the domestic interest rates, r^f as the foreign interest rate, Δe the exchange rate change and E as the expectations operator. The central argument of the target zone models is that a target zone allows for a temporary deviation of domestic from foreign interest rates, if the target zone is credible. The size and the length of the deviation then measure the degree of monetary policy autonomy. The analogous argument applies to other exchange rate regimes as well. For instance, a non-credible domestic monetary authority may not enjoy much monetary independence even under a more flexible exchange rate regime. By contrast, interest rates may diverge persistently under a flexible exchange rate regime if the domestic policies are credible and the authority primarily targets domestic variables such as inflation and output.

The UIP condition as the starting point of the empirical model is formulated as:

$$r_t = \kappa + \beta r_t^f + \delta E\left[\Delta e_t^{t+k} \middle| \Omega_t\right] + \varsigma_t \tag{2}$$

This paper will use the size of the spillover of foreign interest rates as well as the speed with which domestic interest rates adjust to their long-term equilibrium relationship as the measures of monetary policy independence.

2.2 Empirical implementation: a GARCH framework

Implementing and testing the model empirically requires taking into account the specific characteristics of the data. Table 1 provides a summary statistic for the daily interest rate data of 19 developed countries and 12 emerging markets. The interest rate data used are daily closing rates on short-term (three-month) rates, mostly interbank rates. The euro area interest rate is the German three-month interbank rate prior to 1 January 1999, and then the combined euro area interbank rate thereafter. Such rates most closely reflect domestic monetary policy instruments and reactions to foreign interest rate shocks. These short-term rates also incorporate market expectations about future changes in domestic and foreign interest rates because they change often in anticipation and well in advance of actual policy decisions.

The interest rates show a number of striking characteristics: almost all of the interest rate levels and their first differences show skewness and excess kurtosis. There is also strong evidence for heteroskedasticity in all the interest rate data. Finally, a key feature shown by the ADF tests is that most of the interest rate levels are not stationary. In contrast, the first differences of the interest rates are all stationary. As expected, first differences of exchange rates were also found to be stationary but are not listed in Table 1 for reasons of brevity.

A proper modelling of the interest rate data requires addressing the statistical properties outlined in Table 1. The kurtosis and time-varying volatility in the interest rate data makes it imperative to model the second moment of interest rates explicitly. This can be done through a generalised autoregressive conditional heteroskedastic (GARCH) model. A GARCH approach is chosen for two reasons. First, it addresses the issue of heteroskedasticity of the data, and second, it also has the additional advantage that it allows testing the spillover of interest rate volatility from across markets.

Moreover, a further issue that needs to be addressed is which foreign interest rates are relevant for the domestic money market. For many emerging markets, the US is the dominant foreign market whose interest rate decision are most likely to have the largest effect on domestic interest rates. However, also euro area monetary shocks (or German monetary shocks prior to 1999) and changes in Japanese interest rates may play a significant role, at least for regional economies. The first moments of equation (2) can accordingly be reformulated as

$$r_t = \kappa_0 + \sum_{j=0}^{J} \left(\beta_j^{US} r_{t-j}^{US} + \beta_j^{EA} r_{t-j}^{EA} + \beta_j^{Ja} r_{t-j}^{Ja} \right) + \delta \Delta e_t^{t+k} + \nu D_t^O + \varepsilon_t \qquad (3)$$

with β^k (*k=US, EA, Ja*) as the coefficients for the interest rate transmission, and also including a set of impulse dummies D^O to correct for large outliers.[2] κ_0 may be

[2] The impulse dummy is defined as $D^O = 1$ for outliers, i.e. those days in which interest rates change by more than 25 basis points for most countries, and as $D^O = 0$ otherwise.

interpreted as a risk premium driving a wedge between the two interest rates. Due to the kurtosis and time-varying volatility, i.e. $\varepsilon_t|\Omega_{t-1} \sim N(0,\sigma_t^2)$, the GARCH model formulates the conditional second moment σ_t for each individual market as

$$\sigma_t^2 = \omega_0 + \omega_1\sigma_{t-1}^2 + \omega_2\varepsilon_{t-1}^2 + \omega^{US}\left(\varepsilon_t^{US}\right)^2 + \omega^{EA}\left(\varepsilon_t^{EA}\right)^2 + \omega^{Ja}\left(\varepsilon_t^{Ja}\right)^2 \tag{4}$$

which expresses the conditional variance as a function of its own past variance, own past squared shock and by contemporaneous squared interest rate shocks in the US, the euro area and Japan.[3] The GARCH model is jointly implemented for the data via maximum likelihood estimation of the log likelihood function

$$L(\theta) = -\left(\frac{T}{2}\right)\ln(2\pi) - \frac{1}{2}\sum_{t=1}^{T}\left(\ln|\sigma_t| + \varepsilon_t'\sigma_t^{-1}\varepsilon_t\right) \tag{5}$$

where T indicates the number of observations, θ the vector of parameters of interest, and σ_t the time varying conditional variance-covariance matrix. Initial values are obtained through a Simplex algorithm, and numerical maximization is used through the algorithm developed by Berndt, Hall, Hall and Hausman (1974) to get the final parameter estimates.

One further issue to be checked in equation (3) is for a potential multicollinearity bias in the estimation of the β^k in equation (3) due to a possible transmission of interest rate changes among the US, Japan and the euro area. To check for the interdependence of interest rate movements in these three markets, a trivariate GARCH model is estimated with the following conditional first moments:

$$r_t^{Ja} = \kappa_{10} + \beta_1 r_{t-1}^{Ja} + \beta_1^{EA} r_{t-1}^{EA} + \beta_1^{US} r_{t-1}^{US} + \nu_1 D_t^{Ja,O} + \varepsilon_t^{Ja} \tag{6.a}$$

$$r_t^{EA} = \kappa_{20} + \beta_2 r_{t-1}^{EA} + \beta_2^{Ja} r_t^{Ja} + \beta_2^{US} r_{t-1}^{US} + \nu_2 D_t^{EA,O} + \varepsilon_t^{EA} \tag{6.b}$$

$$r_t^{US} = \kappa_{30} + \beta_3 r_{t-1}^{US} + \beta_3^{Ja} r_t^{Ja} + \beta_3^{EA} r_t^{EA} + \nu_3 D_t^{US,O} + \varepsilon_t^{US} \tag{6.c}$$

Due to $\varepsilon_t^k|\Omega_{t-1} \sim N(0,H_t)$, the conditional variance equations for each of the three interest rates are defined analogously to equation (4):

$$H_t = K + A\varepsilon_{t-1}^2 + BH_{t-1} \tag{7}$$

with H_t as the 3 x 1 vector of variances, $H_t' = [\sigma_{t,US}^2, \sigma_{t,EA}^2, \sigma_{t,Ja}^2]$, ε_{t-1} as a 3 x 1 vector of interest rate shocks from equations (6), and A and B 3 x 3 matrices of coefficients. Note that the estimation can be undertaken via Maximum Likelihood without having to impose an exogeneity assumption because the Japanese market, the euro area

[3] The GARCH model may be adjusted to take account of the asymmetries in the data. Two alternative specifications to distinguish between the effects of positive and negative shocks that were tested are the EGARCH model of Nelson (1991) and the GJR specification of Glosten, Jagannathan, and Runkle (1993). Both produced results that were similar to those presented in Tables 4 and 7.

markets and the US market are open sequentially, with developments in the Japanese markets affecting both the European and US markets during the same calendar day and the European market affecting the US market on the same calendar day. The European and the US markets influence the Japanese market as well as the US market the European ones only on the following business day.

Table 2 lists all the equations of the trivariate model, including the covariance equations, as well as the estimation results. The results show that there is evidence for some persistent transmission of interest rate changes as well as volatility only from the US to both the Japanese and the euro area market. However, the size of the transmission is small and the correlation coefficients across markets are small and not statistically significant.

2.3 Dealing with non-stationarity: an Error Correction Model (ECM) framework

While modelling interest rates in a GARCH framework deals with most of the data problems described above, it does not explicitly account for the non-stationarity of the data for interest rate levels. Two ways of dealing with the non-stationarity issue are being analysed. First, it is tested whether or not the residuals ε_t of the GARCH estimation of equation (3) are stationary. If these residuals prove to be stationary, then the results can be interpreted as measuring a long-term (cointegrating) relationship between the domestic interest rate r and the foreign rate r^f. Previous work on the exchange rate regime – monetary autonomy nexus, for instance by Borensztein, Zettelmeyer and Philippon (2001), has argued along these lines to defend their methodology using interest rate levels, while most of the other above mentioned work on the issue has ignored this question entirely.

However, numerous problems remain with this line of argument. Most importantly, the main disadvantage of looking only at the long-term relationship between the non-stationary interest rate levels is that it provides no information about the adjustment process and the short-term dynamics of the system. For analysing the link between exchange rate regimes and the degree of monetary policy autonomy, it may be crucial to understand how persistent deviations from a long-run equilibrium can be, how quickly interest rates adjust and which interest rates actually adjust to the equilibrium relationship. For instance, while two countries with different exchange rate regimes may have a similar long-term relationship with e.g. the US interest rate, one of these countries may have substantially more monetary autonomy, at least temporarily, if the adjustment process to this long-term equilibrium is slow.

The use of an error correction model (ECM) makes such an analysis possible. The ECM transformation of equation (3) can be formulated as

$$\Delta r_t = \varphi + \alpha(\beta' x_{t-1}) + \sum_{j=0}^{J} \Gamma_j \Delta x_{t-j} + \delta \Delta e_t^{t+k} + \iota D_t^O + \xi_t \qquad (8)$$

with Δ as the first differences operator, and $x_t' = [r_t^{US}, r_t^{EA}, r_t^{Ja}]$. The rank of $\alpha\beta$, $\Pi =$ *rank* $(\alpha\beta)$, indicates the number of cointegrating relationships in the system. In the univariate case of equation (8), what needs to be tested is whether $\Pi = 1$, i.e. whether or not there is a long-run relationship among the variables. If $\Pi = 0$, there is no cointegrating relationship and the appropriate form of testing for interest rate transmission is to estimate (8) using only first differences. If $\Pi = 1$, the β vector indicates the coefficients of the cointegrating relationship and the α vector measures the speed of adjustment of the variables to this long-run relationship. Γ in (8) measures the short-run spillover effects of changes in interest rates. Note that since the change in the exchange rate Δe is a stationary process, it is not included in the cointegrating relationship.

The Engle-Granger two-step method (Engle and Granger 1987) is used to determine the existence as well as the coefficients of a long-run relationship in (8). In the first step, the Engle-Granger method implies estimating equation (3) and obtaining the parameters of the model that produce a maximum of stationarity in the residuals. In the second step, the parameter estimates from this first step are then used in the ECM of equation (8) to obtain the other parameters of interest.[4]

2.4 Formulating hypotheses about the degree of monetary policy autonomy

From equation (8), we can derive the different hypotheses about the degree of monetary policy autonomy under alternative exchange rate regimes:

	Flexible Exchange Rate	Fixed Exchange Rate
Large monetary autonomy	H_1: $\alpha \approx 0$, $\beta \approx 0$	H_2: α small, $\beta \leq 1$
Little monetary autonomy	H_3: α large, $\beta \geq 1$	H_4: α large, $\beta \geq 1$

The coefficient β for the long-term relationship as well as α, which is measuring the speed of the short-term adjustment process to the long-term equilibrium relationship, are complementary measures for the degree of monetary policy autonomy.

Under a flexible currency arrangement, a low degree of monetary policy independence of H_3 means that domestic interest rates closely follow those of another economy, which should be reflected in large coefficients for both α and β. On the contrary, a high degree of monetary policy autonomy under H_1 could *either* be

[4] In the absence of strong ARCH effects, the method proposed by Johansen (1991, 1995) is a superior way of estimating cointegrating vectors in a multivariate setting because this method does not impose any prior exogeneity assumptions on the system. The exogeneity assumption of the US, German and Japanese interest rates, for instance, can be tested explicitly with the Johansen method by testing for the validity of restrictions on the α vector and the β vector in a vector error correction model (VECM). However, due to the strong ARCH effects in the data it seems more appropriate to apply the Engle-Granger method in a GARCH framework, which allows an explicit modelling of the variance, to determine the parameters of interest. However, when ignoring ARCH effects and employing the Johansen method for a number of countries, the results were similar to the one of the GARCH modelling. In particular, the exogeneity of US, German and Japanese interest rates was confirmed for most countries. Moreover, the existence of a cointegrating relationship between US, German and Japanese interest rates *alone* could also be rejected.

reflected in a low value of β *or* a low value for α *or* both. In particular, a country may enjoy some degree of temporary monetary policy autonomy, indicated by a low value for α, even if interest rates move in a similar way as foreign rates in the longer term.

Under a fixed exchange rate regime, it is clear that β will be around unity or larger for the interest rate relationship with the economy to which the exchange rate is fixed.[5] However, as emphasised by the target zone literature of Svensson (1994) and Bertola and Svensson (1993), governments may still have some degree of temporary monetary policy autonomy if the fixed exchange rate regime is credible. In the model of equation (8), these hypotheses H_2 versus H_4 can be tested by comparing the size of the adjustment coefficient α. The larger α the faster the adjustment to the long-term equilibrium, and hence the lower the degree of policy autonomy.

3 Empirical results

Concerning the hypotheses formulated in section 2, the central focus is on the question whether countries that have flexible exchange rates are able to enjoy a larger degree of monetary policy independence than those with fixed currency regimes. Moreover, it will be analysed whether and under what conditions countries that abandon fixed exchange rates move immediately towards full autonomy (H_1) or first to a state in which they are still limited in their degree of policy independence (H_3).

Section 3.1 focuses on the ERM and other European countries, and compares these countries' experience before and after the 1992-93 ERM crisis and under alternative currency regimes. Section 3.2 then looks at emerging markets and the evidence for the exchange rate regime – monetary policy autonomy nexus in those economies.

3.1 Results for the ERM

The early 1990s experienced a controversial debate about the "German dominance hypothesis", i.e. whether or not the monetary policy by members of the European Monetary System (EMS) was dominated by the policy decisions of the Bundesbank. Von Hagen and Fratianni (1990a, 1990b), for instance, analyse to what extent monetary policy in individual EMS members was influenced by German versus US monetary policy decisions. They find evidence for the asymmetric functioning of the EMS, i.e. that German interest rate changes had a strong effect on other EMS members, while the latter have a small, but still significant impact on German interest rate policies.[6] They also present evidence that US policy has some effect both on German interest rates and on interest rates of other EMS members.

Numerous other papers (Artis and Zhang, 1998, Artus et al. 1991, Biltoft and Boersch 1992, Cohen and Wyplosz 1989, De Grauwe 1989, Giavazzi and Giovannini 1987, Weber 1990) on the issue find similar results, though they often disagree about the

[5] The effect may be larger than $\beta = 1$ due to country risk and currency risk premia.

[6] They write: "…, the EMS is best portrayed as an interactive web of monetary policies, where Germany is an important player, but not the dominating one. … However, other countries react more strongly to German policies than vice versa." (p.373, 1990a)

degree to which German monetary policy dominated that of other EMS central banks and also about whether interest rate policies of other countries, such as France, had some effect on German interest rates.

What many of these papers have in common is that they mostly use monthly or quarterly data and often rely on Granger causality type of tests to analyse interest rate linkages. It is questionable how accurate results of such an analysis can be by relying on low frequency data and empirical tests that do not allow for an analysis of dynamic linkages. In this sense, the analysis for European countries in this paper here in part builds on this earlier debate of the "German dominance hypothesis" and conducts an econometric analysis that allows for dynamic linkages.

The analysis of this section focuses on four key questions: (1) whether joining the ERM lowered the degree of monetary policy autonomy; (2) whether EMS members enjoyed more monetary independence under the wider EMS bands in 1993-98 than under the narrower bands until 1993; (3) whether core EMS members were more responsive to monetary policy shocks in Germany than those which had less credibility or were less likely to join the Euro; and (4) to what extent US monetary policy influenced interest rates within the EMS. Table 3 lists some of the key dates of the included countries with respect to their exchange rate arrangements.

Table 4 presents the results for the analysis using interest rate levels whereas Table 5 shows the empirical findings for the ECM framework.[7] The ADF test reveals that the residuals of all of the models with interest rate levels are stationary, indicating that the results can indeed be interpreted as long run, cointegrating relationships between interest rate levels.

Concerning the first of the four questions, there is strong evidence that the countries that joined the EMS in the 1990s permanently (Austria, Finland and Greece) all experienced some increased dependence on monetary policy in Germany.

Austria, pre-ERM: (1/1/91 – 8/1/95)	$i_t^{Oe} = \kappa_0 + 0.71 \;\; i_t^{Ge} + 0.53 \;\; i_t^{US}$	$\alpha^{Oe} = -0.0041$
Austria, ERM: (9/1/95 – 31/12/98)	$i_t^{Oe} = \kappa_0 + 0.98 \;\; i_t^{Ge} + 0.41 \;\; i_t^{US}$	$\alpha^{Oe} = -0.0075$

The case of Austria provides an example. The β coefficient for the long-term relationship with German interest rates increases somewhat from 0.71 to about unity after Austria joined the ERM in early 1995. Similarly, the speed of adjustment to this long-term equilibrium rises from –0.0041, which implies a half-life of 170 days, to –0.0075, i.e. a half-life of around 100 day*s*.

[7] Tables 4 and 5 only report the coefficients for the transmission of contemporary interest rates (or those with one lag where the effect occurs only on the following business day due to different operating times of the markets) as well as the short-term adjustment to the long-term equilibrium in the ECM. Testing various alternative econometric specifications showed that interest rates are transmitted very rapidly across markets, mostly showing significant coefficients only for the contemporary transmission but not for those with lags.

For the case of the UK, the transmission of interest rate shocks from Germany to the UK was substantially larger during the period when the UK was an EMS member (8 October 1990 - 16 September 1992) than after it had left the ERM:

UK, ERM: (8/10/90 – 16/9/92)	$i_t^{UK} = \kappa_0 + 1.09 \ i_t^{Ge} + 0.23 \ i_t^{US}$	$\alpha^{UK} = -0.0054$
UK, non-ERM 2: (1/1/99 – 30/1/2001)	$i_t^{UK} = \kappa_0 + 0.37 \ i_t^{EA} + 0.33 \ i_t^{US}$	$\alpha^{UK} = -0.0035$

UK interest rates moved basically one-to-one with German rates during UK's ERM membership but this link then weakened substantially thereafter. Since the introduction of the euro, UK monetary policy seems to be largely autonomous although UK interest rates are still integrated with euro area and US interest rates, forming a stable long-term relationship but with lower α and β coefficients.

I now turn to the second question, which is whether German monetary policy was more dominant during the period 1987-92, with narrow bands of mostly +- 2.25%[8], than during the 1993-98 period when most bands had been widened to +- 15%.[9] Overall, there is no compelling evidence that the move from narrow ERM bands in 1987-93 to wider bands in 1993-98 raised the degree of monetary policy autonomy for EMS members.

Most EMS member countries show an increased interest rate shock transmission from Germany across these two periods as well as a faster short-run equilibrium adjustment α. The only exceptions are Belgium and France where the β coefficient declined somewhat across the sub-periods, although β remained around unity for both countries, signalling the availability of little if any autonomy. Overall, this indicates that the move towards more flexible exchange rate arrangements did not give EMS member countries systematically more autonomy to set interest rates according to domestic policy needs.

The case of Ireland illustrates this point nicely, and is also quite representative for most other ERM member countries. The coefficient for the long-term relationship with Germany rose from 0.68 to about unity from the narrow ERM to the wider ERM periods, whereas the influence of US interest rates declined. Also the adjustment to the long-term equilibrium became somewhat faster during the 1993-98 period under *de jure* wider ERM bands.

Ireland, narrow ERM: (1/1/89 – 31/7/92)	$i_t^{IR} = \kappa_0 + 0.68 \ i_t^{Ge} + 0.32 \ i_t^{US}$	$\alpha^{IR} = -0.0052$
Ireland, wider ERM: (1/8/93 – 31/12/98)	$i_t^{IR} = \kappa_0 + 0.98 \ i_t^{Ge} + 0.12 \ i_t^{US}$	$\alpha^{IR} = -0.0066$

At first, this result may seem contrary to what the target zone model would imply. In theory, wider bands should allow countries to exert a larger degree of monetary autonomy, even if this autonomy is a temporary one, i.e. reflected by a slower speed of adjustment to the long-term equilibrium relationship. However, it should be noted

[8] Of the EMS members, only Spain and Portugal had exchange rate bands of +- 6%.
[9] Germany and the Netherlands continued to maintain bands of +- 2.25% width relative to the central parity.

that although *de jure* the ERM bands were wider in 1993-98, ERM member countries did not use these bands to let their exchange rate fluctuate more, but *de facto* stayed mostly within the old, narrower bands (Bartolini and Prati, 1999). One of the reasons for widening the bands after the ERM crisis of 1992-93, was to deter speculative pressure rather than encouraging more exchange rate variability within the wider bands (European Monetary Institute, 1995).

Moreover, keeping exchange rates essentially within the old bands after 1993 may have required a stronger policy response by central banks because of the reduced "bias in the band", i.e. a reduced stabilizing effect of the wider bands when the exchange rate is close to its parity.[10] The finding of lower monetary policy autonomy under the wider ERM bands may therefore be the logic result. Finally, a higher degree of financial integration within in Europe and the prospect of monetary union may also contribute to an explanation of increased interdependence in 1993-98.

A further interesting example in this regard is Italy. Italy was forced to withdraw from the ERM after strong speculative pressure on the lira on 18 September 1992. It stayed out of the ERM until rejoining on 25 November 1996.

Italy, narrow ERM: (1/1/89 – 31/7/92)
$$i_t^{IT} = \kappa_0 + 0.56\ i_t^{Ge} + 0.21\ i_t^{US} \qquad \alpha^{IT} = -0.0023$$

Italy, non-ERM: (1/8/92 – 24/11/96)
$$i_t^{IT} = \kappa_0 + 0.72\ i_t^{Ge} + 0.47\ i_t^{US} \qquad \alpha^{IT} = -0.0054$$

Italy, wider ERM: (25/11/96 – 31/12/98)
$$i_t^{IT} = \kappa_0 + 0.75\ i_t^{Ge} + 0.22\ i_t^{US} \qquad \alpha^{IT} = -0.0087$$

Despite the temporary withdrawal from the ERM, Italy's central bank continued to closely follow German monetary policy between 1992 and 1996. This explains why both the long-term coefficient β and the adjustment factor α both remained high and even rose compared to the period of the narrow ERM in 1987-1992. Also after rejoining the ERM in November 1996, Italy kept following German monetary policy closely until the introduction of the euro.

For the third question, there is no systematic evidence that "core" EMS members (e.g. Austria, Belgium, France, the Netherlands) were more dependent on German interest rate changes than other members that may have enjoyed less credibility or may have been seen in the mid-1990s as less likely candidates to join the euro (e.g. Greece, Italy, Portugal, Spain).

The Netherlands and Spain provide fairly representative examples for this finding:

Netherl., narrow ERM: (1/1/89 – 31/7/92)
$$i_t^{NE} = \kappa_0 + 0.94\ i_t^{Ge} + 0.21\ i_t^{US} \qquad \alpha^{NE} = -0.0055$$

Netherl., wider ERM: (1/8/93 – 31/12/98)
$$i_t^{NE} = \kappa_0 + 1.07\ i_t^{Ge} + 0.28\ i_t^{US} \qquad \alpha^{NE} = -0.0072$$

Spain, narrow ERM: (1/1/89 – 31/7/92)
$$i_t^{SP} = \kappa_0 + 1.12\ i_t^{Ge} + 1.01\ i_t^{US} \qquad \alpha^{SP} = -0.0042$$

[10] I am grateful to John Williamson for pointing out this explanation.

Spain, wider ERM: (1/8/93 – 31/12/98) $i_t^{SP} = \kappa_0 + 1.11\ i_t^{Ge} + 0.42\ i_t^{US}$ $\alpha^{SP} = -0.0059$

Both the Netherlands and Spain had β coefficients of around unity for the relationship with German interest rates. The adjustment coefficient α is somewhat higher for the Netherlands, possibly reflecting the narrower bands that the Netherlands pursued for most of the period compared to Spain. The lack of a clear difference between core countries and periphery countries may be explained by the need of less credible EMS members to respond more strongly to interest rate moves in Germany in order to repeatedly signal their commitment to the EMS.

Fourth, in contrast to the increased dependence of EMS member countries on interest rates in Germany over time, US interest rates have lost in influence over time. Only for a few countries, often outside the EMS such as the UK and Norway (and also Australia and Canada), does the transmission of US interest rate shocks increase with time. As expected, Japanese interest rates do not seem to play any relevant role in determining monetary policy in Europe.

Greece, pre-ERM: (1/1/94 – 14/3/98) $i_t^{GR} = \kappa_0 + 1.03\ i_t^{Ge} + 0.51\ i_t^{US}$ $\alpha^{GR} = -0.0033$

Greece, ERM: (15/3/98 – 31/12/2000) $i_t^{GR} = \kappa_0 + 1.12\ i_t^{EA} + 0.31\ i_t^{US}$ $\alpha^{GR} = -0.0094$

Sweden, non-ERM 1: (1/1/93 – 31/12/98) $i_t^{SD} = \kappa_0 + 0.55\ i_t^{Ge} + 0.23\ i_t^{US}$ $\alpha^{SD} = -0.0040$

Sweden, non-ERM 2: (1/1/99 – 30/1/2001) $i_t^{SD} = \kappa_0 + 0.68\ i_t^{EA} + 0.15\ i_t^{US}$ $\alpha^{SD} = -0.0036$

The two examples above for Greece and for Sweden underline the point that the influence of US monetary policy within Europe has become somewhat less important over time, although US interest rates do continue to exert some impact on European money markets.

Finally, an interesting result occurs when looking at the ERM crisis of 1992-93. The striking finding is that during the 1992-93 turmoil in the ERM, the interdependence among the core EMS members (Belgium, France, the Netherlands) increased, whereas EMS members in the periphery (Ireland, Spain, Denmark) experienced a lower transmission of interest rate shocks from Germany.

On the one hand, interdependence may rise if domestic market participants become more sensitive to external developments in other markets. On the other hand, the transmission of interest rate shocks may decrease during periods of turmoil as other factors become relatively more important in determining domestic interest rates. For instance, expectations of exchange rate realignments, changes in the bandwidth, or the exit of a country from the existing exchange rate arrangement may drive at least a temporary wedge between domestic and foreign interest rate developments. This may provide some tentative explanation for the difference between core and non-core ERM countries.

In summary, taken these results together, the picture that emerges is that an ever more integrated monetary block formed in Europe since the 1980s, with Germany as its dominant force in determining interest rate policies till the onset of monetary union in 1999. This occurred despite a (temporary) move towards more *de jure* exchange rate flexibility within the EMS during 1993-98, which seemed to have lowered the degree of monetary policy autonomy of ERM members further due to the close exchange rate targeting also within the wider ERM and possibly a higher degree of integration and in anticipation of monetary union.

3.2 Emerging markets

The advantage of analysing the exchange rate regime – monetary policy autonomy nexus for emerging market economies (EMEs) is that these economies offer a more diverse spectrum of exchange rate regimes and often experienced dramatic changes in their currency regimes during the course of the 1990s. The EMEs included are three accession countries (Czech Republic, Hungary, Poland), three of the four largest Latin American economies (Argentina, Chile, Mexico)[11], and six Asian countries (Hong Kong, Indonesia, South Korea, Malaysia, Singapore, Thailand).

The reason for choosing these countries is that they are not only relatively open financially and mostly transparent with respect to their exchange rate arrangement, but also that in most cases they experienced a significant change in their exchange rate regime during the 1990s. In many cases, this change was brought about either by the Latin American crisis of 1994-95 or the Asian financial crisis of 1997-98. Table 6 gives a short summary of changes in the currency regimes of these economies.

Tables 7 and 8 present the results for the transmission of interest rate shocks from the US, from Germany/the euro area, and from Japan. As a prerequisite for the validity of the ECM, ADF tests confirm the stationarity of the models of interest rate levels (Table 7). Four main results emerge from the analysis.

First, there is no strong evidence that countries with more flexible exchange rate regimes have more autonomy from monetary policy shocks in the US, Europe and Japan than countries that have less flexible regimes. For instance, after the Asian crisis countries like Indonesia and Thailand, under floating regimes, were more sensitive to US interest rates in the long term than Hong Kong, under its currency board system. By contrast, Singapore is the only of the six Asian countries that enjoyed a larger degree of autonomy under a more flexible currency regime:

Hong Kong, currency board (1/7/98 – 30/1/01):	$i_t^{HK} = \kappa_0 + 1.06\ i_t^{US}$	$\alpha^{HK} = -0.0180$
Indonesia, float: (1/7/98 – 30/1/01)	$i_t^{Ino} = \kappa_0 + 2.91\ i_t^{US}$	$\alpha^{Ino} = -0.0005$
Singapore, float: 1/7/98 – 30/1/01)	$i_t^{Sin} = \kappa_0 + 0.51\ i_t^{US} + 0.18\ i_t^{Ja}$	$\alpha^{Sin} = -0.0008$

[11] Including Brazil, as Latin America's largest economy, proved difficult because of the country's long experience of high and volatile inflation and interest rates, which rendered only a relatively short period for a sensible analysis.

A similar result applies to the Latin American economies and the accession countries. Among the accession countries, the economy with the least flexible currency regime, Hungary, experiences a larger transmission of interest rate shocks from the euro area than either the Czech Republic or Poland. Argentina, under its currency board arrangement, was in the long run not more dependent on interest rate policy in the US than Mexico, which had relative more flexible regimes since 1995:

Argentina, currency board (1/7/95 – 30/1/01):	$i_t^{Arg} = \kappa_0 + 1.44 \ i_t^{US}$	$\alpha^{Arg} = -0.0180$
Mexico, float: (1/7/95 – 30/1/01)	$i_t^{Mex} = \kappa_0 + 1.46 \ i_t^{US}$	$\alpha^{Mex} = -0.0005$

The ECM results show that interest rates in Hong Kong and Argentina adjust more quickly to the long-run equilibrium than in countries with more flexible regimes. For instance, deviations from the long-run equilibrium for the sub-period 1998-2001 have a half-life of about 38 days for Hong Kong and Argentina but more than 150 days for countries like Indonesia, Malaysia and Mexico. This reveals that the degree of temporary autonomy is still relatively short with a half-life of about one half of a year at most and, overall, that most EMEs with flexible exchange rate regimes in the sample have not enjoyed a significantly higher degree of monetary policy independence.

As a second main result, there is no strong evidence that for individual countries the move towards more exchange rate flexibility reduced their dependence on monetary policy decisions in the US, the euro area and Japan. Most of the countries in the sample in fact experienced an *increased* dependence on interest rate shocks in the euro area or the US over time, in particular after having experienced a financial crisis.

For example, the degree of monetary autonomy decreased for the Czech Republic and for Chile after these countries moved to more flexible exchange rate arrangements. Both α and β coefficients have increased over time. In case of the Czech Republic, the dependence is primarily on Germany/the euro area, whereas the only monetary policy that seems to impact Chile's interest rates is that of the US.

Czech Rep., peg: (1/1/93 – 31/3/97)	$i_t^{Cze} = \kappa_0 + 1.12 \ i_t^{Ge} + 0.65 \ i_t^{US}$	$\alpha^{Cze} = -0.005$
Czech Rep., float: (1/1/98 – 30/1/01)	$i_t^{Cze} = \kappa_0 + 1.56 \ i_t^{EA} + 0.34 \ i_t^{US}$	$\alpha^{Cze} = -0.007$
Chile, bands: (1/1/94 – 30/6/97)	$i_t^{Chl} = \kappa_0 + 0.98 \ i_t^{US}$	$\alpha^{Chl} = -0.005$
Chile, m. float: (1/7/97 – 30/1/01)	$i_t^{Chl} = \kappa_0 + 1.50 \ i_t^{US}$	$\alpha^{Chl} = -0.005$

Third, the results show that one can indeed speak of a "euro area bloc" and a "US bloc" according to the regions where monetary policy of the two are dominant. For the accession countries, the impact of shocks from Germany / the euro area has increased over time, whereas the transmission of US interest rate shocks diminished for all three countries. US monetary policy is dominant and often even increased in importance both in Latin America and in Asia. It is striking that the effects of shocks in Japanese interest rates are either not significant or at most small for all of the Asian economies. Given the large importance of US shocks for Asian countries, these findings clearly point towards the development of a "US bloc" also in Southeast and East Asia.

Poland, peg: (1/7/93 – 15/5/95)	$i_t^{Pol} = \kappa_0 + 0.54\ i_t^{Ge} + 0.66\ i_t^{US}$	$\alpha^{Pol} = -0.004$
Poland, crawl: (16/5/95 – 11/4/00)	$i_t^{Pol} = \kappa_0 + 1.31\ i_t^{Ge} + 0.52\ i_t^{US}$	$\alpha^{Pol} = -0.006$
Poland, float: (12/4/00 – 30/1/01)	$i_t^{Pol} = \kappa_0 + 1.09\ i_t^{EA} + 0.47\ i_t^{US}$	$\alpha^{Pol} = -0.008$
Chile, bands: (1/1/94 – 30/6/97)	$i_t^{Chl} = \kappa_0 + 0.98\ i_t^{US}$	$\alpha^{Chl} = -0.005$
Chile, m. float: (1/7/97 – 30/1/01)	$i_t^{Chl} = \kappa_0 + 1.50\ i_t^{US}$	$\alpha^{Chl} = -0.005$
Indonesia, bands: (1/6/94 – 30/6/97)	$i_t^{Ino} = \kappa_0 + 1.61\ i_t^{US} + 0.43\ i_t^{Ja}$	$\alpha^{Ino} = -0.013$
Indonesia, float: (1/7/98 – 30/1/01)	$i_t^{Ino} = \kappa_0 + 2.91\ i_t^{US}$	$\alpha^{Ino} = -0.005$

An interesting result is that while Japanese interest shocks do affect other Asian markets in the earlier periods, this transmission becomes smaller and often statistically insignificant in recent years. The case of Indonesia above provides an example for this finding.

A fourth finding relates to the periods of financial crisis, which most of the countries in the sample were subject to at some point during the 1990s. All of the affected countries, with the exception of Hong Kong, experienced an *increased* dependence on interest rate shocks from the dominant partner country during a crisis episode. In some cases, the rise in the shock transmission was quite dramatic, which suggests that interest rate linkages in crisis periods tend to strengthen, making it even more difficult for affected countries to re-focus their monetary policy stance towards domestic policy objectives.

In summary, one interpretation that emerges from these empirical results is that moving from a fixed to a flexible exchange rate regime alone may not be sufficient to raise the degree of monetary autonomy. What may be required in addition to adopting a flexible exchange rate arrangement are credibility and a track record to establish a reputation in financial markets. It is striking that Chile and Singapore, two countries with the highest degree of credibility and strongest track record in the sample, also seemed to be least dependent on external interest rate shocks.

However, an alternative, though partly complementary explanation of the findings is that the rising degree of financial and real integration has also led to an increased interdependence of interest rate movements. Hence this higher degree of interdependence may have occurred despite rather than because of the general tendency to move towards exchange rate flexibility.

3.3 Event study: monetary policy announcements

The analysis so far has looked at the transmission of interbank rates and assumed that changes in these interbank rates solely reflect anticipated or actual changes in monetary policy. Although this assumption should be fairly accurate as such market interest rates reflect closely the policy instruments, a more direct way of analysing the transmission of monetary policy across countries is to look specifically at those days when actual changes in monetary policy were announced and to analyse whether and how the transmission of market interest rates is different on these specific days. There is a broad literature that analyses announcement effects of various types of macroeconomic variables, such as inflation rates, monetary policy, unemployment rates, GDP growth rates, etc. (e.g. Fleming and Remolona 1999, Roley and Sellon 1998). The focus here, however, is only on monetary policy changes.

In theory, if monetary policy decisions are fully anticipated, there should be no change in market interest rates on the date of the announcement of the policy decision. Hence changes in market interest rates on the dates of policy announcements are pure policy *surprises*, i.e. they measure to what extent policy changes were not anticipated and already incorporated in market rates and prices. The advantage of looking at such monetary policy surprises is that such an analysis may be more accurate in measuring the true transmission effects of interest rate changes. The disadvantage, however, is that such an analysis usually leaves only relatively few observations to work with.

During the period January 1986 – March 2001, there were 84 changes in the US federal funds target rate, 34 changes in the German lombard/discount rates, and 21 changes in the Japanese official discount rate. To test whether the transmission of interest rate shocks is different on announcement days from other days, equation (3) is modified in the following way:

$$\begin{aligned} r_t &= \kappa_0 + \beta_j^{US} r_t^{US} + \beta_j^{EA} r_t^{EA} + \beta_j^{Ja} r_t^{Ja} + \eta^{US} D_t^{US} r_t^{US} + \eta^{EA} D_t^{EA} r_t^{EA} + \eta^{Ja} D_t^{Ja} r_t^{Ja} \\ &\quad + \delta \Delta e_t^{t+k} + \nu D_t^{O} + \varpi D_t^{S} + \varepsilon_t \end{aligned} \tag{9}$$

so that the model now also includes three impulse dummies D^k ($k=US,EU,Ja$) with $D^k=1$ for those days when an interest rate change is announced in one of the three countries, and $D^k=0$ otherwise. A set of step dummies, D^S, is included to account for structural breaks due to changes in the exchange rate regime as indicated in Tables 3 and 6 above. The hypotheses for testing whether the transmission of interest rate changes is different on announcement days can therefore be formulated as

$$H_5: \quad \beta^{US} + \eta^{US} = \beta^{US}$$

$$H_6: \quad \beta^{EA} + \eta^{EA} = \beta^{EA}$$

$$H_7: \quad \beta^{Ja} + \eta^{Ja} = \beta^{Ja}$$

The ECM of equation (8) can be modified in a similar way with the above hypotheses formulated accordingly. Table 9 presents the coefficients for the transmission of interest rate surprises on the day of announcements for both the models with interest rate levels and with first differences in the ECM. The following general results stand out.

First, almost all of the coefficients of the monetary policy surprises are substantially larger than the coefficients for monetary policy shocks presented in Tables 4 and 7. This finding is intuitively convincing because one would expect that the transmission of interest rate changes are stronger on those days on which *actual* policy changes are announced than on those on which expectations or beliefs about possible future policy changes are altered. The size of the increase is very large, with coefficients for the transmission of euro area and US interest changes often rising by a factor of 2 or 3.

Second, US interest rates seem to become even more dominant in world financial markets on days when the Fed announces monetary policy changes. The coefficients for US monetary surprises are large and significant for almost all countries in all three regions, both in the model with interest rate levels and in the ECM.

Third, despite the increased importance of US interest rate announcements, the euro area still remains the dominant financial market within Europe and for the accession countries. Japan's announced monetary policy changes are clearly important for most of the Asian countries. However, the conclusion of the previous sections is confirmed in that a "US bloc" has been forming both in the Americas and in Asia, and that a "euro area bloc" has emerged within Europe.

4. Conclusions

This paper has analysed empirically whether countries under flexible exchange rate arrangements are enjoying more monetary policy autonomy than countries under less flexible regimes. Three key results from the empirical analysis using GARCH and ECM frameworks stand out. First, joining a particular exchange rate arrangement, such as the ERM, mostly lowers the degree of monetary independence (e.g. Austria, Finland, Greece).

Second, the move in the opposite direction from fixed to flexible exchange rate regimes does not always allow countries to gain monetary independence. In fact, all of the analysed emerging markets that faced a financial crisis in the 1990s experienced a greater dependence on interest rate changes in the US or the euro area following the crisis, and this in despite of switching mostly to more flexible currency regimes. Similarly, EMS member countries generally did not have more monetary autonomy under the wider ERM in 1993-98 than under the narrow ERM in 1987-92. This finding is in line with the observation that most ERM members in 1993-98 kept their exchange rates within the old, narrower exchange rate bands.

Third, it is found that there has been a polarisation of monetary policy dominance in the world. A "Dollar bloc" exists in Latin America and in Asia as interest rates in both regions are dominated strongly by US monetary policy. In contrast, a "Euro bloc" has been forming in Europe as the importance of monetary policy from the euro area has been increasing over time, whereas the relevance of US interest rate changes has declined. Japanese monetary policy seems to have had increasingly little influence, also for most of the Asian economies analysed in this paper.

One interpretation from these empirical results is that moving from a fixed to a flexible exchange rate regime alone may not be sufficient to raise the degree of monetary autonomy. What may be required in addition to adopting a flexible exchange rate arrangement are credibility and a track record to establish a reputation in financial markets. An alternative, though partly complementary explanation of the findings is that it has been the rising degree of financial and real integration among economies which has also led to an increased interdependence of interest rate movements. What this may indicate is that in an increasingly interdependent world we are moving from an "Impossible Trinity" to an "Impossible Duality", i.e. even under flexible exchange rate arrangements it becomes ever more difficult for countries to exert independent and autonomous monetary policy.

As for policy relevance, the findings of this paper suggest two central lessons. First, the findings challenge the increasingly popular view among economists and policy-makers that the proper choice of a currency regime can only be at the extremes, i.e. either fully floating or irreversibly fixed. An economy may hardly gain any monetary autonomy by letting its exchange rate float freely if the economy is highly integrated and interdependent with a large and dominant one like the USA or the euro area. Hence intermediate exchange rate regimes may be a more attractive alternative for countries if they can avoid misalignments and prevent the regime from becoming the target of speculative attacks.

A second lesson refers to policy-makers in the US and in the euro area. The findings of the paper suggest that monetary policy decisions in both affect not only their own economies but have an increasingly large impact also on other economies. This, in turn, makes monitoring and understanding developments in other economies ever more important also for monetary policy in the US and in the euro area.

References

Artis, M., and W. Zhang, (1998). The Linkage of Interest Rates within the EMS. *Weltwirtschaftliches Archiv*. 134(1): 117-32.

Artus, P., S. Avouyi-Dovi, E. Bleuze, and F. Lecointe. (1991). Transmission of US Monetary Policy to Europe and Asymmetry in the European Monetary System. *European Economic Review*. 35: 1369-1384.

Ball, Laurence. (1999). Policy Rules for Open Economies. In John Taylor (ed.): *Monetary Policy Rules*. University of Chicago Press.

Ball, Laurence. (2000). Policy Rules and External Shocks. NBER Working Paper No. 7910.

Bartolini, L., and A. Prati. (1999). Soft Exchange Rate Bands and Speculative Attacks: Theory, and Evidence from the ERM since August 1993. *Journal of International Economics*. 49(1): 1-29.

Bernanke, B., T. Laubach, F. Mishkin, and A. Posen. (1999). *Inflation Targeting: Lessons from the International Experience*. Princeton University Press.

Bernanke, B. and I. Mihov. (1995). Measuring Monetary Policy. *Quarterly Journal of Economics*. 113: 869-902.

Bertola, Giuseppe, and Lars E. O. Svensson. (1993). Stochastic Devaluation Risk and the Empirical Fit of Target-Zone Models. *Review of Economic Studies*. 60(3): 689-712.

Biltoft, Karsten, and Christian Boersch. (1992). Interest Rate Causality and Asymmetry in the EMS. *Open Economies Review*. 3: 297-306.

Borensztein, Eduardo, Jeromin Zettelmeyer, and Thomas Philippon (2001). Monetary Independence in Emerging Markets: Does the Exchange Rate Regime Make a Difference? IMF Working Paper No. 01.

Calvo, Guillermo and Carmen Reinhart (2000). Fear of Floating. Unpublished draft, University of Maryland College Park. www.bsos.umd/ed/econ/ciecalvo.htm.

Clarida Richard, Jordi Galí, and Mark Gertler. (1998). Monetary Policy Rules in Practice: Some International Evidence, *European Economic Review*. 42 (6): 1033-1067.

Clarida Richard, Jordi Galí, and Mark Gertler. (2000). Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory. *Quarterly Journal of Economics*. 115 (1): 147-180.

Cohen, Daniel and Charles Wyplosz. (1989). The European Monetary Union – An Agnostic Evaluation. In R. Bryant, D. Currie, J. Frenkel, P. Masson, R. Portes (eds.): *Macroeconomic Policies in an Interdependent World*. International Monetary Fund.

De Grauwe, Paul. (1989). Is the European Monetary System a DM-Zone? CEPR Discussion Paper No. 297.

Edison, H. (1997). The Reaction of Exchange Rates and Interest Rates to News Releases. *International Journal of Finance and Economics*. 2: 87-100.

Eichengreen, B. and C. Wyplosz. (1993) The Unstable EMS. *Brookings Papers on Economic Activity*. 1.

European Monetary Institute. (1995). *Annual Report 1994*. Frankfurt am Main.

Engle, Robert and Clive Granger. (1987). Cointegration and Error Correction: Representation, Estimation and Testing. *Econometrica*. 35: 251-276.

Fleming, Michael and Eli Remolona. (1999). The Term Structure of Announcement Effects. Federal Reserve Bank of New York, mimeo, May 1999.

Flood, Robert, and Andrew Rose. (1995). Fixing Exchange Rates: A Virtual Quest for Fundamentals. *Journal of Monetary Economics.* 36: 3-37.
Frankel, Jeffrey. (1999). No Single Currency Regime is Right for all Countries at all Times. NBER Working Paper No. 7338.
Frankel, Jeffrey, Sergio Schmukler, and Luis Serven. (2000). Global Transmission of Interest Rates: Monetary Independence and Currency Regimes. Unpublished draft, World Bank Working Paper 2424.
Fratianni, Michele, and JuergenVon Hagen. (1990b). German Dominance in the EMS: The Empirical Evidence. *Open Economies Review*. 1: 67-87.
Fratzscher, Marcel. (1998). The Impact of Exchange Rate Regimes and Stability on Macroeconomic Performance: An Empirical Analysis. *Research Monograph 1998/9*, Centre for European Studies at Chulalongkorn University, and Kiel Institute of World Economics.
Giavazzi, Francesco, and Alberto Giovannini. (1987). Models of the EMS: Is Europe a Greater Deutschmark Zone? In R. Bryant and R. Portes (eds.): *Global Macroeconomics: Policy Conflict and Cooperation*. MacMillan Press.
Glosten, Lawrence, Ravi Jagannathan and David Runkle (1993) On the Relation between the Expected Value and the Volatility of the Nominal Excess Return on Stocks. *Journal of Finance*. 48: 1779-1802.
Hamilton, James, and Oscar Jorda. (2000). A Model for the Federal Funds Rate Target. NBER Working Paper no. 7847.
Hausmann, Ricardo, Michael Gavin, Carmen Pages, and Ernesto Stein. (1999). Financial Turmoil and the Choice of Exchange Rate Regime. Inter-American Development Bank, Research Department Working Paper No. 400.
Hausmann, Ricardo, Ugo Panizza, and Ernesto Stein. (2000). Why do Countries Float the Way they Float? Inter-American Development Bank, Research Department Working Paper No. 418.
International Monetary Fund. Various issues (1988-2000). *Exchange Rate Arrangements and Restrictions*.
Johansen, Søren. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. *Econometrica*. 59: 1551-80.
Johansen, Søren. (1995). *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*. Oxford University Press.
Kim, Suk-Joong, and Jeffrey Sheen. (2000). International Linkages and Macroeconomic News Effects on Interest Rate Volatility – Australia and the US. *Pacific-Basin Finance Journal*. 8: 85-113.
Mishkin, Frederic. (1999). International Experience with Different Monetary Policy Regimes. *Journal of Monetary Economics*. 43: 579-605.
Mishkin, Frederic, and Miguel Savastano. (2000). Monetary Policy Strategies for Latin America. NBER Working Paper No. 7617.
Nelson, Daniel. (1991). Conditional Heteroskedasticity in Asset Returns: A New Approach. *Econometrica*. 59: 347-70.
Rolley, Vance and Gordon Sellon. (1998). The Response of Interest Rates to Anticipated and Unanticipated Monetary Policy Actions. Federal Reserve Bank of Kansas City, mimeo, June 1998.
Rose, Andrew K., and Lars E. O. Svensson. (1994). European Exchange Rate Credibility before the Fall. *European Economic Review*. 38(6): 1185-1216.
Rose, Andrew K., and Lars E. O. Svensson. (1995). Expected and Predicted Realignments: The FF/DM Exchange Rate during the EMS, 1979-93. *Scandinavian Journal of Economics*. 97(2): 173-200.

Svensson, Lars E. O. (1994). Why Exchange Rate Bands? Monetary Independence in Spite of Fixed Exchange Rates. *Journal of Monetary Economics*. 33(1): 157-99.

Thornton, Daniel. (2000). The Relationship between the Federal Funds Rate and the Fed's Federal Funds Target: Is it Open Market or Open Mouth Operations? The Federal Reserve Bank of St. Louis Working Paper No.1999/022.

Von Hagen, Juergen, and Michele Fratianni. (1990a). German Dominance in the EMS. Evidence from Interest Rates. *Journal of International Money and Finance*. 9: 358-375.

Weber, Axel. (1990). EMU and Asymmetries and Adjustment Problems in the EMS: Some Empirical Evidence. CEPR Discussion Paper No, 448.

Williamson, John. (2000). *Exchange Rate Regimes for Emerging Markets: Reviving the Intermediate Option*. Institute for International Economics, Washington D.C.

Appendices

Table 1: Statistical properties of interest rate levels and their first differences

	INTEREST RATE LEVELS							FIRST DIFFERENCES						
	Mean	Standard Error	Skewness	Excess Kurtosis	Q(30): Serial Correlation	^{2}(30):Serial Correlation	ADF: Unit Root	Mean	Standard Error	Skewness	Excess Kurtosis	Q(30): Serial Correlation	^{2}(30):Serial Correlation	ADF: Unit Root
DEVELOPED COUNTRIES														
Austria	5.005	2.184	1.067 **	-0.264 *	739.75 **	3033.0 **	-2.427 *	-0.002	0.031	-2.813 **	76.14 **	136.09 **	857.4 **	-22.70 **
Belgium	5.996	2.754	0.415 **	-1.441 **	855.16 **	3694.3 **	-1.441	-0.002	0.144	2.549 **	123.20 **	466.31 **	1972.5 **	-26.02 **
Finland	7.750	4.279	0.525 **	-0.890	1048.79 **	5065.7 **	-1.499	-0.002	0.303	-10.090 **	517.93 **	357.73 **	1880.6 **	-31.46 **
France	6.776	2.688	0.055	-1.037 **	1119.29 **	4734.6 **	-1.402	-0.001	0.193	-1.176 **	147.89 **	796.22 **	3264.5 **	-28.65 **
Greece	12.776	3.544	0.375 **	-0.085	467.11 **	2455.6 **	-1.074	-0.008	0.312	2.954 **	66.60 **	95.84 **	613.4 **	-26.02 **
Ireland	7.983	4.037	1.418 **	5.119 **	778.32 **	3362.3 **	-5.921 **	-0.002	1.572	12.084 **	1047.52 **	1095.33 **	4633.2 **	-48.51 **
Italy	9.375	3.425	-0.061	0.801 **	1076.59 **	5199.9 **	-1.357	-0.003	0.275	5.291 **	281.28 **	762.33 **	4007.6 **	-34.87 **
Netherlands	5.557	2.211	0.490 **	-1.052 **	1165.43 **	4929.8 **	-1.391	0.000	0.046	0.253 **	20.17 **	147.12 **	1059.3 **	-28.07 **
Portugal	7.376	3.823	0.998 **	1.050 **	560.44 **	2946.2 **	-2.215 *	-0.004	0.477	-0.166 **	446.42 **	255.51 **	1175.3 **	-27.01 **
Spain	8.462	4.095	0.518 **	0.633 **	775.06 **	3177.7 **	-2.108	-0.003	0.654	20.025 **	1327.39 **	399.85 **	1959.3 **	-36.74 **
Denmark	7.292	3.883	1.874 **	6.780 **	755.63 **	3264.3 **	-4.809 **	-0.001	0.835	6.006 **	217.65 **	676.57 **	3382.9 **	-32.13 **
Norway	5.672	1.351	0.296 **	0.400 **	517.56 **	2189.3 **	-2.338 *	0.000	0.223	7.209 **	677.23 **	283.90 **	1220.8 **	-25.87 **
Sweden	5.891	2.252	0.494 **	-1.000 **	598.46 **	3146.1 **	-4.609 **	-0.004	0.062	2.039 **	168.04 **	318.14 **	1431.6 **	-19.89 **
UK	8.593	3.127	0.720 **	-0.757 **	1143.44 **	4939.7 **	-1.531	-0.002	0.216	20.860 **	1412.82 **	347.50 **	1826.8 **	-43.38 **
Australia	8.900	4.121	0.750 **	-0.881 **	1138.70 **	5499.9 **	-1.541	-0.003	0.140	0.919 **	70.63 **	137.81 **	992.2 **	-33.59 **
Canada	7.076	2.796	0.675 **	-0.549 **	1135.80 **	5679.0 **	-1.567	-0.001	0.120	4.523 **	123.93 **	106.51 **	734.9 **	-32.56 **
EMERGING MARKETS														
Czech Republic	10.540	3.686	0.376 **	0.245 **	598.22 **	2889.4 **	-2.006 *	-0.013	0.146	-0.275 **	18.16 **	405.51 **	1715.3 **	-25.37 **
Hungary	13.636	2.513	0.511 **	-0.658 **	388.61 **	1643.8 **	-1.200	-0.008	0.279	0.008 **	34.85 **	155.56 **	964.5 **	-22.62 **
Poland	22.863	5.784	0.187 **	-0.874 **	578.98 **	3043.7 **	-1.442	-0.007	0.454	-0.078	11.07 **	381.83 **	1649.5 **	-30.91 **
Argentina	11.797	6.439	2.364 **	6.031 **	332.63 **	1363.8 **	-6.406 **	-0.010	2.739	0.119 **	22.03 **	216.59 **	1046.1 **	-30.02 **
Chile	6.449	1.676	2.791 **	2.191 **	401.09 **	1732.7 **	-2.661 **	-0.001	0.327	-3.386 **	90.15 **	358.35 **	1515.8 **	-26.98 **
Mexico	13.468	5.817	2.367 **	7.438 **	528.38 **	2235.0 **	-1.290	-0.003	1.550	6.700 **	183.32 **	200.21 **	967.0 **	-23.95 **
Hong Kong	6.237	2.140	1.821 **	1.996 **	717.27 **	2940.8 **	-7.235 **	-0.001	0.695	9.437 **	1433.66 **	775.30 **	3279.5 **	-39.77 **
Indonesia	22.745	20.313	1.817 **	2.423 **	955.64 **	4395.9 **	-1.439	0.003	3.874	1.220 **	34.13 **	340.28 **	1788.9 **	-35.27 **
Korea	12.252	4.012	0.279 **	0.009	642.84 **	3149.9 **	-1.502	-0.005	0.210	4.854 **	105.23 **	361.02 **	1480.2 **	-21.79 **
Malaysia	5.982	2.305	0.337 **	-0.156	542.29 **	2711.5 **	-1.672	-0.002	0.240	7.142 **	549.37 **	262.41 **	1133.6 **	-26.29 **
Singapore	3.615	1.627	1.063 **	2.922 **	933.47 **	4013.9 **	-4.891 **	-0.001	0.343	-1.058 **	476.11 **	660.77 **	2795.1 **	-33.92 **
Thailand	10.516	5.581	1.027 **	1.005 **	641.27 **	2885.7 **	-1.582	-0.003	0.402	1.751 **	75.36 **	89.81 **	727.5 **	-25.48 **
USA	5.371	1.382	0.297 **	-0.148 *	1144.97 **	6068.3 **	-1.516	-0.001	0.055	-0.483 **	14.28 **	201.72 **	1060.4 **	-31.87 **
Germany/euro area	5.418	2.222	0.669 **	-0.985 **	1164.27 **	6287.1 **	-0.908	0.000	0.061	-0.309 **	59.64 **	136.05 **	843.5 **	-30.79 **
Japan	3.132	2.514	0.444 **	-0.948 **	1155.34 **	5776.7 **	-0.968	-0.001	0.071	-0.225 **	24.43 **	68.94 **	475.7 **	-31.37 **

Note: Q(30) and $Q^2(30)$ show the Ljung-Box test statistic for serial correlation of order up to 30. ADF shows the augmented Dickey-Fuller test for the null hypothesis of a unit root.
** and * indicate significance at the 1% and 10% level, respectively.

Table 2: GARCH results for tests of interest rate transmission between the euro area, Japan and the USA

The trivariate GARCH model for the US, Japan and the euro area is formulated analogously to the univariate system of equations (6)-(8)

with the conditional first moments,

$$r_t^{Ja} = \kappa_{10} + \kappa_1^{'} F_t^{Ja} + \beta_1 r_{t-1}^{Ja} + \beta_1^{EA} r_{t-1}^{EA} + \beta_1^{US} r_{t-1}^{US} + \nu_1 D_t^{Ja,O} + \varepsilon_t^{Ja} \tag{9.a}$$

$$r_t^{EA} = \kappa_{20} + \kappa_2^{'} F_t^{EA} + \beta_2 r_{t-1}^{EA} + \beta_2^{Ja} r_t^{Ja} + \beta_2^{US} r_{t-1}^{US} + \nu_2 D_t^{EA,O} + \varepsilon_t^{EA} \tag{9.b}$$

$$r_t^{US} = \kappa_{30} + \kappa_3^{'} F_t^{US} + \beta_3 r_{t-1}^{US} + \beta_3^{Ja} r_t^{Ja} + \beta_3^{EA} r_t^{EA} + \nu_3 D_t^{US,O} + \varepsilon_t^{US} \tag{9.c}$$

the conditional second moments,

$$\left(\sigma_t^{Ja}\right)^2 = \omega_{10} + \omega_{11}\left(\sigma_{t-1}^{Ja}\right)^2 + \omega_1^{Ja}\left(\varepsilon_{t-1}^{Ja}\right)^2 + \omega_1^{EA}\left(\varepsilon_{t-1}^{EA}\right)^2 + \omega_1^{US}\left(\varepsilon_{t-1}^{US}\right)^2 \tag{9.d}$$

$$\left(\sigma_t^{EA}\right)^2 = \omega_{20} + \omega_{21}\left(\sigma_{t-1}^{EA}\right)^2 + \omega_2^{Ja}\left(\varepsilon_t^{Ja}\right)^2 + \omega_2^{EA}\left(\varepsilon_{t-1}^{EA}\right)^2 + \omega_2^{US}\left(\varepsilon_{t-1}^{US}\right)^2 \tag{9.e}$$

$$\left(\sigma_t^{US}\right)^2 = \omega_{30} + \omega_{31}\left(\sigma_{t-1}^{US}\right)^2 + \omega_3^{Ja}\left(\varepsilon_t^{Ja}\right)^2 + \omega_3^{EA}\left(\varepsilon_t^{EA}\right)^2 + \omega_3^{US}\left(\varepsilon_{t-1}^{US}\right)^2 \tag{9.f}$$

and the covariance equations:

$$\sigma_t^{k,o} = \rho^{k,o}\left(\sigma_t^k \sigma_t^o\right) \quad for\ k,o = Ja, EA, US,\ \ k \neq o \tag{9.g}$$

	interest rate transmission			**volatility transmission**			**correlation**	
	from:			from:			between:	
	Japan	Euro area	USA	Japan	Euro area	USA	Japan	Euro area
to:	β^{Ja}	β^{EA}	β^{US}	ω^{Ja}	ω^{EU}	ω^{US}	$\rho^{Ja,o}$	$\rho^{EA,o}$
1986-1992								
Japan	---	0.082	0.058 **	0.189 **	0.020 **	0.016 *		
		(0.102)	(0.017)	(0.070)	(0.007)	(0.008)		
Germany	0.014 **	---	0.078 **	0.008	0.503 **	0.024	0.047	
	(0.004)		(0.007)	(0.010)	(0.017)	(0.017)	(0.031)	
USA	0.011	0.012	---	-0.001	0.022	0.125 **	-0.032	-0.062
	(0.022)	(0.021)		(0.002)	(0.040)	(0.013)	(0.061)	(0.052)
1993-1998								
Japan	---	-0.024	0.022 *	0.197 **	0.031	-0.001		
		(0.039)	(0.011)	(0.021)	(0.022)	(0.002)		
Germany	0.007	---	0.041 **	0.024 **	0.188 **	0.014 **	0.064	
	(0.022)		(0.013)	(0.008)	(0.013)	(0.004)	(0.054)	
USA	0.013	0.012 *	---	-0.001	-0.001	0.117 **	0.041	0.066
	(0.019)	(0.006)		(0.001)	(0.002)	(0.009)	(0.046)	(0.053)
1999-4/2001								
Japan	---	0.038	0.015	0.201 **	-0.017	0.021 *		
		(0.045)	(0.009)	(0.041)	(0.025)	(0.010)		
Euro area	0.022	---	0.043 **	0.011	0.049 **	0.022	0.082	
	(0.024)		(0.012)	(0.013)	(0.009)	(0.013)	(0.180)	
USA	0.013	0.016 *	---	-0.003	0.031	0.223 **	-0.063	0.057
	(0.010)	(0.008)		(0.028)	(0.069)	(0.028)	(0.157)	(0.097)

Note: Standard errors are in parentheses.** and * indicate significance at the 1% and 10% level, respectively.

Table 3: Key dates of exchange rate regime changes in European countries

Country:	*Regime changes:*
Austria	Before 9/1/95: peg to composite of ERM currencies; 9/1/95: Austria joins ERM at +-15%
Belgium	Before 2/8/93: ERM member with +- 2.25% bands; 2/8/93 – 31/12/98: ERM member with +- 15% bands
Denmark	Before 2/8/93: ERM member with +- 2.25% bands; 2/8/93 – 31/12/98: ERM member with +- 15% bands; since 1/1/99: ERM member with +- 2.25% bands
Finland	Before 14/10/96: peg with bands to ECU with some realignments; 14/10/96: Finland joins the ERM with +-15% bands
France	Before 2/8/93: ERM member with +- 2.25% bands; 2/8/93 – 31/12/98: ERM member with +- 15% bands
Greece	Before 15/3/98: MF with some interventions vis-à-vis US$ and DM; 15/3/98: Greece joins the ERM with +-15% bands
Ireland	Before 2/8/93: ERM member with +- 2.25% bands; 2/8/93 – 31/12/98: ERM member with +- 15% bands
Italy	Before 18/9/92: ERM member with bands being narrowed stepwise to +- 2.25%; 18/9/92: Italy drops out from ERM; 25/11/96: Italy rejoins ERM at 1906 to ECU and +-15% bands
Netherlands	Stable within ERM; maintains narrow bands towards DM also after 2/8/93
Norway	Managed float with some interventions to stabilize exchange rate
Portugal	6/4/92: Portugal joins the ERM with +-6% bands; 2/8/93 – 31/12/98: ERM member with +- 15% bands
Sweden	Managed float with some interventions to stabilize exchange rate
Spain	19/6/89: Spain joins the ERM with +-6% bands; 2/8/93 – 31/12/98: ERM member with +- 15% bands
UK	8/10/90: UK joins the ERM with +/-2.25% bands; 16/9/92: UK drops out from ERM

Sources: IMF Exchange Rate Arrangements and Restrictions; NCBs.

Table 4: GARCH results for interest rate transmission under alternative exchange rate regimes: Developed Countries

EURO AREA COUNTRIES

to:	transmission from: Germany β^{Ge}	USA β^{US}	Japan β^{Ja}	ADF test
Austria				
pre-ERM:	0.71 **	0.53 **	-0.11	-16.09 **
1/1/91 - 8/1/95	(0.14)	(0.09)	(0.09)	
ERM:	0.98 **	0.41 **	0.09	-21.72 **
9/1/95 - 31/12/98	(0.15)	(0.10)	(0.09)	
Belgium				
narrow ERM:	1.36 **	0.53 **	0.40 **	-29.15 **
01/01/89 - 31/7/92	(0.21)	(0.12)	(0.12)	
ERM crisis:	2.61 **	1.70 **	0.21	-24.34 **
1/8/92 - 31/7/93	(0.16)	(0.12)	(0.16)	
wide ERM:	0.95 **	0.62 **	0.45	-22.53 **
1/8/93 - 31/12/98	(0.25)	(0.25)	(0.31)	
Finland				
pre-ERM:	1.16 **	-0.38	-0.13	-28.87 **
1/1/87 - 13/10/96	(0.17)	(0.33)	(0.24)	
ERM:	1.84 **	0.75 **	0.04	-30.18 **
14/10/96 - 31/12/98	(0.11)	(0.22)	(0.14)	
France				
narrow ERM:	1.23 **	0.39 *	-0.03	-27.43 **
01/01/89 - 31/7/92	(0.28)	(0.18)	(0.14)	
ERM crisis:	1.33 **	0.38 *	-0.11	-28.07 **
1/8/92 - 31/7/93	(0.28)	(0.18)	(2.59)	
wide ERM:	1.14 **	0.54	0.17	-27.18 **
1/8/93 - 31/12/98	(0.32)	(0.48)	(0.48)	
Greece				
pre-ERM:	1.03 **	0.51 *	0.09	-21.70 **
1/11/94 - 14/3/98	(0.22)	(0.25)	(0.36)	
ERM:	1.12 **	0.31 *	0.11	-25.39 **
15/3/98 - 31/12/00	(0.25)	(0.15)	(0.33)	

to:	transmission from: Germany β^{Ge}	USA β^{US}	Japan β^{Ja}	ADF test
Ireland				
narrow ERM:	0.68 **	0.32 **	0.05	-32.68 **
01/01/89 - 31/7/92	(0.12)	(0.10)	(0.33)	
ERM crisis:	0.33 *	0.06	-0.11	-33.36 **
1/8/92 - 31/7/93	(0.11)	(0.08)	(0.21)	
wide ERM:	0.98 **	0.12 *	-0.03	-32.94 **
1/8/93 - 31/12/98	(0.08)	(0.06)	(0.08)	
Italy				
narrow ERM:	0.56 *	-0.21	-0.30	-33.72 **
01/01/89 - 31/7/92	(0.39)	(0.33)	(0.33)	
non-ERM:	0.72 **	0.47 *	0.26	-35.16 **
1/8/92 - 24/11/96	(0.13)	(0.26)	(0.30)	
wide ERM:	0.75 **	0.22 *	0.12	-34.54 **
25/11/96 - 31/12/98	(0.22)	(0.12)	(0.21)	
Netherlands				
narrow ERM:	0.94 **	0.21 **	0.04	-27.74 **
01/01/89 - 31/7/92	(0.07)	(0.03)	(0.06)	
ERM crisis:	1.12 **	-0.45	0.11	-26.65 **
1/8/92 - 31/7/93	(0.13)	(0.35)	(0.13)	
wide ERM:	1.07 **	0.28 **	0.31 **	-27.52 **
1/8/93 - 31/12/98	(0.14)	(0.06)	(0.06)	
Portugal				
wide ERM:	1.89 **	0.25	0.78	-24.52 **
1/8/93 - 31/12/98	(0.31)	(0.54)	(0.49)	
Spain				
narrow ERM:	1.12 **	1.01 **	-0.32	-28.71 **
01/01/89 - 31/7/92	(0.23)	(0.36)	(0.39)	
ERM crisis:	0.74 **	0.23 *	0.03	-23.76 **
1/8/92 - 31/7/93	(0.28)	(0.12)	(0.22)	
wide ERM:	1.11 **	0.42 *	0.11	-28.09 **
1/8/93 - 31/12/98	(0.22)	(0.22)	(0.33)	

NON-EURO AREA COUNTRIES

to:	transmission from: Euro area β^{EA}	USA β^{US}	Japan β^{Ja}	ADF test
Denmark				
ERM crisis:	0.88 **	0.15	0.12	-25.99 **
1/8/92 - 31/7/93	(0.38)	(0.18)	(0.14)	
wide ERM:	1.13 **	0.12	0.09	-27.75 **
1/8/93 - 31/12/98	(0.22)	(0.21)	(0.09)	
narrow ERM:	1.19 **	-0.05	-0.14	-28.20 **
1/1/99 - 30/1/01	(0.23)	(0.12)	(0.13)	
Norway				
non-ERM 1:	0.45 *	-0.12	-0.08	-25.81 **
1/1/93 - 31/12/98	(0.22)	(0.12)	(0.12)	
non-ERM 2:	0.54 **	0.22 *	0.12	-24.30 **
1/1/99 - 30/1/01	(0.24)	(0.11)	(0.11)	
Sweden				
non-ERM 1:	0.55 **	0.23 *	0.05	-19.79 **
1/1/93 - 31/12/98	(0.21)	(0.11)	(0.28)	
non-ERM 2:	0.68 **	0.15 *	-0.12	-21.26 **
1/1/99 - 30/1/01	(0.24)	(0.07)	(0.12)	
UK				
narrow ERM:	1.09 **	0.23 *	-0.17	-40.49 **
8/10/90 - 16/9/92	(0.29)	(0.12)	(0.27)	
non-ERM 1:	0.74 *	-0.16	-0.36	-41.54 **
17/9/92 - 31/12/98	(0.36)	(0.42)	(0.22)	
non-ERM 2:	0.37 **	0.33 **	0.11	39.84 **
1/1/99 - 30/1/01	(0.08)	(0.12)	(0.24)	
Australia				
period 1:	-0.11	0.35 **	0.22 *	-33.26 **
01/01/89 - 31/12/95	(0.22)	(0.12)	(0.11)	
period 2:	0.12	0.39 **	0.19 *	-33.36 **
1/1/96 - 30/1/01	(0.11)	(0.17)	(0.10)	
Canada				
period 1:	0.50 *	0.67 **	0.18	-32.07 **
01/01/89 - 31/12/95	(0.22)	(0.27)	(0.14)	
period 2:	0.44 *	1.07 **	0.15	-29.89 **
1/1/96 - 30/1/01	(0.27)	(0.27)	(0.18)	

Note: ADF shows the test augmented Dickey-Fuller test for the null hypothesis of a unit root in the residual. Standard errors are in parentheses. ** and * indicate significance at the 1% and 10% level.

Table 5: Error correction model (ECM) results for interest rate transmission under alternative exchange rate regimes: Developed Countries

EURO AREA COUNTRIES

	ECR adjustment α	transmission from: Germany Γ^{Ge}	USA Γ^{US}	Japan Γ^{Ja}
Austria				
pre-ERM:	-0.0041 **	0.18 **	-0.02	-0.002
1/1/91 - 8/1/95	(0.0003)	(0.01)	(0.03)	(0.002)
ERM:	-0.0075 **	0.32 **	0.019	-0.001
9/1/95 - 31/12/98	(0.0004)	(0.02)	(0.013)	(0.003)
Belgium				
narrow ERM:	-0.0051 **	0.40 **	0.10 **	-0.002
01/01/89 - 31/7/92	(0.0007)	(0.04)	(0.04)	(0.006)
ERM crisis:	-0.0070 *	0.62 **	0.38 **	0.04
1/8/92 - 31/7/93	(0.0041)	(0.07)	(0.14)	(0.06)
wide ERM:	-0.0067 **	0.57 **	0.09 **	0.006
1/8/93 - 31/12/98	(0.0009)	(0.03)	(0.02)	(0.008)
Finland				
pre-ERM:	-0.0036 **	0.15 *	0.03	-0.006
1/1/87 - 13/10/96	(0.0008)	(0.08)	(0.09)	(0.005)
ERM:	-0.0048 **	0.21 **	0.01	0.003
14/10/96 - 31/12/98	(0.0012)	(0.03)	(0.02)	(0.005)
France				
narrow ERM:	-0.0047 **	0.23 **	0.08 **	-0.001
01/01/89 - 31/7/92	(0.0004)	(0.02)	(0.03)	(0.002)
ERM crisis:	-0.0071 **	0.62 **	-0.26	0.001
1/8/92 - 31/7/93	(0.0009)	(0.14)	(0.33)	(0.04)
wide ERM:	-0.0071 **	0.45 **	0.04	0.001
1/8/93 - 31/12/98	(0.0012)	(0.09)	(0.06)	(0.006)
Greece				
pre-ERM:	-0.0033 **	0.39 **	0.31 **	0.03 **
1/11/94 - 14/3/98	(0.0011)	(0.06)	(0.04)	(0.01)
ERM:	-0.0094 **	0.47 **	0.37 **	0.04 *
15/3/98 - 31/12/00	(0.0014)	(0.07)	(0.04)	(0.02)

	ECR adjustment α	transmission from: Germany Γ^{Ge}	USA Γ^{US}	Japan Γ^{Ja}
Ireland				
narrow ERM:	-0.0052 **	0.24 **	0.13 **	-0.005
01/01/89 - 31/7/92	(0.0009)	(0.05)	(0.03)	(0.003)
ERM crisis:	-0.0039 **	0.29 **	-0.12	-0.01
1/8/92 - 31/7/93	(0.0015)	(0.09)	(0.15)	(0.03)
wide ERM:	-0.0066 **	0.37 **	-0.04	-0.005
1/8/93 - 31/12/98	(0.0022)	(0.05)	(0.03)	(0.005)
Italy				
narrow ERM:	-0.0023 **	0.28 **	-0.11	-0.001
01/01/89 - 31/7/92	(0.0006)	(0.09)	(0.08)	(0.005)
non-ERM:	-0.0054 **	0.50 **	0.12	-0.003
1/8/92 - 24/11/96	(0.0022)	(0.08)	(0.09)	(0.007)
wide ERM:	-0.0087 **	0.51 **	0.08	-0.01
25/11/96 - 31/12/98	(0.0019)	(0.07)	(0.08)	(0.01)
Netherlands				
narrow ERM:	-0.0055 **	0.33 **	0.03 *	-0.01
01/01/89 - 31/7/92	(0.0012)	(0.02)	(0.018)	(0.01)
ERM crisis:	-0.0021 *	0.39 **	-0.02	-0.01
1/8/92 - 31/7/93	(0.0011)	(0.03)	(0.06)	(0.01)
wide ERM:	-0.0072 **	0.35 **	0.04 **	0.000
1/8/93 - 31/12/98	(0.001)	(0.01)	(0.01)	(0.001)
Portugal				
wide ERM:	-0.0035 **	0.46 *	-0.24	-0.007
1/8/93 - 31/12/98	(0.0014)	(0.29)	(0.22)	(0.013)
Spain				
narrow ERM:	-0.0042 **	0.26 **	0.11 *	-0.012
01/01/89 - 31/7/92	(0.0013)	(0.07)	(0.06)	(0.008)
ERM crisis:	0.0025	0.25	0.16	-0.016
1/8/92 - 31/7/93	(0.0019)	(0.14)	(0.25)	(0.017)
wide ERM:	-0.0059 **	0.36 **	-0.001	-0.013
1/8/93 - 31/12/98	(0.0008)	(0.06)	(0.044)	(0.004)

NON-EURO AREA COUNTRIES

	ECR adjustment α	transmission from: Euro area Γ^{EA}	USA Γ^{US}	Japan Γ^{Ja}
Denmark				
ERM crisis:	-0.0033 **	0.19 *	0.02	0.003
1/8/92 - 31/7/93	(0.0011)	(0.09)	(0.02)	0.005
wide ERM:	-0.0042 **	0.17 *	0.12 **	0.01
1/8/93 - 31/12/98	(0.0013)	(0.09)	(0.05)	(0.02)
narrow ERM:	-0.0059 **	0.24 **	0.08	0.003
1/1/99 - 30/1/01	(0.0014)	(0.11)	(0.06)	(0.003)
Norway				
non-ERM 1:	-0.0016 *	0.26 **	0.01	0.006
1/1/93 - 31/12/98	(0.0008)	(0.08)	(0.04)	(0.004)
non-ERM 2:	-0.0025 *	0.25 *	-0.08	0.006
1/1/99 - 30/1/01	(0.0012)	(0.09)	(0.08)	(0.010)
Sweden				
non-ERM 1:	-0.0040 *	0.14 **	-0.02	-0.007
1/1/93 - 31/12/98	(0.0024)	(0.03)	(0.03)	(0.028)
non-ERM 2:	-0.0036 **	0.20 **	0.03 *	0.004
1/1/99 - 30/1/01	(0.0014)	(0.05)	(0.016)	(0.003)
UK				
narrow ERM:	-0.0054 **	0.29 **	0.06	-0.004
8/10/90 - 16/9/92	(0.0022)	(0.06)	(0.06)	(0.02)
non-ERM 1:	-0.0037 *	0.16 **	0.09 *	-0.018
17/9/92 - 31/12/98	(0.0018)	(0.05)	(0.04)	(0.012)
non-ERM 2:	-0.0035 *	0.21 **	0.09 *	0.009
1/1/99 - 30/1/01	(0.0017)	(0.09)	(0.04)	(0.05)
Australia				
period 1:	-0.0021 **	0.053	0.070 *	-0.004
01/01/89 - 31/12/95	(0.0008)	(0.040)	(0.036)	(0.02)
period 2:	-0.0024 **	0.014	0.10 *	-0.01
1/1/96 - 30/1/01	(0.0009)	(0.043)	(0.05)	(0.02)
Canada				
period 1:	-0.0013 **	0.008	0.21 **	-0.003
01/01/89 - 31/12/95	(0.0004)	(0.051)	(0.04)	(0.003)
period 2:	-0.0019 **	0.03	0.50 **	0.01 *
1/1/96 - 30/1/01	(0.0005)	(0.03)	(0.06)	(0.005)

Note: Standard errors are in parentheses. ** and * indicate significance at the 1% and 10% level, respectively.

Table 6: Key dates of exchange rate regime changes in emerging markets

Country:	*Regime changes:*
Czech Republic	Until 1996: peg to DM (65%) and US$ (35%) with +- 0.5% bands ; 28/2/96: band widened to +- 7.5% ; 27/5/97: floating of koruna, some managed float, i.e. intervention to smooth fluctuations
Hungary	1991-1995: peg with periodic adjustments and weights US$ - DM 50% - 50% ; 13/3/95: 8.3% devaluation, reweighting (70% DM, 30% US$) and crawl with bands of +-2.25% ; repeated widening of bands and changes in monthly target rate of depreciation
Poland	before 14/10/91: peg, then crawl with 1.8% depreciation per month ; 1/1/95: introduction of new currency ; 16/5/95: band widened to +- 7% ; 1995-99: band widened several times and depreciation rate reduced to 0.5% p.m.; 1/1/99: change weights in peg to Euro (55%) and US$ (45%); 24/3/99: band widened to +-15%; reduction of monthly depreciation from 0.5% to 0.3% ; 12/4/2000: floating of zloty
Argentina	Currency board system since April 1991
Chile	Until 1997: Exchange rate bands, repeatedly widened, to basket of three currencies (US$, DM, yen); 1997-2000: widening of bands to 12.5% and increased weight to US$) 2000: floating of currency
Mexico	Until 22/12/94: crawling peg with bands that were widened continuously; Since 22/12/94: floating of peso; since 1/8/96: market interventions of BOM via monthly auctions to buy US$ from financial institutions
Hong Kong	Currency board system
Indonesia	Before 13/8/97: crawl with repeated widening of bands to finally 12% in July 1997; 13/8/97: termination of crawl and adoption of floating exchange rate system
Korea	Before 15/12/97: tightly managed float against US $ within +/- 2.25%, depending on previous day's average rate; repeated widening of bands; 15/12/97: (independent) floating
Malaysia	until 1991: trade-weighted basket peg, with US$ as intervention currency; 1991: change to managed float without reference to previous day's value
Singapore	Managed float since 1980s; Monetary Authorities of Singapore (MAS) may intervene but margins and weights to specific currencies are not made public
Thailand	Before 2/7/97: peg to weighted (secret) basket of trading partners (mainly US$); Since 2/7/97: (independent) floating

Sources: IMF Exchange Rate Arrangements and Restrictions; NCBs.

Table 7: GARCH results for interest rate transmission under alternative exchange rate regimes: Emerging Markets

EASTERN EUROPEAN, LATIN AMERICAN AND SOUTHEAST/EAST ASIAN COUNTRIES

to:	transmission from: Euro area β^{EA}	USA β^{US}	Japan β^{Ja}	ADF test
EASTERN EUROPE:				
Czech Republic				
peg:	1.12 **	0.65 **	0.05	-23.91 **
1/1/93 - 31/3/97	(0.12)	(0.13)	(0.14)	
crisis:	1.25 **	0.61 **	-0.07	-21.48 **
1/4/97 - 31/12/97	(0.06)	(0.07)	(0.08)	
managed float:	1.56 **	0.34 **	0.11	-24.37 **
1/1/98 - 30/1/01	(0.33)	(0.15)	(0.15)	
Hungary				
narrow peg:	1.31 **	0.67 **	0.33	-20.47 **
1/10/95 - 31/12/98	(0.06)	(0.06)	(0.45)	
wider peg:	1.88 **	0.25 **	0.01	-20.42 **
1/1/99 - 30/1/01	(0.10)	(0.06)	(0.03)	
Poland				
peg:	0.54 **	0.66 **	0.07	-19.66 **
1/7/93 - 15/5/95	(0.07)	(0.10)	(0.14)	
crawl:	1.31 **	0.52 **	0.07	-30.64 **
16/5/95 - 11/4/00	(0.05)	(0.09)	(0.08)	
float:	1.09 **	0.47 **	0.55	-27.98 **
12/4/00 - 30/1/01	(0.36)	(0.22)	(0.51)	
LATIN AMERICA:				
Argentina				
crisis:	0.13	4.19 **	-0.09	-20.77 **
1/1/94 - 30/6/95	(0.29)	(0.19)	(0.33)	
currency board:	-0.07	1.44 **	0.06	-21.35 **
1/7/95 - 30/1/01	(0.30)	(0.41)	(0.05)	
Chile				
bands:	0.28	0.98 **	0.07	-23.95 **
1/1/94 - 30/6/97	(0.21)	(0.23)	(0.19)	
wide bands/float:	0.56	1.50 **	0.28	-24.65 **
1/7/97 - 30/1/01	(0.51)	(0.43)	(0.21)	

to:	transmission from: Euro area β^{EA}	USA β^{US}	Japan β^{Ja}	ADF test
LATIN AMERICA (cont.):				
Mexico				
peg:	0.11	1.45 **	0.11	-23.69 **
1/1/93 - 30/11/94	(0.12)	(0.32)	(0.26)	
crisis:	0.06	1.09 **	0.12	-20.08 **
1/12/94 - 30/6/95	(0.15)	(0.35)	(0.18)	
float:	0.22 **	1.46 **	-0.07	-23.89 **
1/7/95 - 30/1/01	(0.09)	(0.08)	(0.14)	
SOUTHEAST/EAST ASIA:				
Hong Kong				
currency board:	0.02	1.06 **	0.05	-22.59 **
1/1/92 - 30/6/97	(0.02)	(0.02)	(0.04)	
crisis:	0.03	0.85 **	0.13	-13.86 **
1/7/97 - 30/6/98	(0.05)	(0.42)	(0.11)	
currency board:	0.10	1.22 **	0.21	-23.49 **
1/7/98 - 30/1/01	(0.12)	(0.22)	(0.15)	
Indonesia				
crawl:	-0.20	1.61 **	0.43 **	-32.61 **
1/6/94 - 30/6/97	(0.20)	(0.28)	(0.20)	
crisis:	0.33	3.40 **	1.33 **	-34.22 **
1/7/97 - 30/6/98	(0.55)	(0.54)	(0.33)	
float:	0.79	2.91 **	0.66	-33.93 **
1/7/98 - 30/1/01	(0.66)	(0.14)	(0.55)	
Korea				
bands:	0.73 **	2.51 **	1.13 **	-22.23 **
1/1/92 - 30/6/97	(0.26)	(0.07)	(0.08)	
crisis:	0.55 *	2.44 **	0.88 **	-22.42 **
1/7/97 - 30/6/98	(0.29)	(0.99)	(0.41)	
float:	-0.26	2.59 **	0.23 *	-22.08 **
1/7/98 - 30/1/01	(0.24)	(0.17)	(0.12)	

to:	transmission from: Euro area β^{EA}	USA β^{US}	Japan β^{Ja}	ADF test
SOUTHEAST/EAST ASIA (cont.):				
Malaysia				
managed float:	0.53 *	1.76 **	0.45 **	-26.08 **
1/8/93 - 30/6/97	(0.29)	(0.22)	(0.15)	
crisis:	0.36	1.99 **	1.11 **	-22.69 **
1/7/97 - 30/6/98	(0.22)	(0.25)	(0.19)	
managed float:	0.55 *	1.85 **	0.38	-23.56 **
1/7/98 - 30/1/01	(0.29)	(0.44)	(0.40)	
Singapore				
managed float:	-0.11	0.33 **	0.23 **	-31.52 **
1/1/92 - 30/6/97	(0.15)	(0.12)	(0.11)	
crisis:	0.09	0.87 **	0.33 **	-27.56 **
1/7/97 - 30/6/98	(0.15)	(0.19)	(0.15)	
float:	0.09	0.51 **	0.18 **	-31.08 **
1/7/98 - 30/1/01	(0.09)	(0.02)	(0.02)	
Thailand				
peg:	0.11	1.09 **	0.22 **	-24.95 **
1/1/92 - 30/6/97	(0.12)	(0.22)	(0.10)	
crisis:	-0.33 **	3.20 **	1.20 **	-25.92 **
1/7/97 - 30/6/98	(0.12)	(0.45)	(0.55)	
float:	0.19 *	2.56 **	0.29 *	-25.25 **
1/7/98 - 30/1/01	(0.09)	(0.24)	(0.14)	

Note: ADF shows the test augmented Dickey-Fuller test for the null hypothesis of a unit root in the residual. Standard errors are in parentheses. ** and * indicate significance at the 1% and 10% level.

Table 8: Error correction model (ECM) results for interest rate transmission under alternative exchange rate regimes: Emerging Markets

EASTERN EUROPEAN, LATIN AMERICAN AND SOUTHEAST/EAST ASIAN COUNTRIES

	ECR adjustment α	transmission from: Euro area Γ^{EA}	USA Γ^{US}	Japan Γ^{Ja}
EASTERN EUROPE:				
Czech Republic				
peg:	-0.005 **	0.48 **	0.23 **	-0.03
1/1/93 - 31/3/97	(0.0018)	(0.11)	(0.06)	(0.06)
crisis:	-0.003 *	0.62 *	0.09 *	0.06
1/4/97 - 31/12/97	(0.0012)	(0.31)	(0.05)	(0.06)
managed float:	-0.007 **	0.53 **	0.22 **	0.03
1/1/98 - 30/1/01	(0.002)	(0.14)	(0.10)	(0.04)
Hungary				
narrow peg:	-0.008 **	0.28 **	0.39 **	0.03
1/10/95 - 31/12/98	(0.001)	(0.06)	(0.14)	(0.04)
wider peg:	-0.009 *	0.57 **	0.12 *	0.00
1/1/99 - 30/1/01	(0.004)	(0.12)	(0.06)	(0.04)
Poland				
peg:	-0.004 **	0.59 **	0.48 **	0.08
1/7/93 - 15/5/95	(0.001)	(0.07)	(0.07)	(0.10)
crawl:	-0.006 **	0.48 **	0.29 **	0.11
16/5/95 - 11/4/00	(0.002)	(0.11)	(0.12)	(0.11)
float:	-0.008 **	0.48 **	0.18 **	0.006
12/4/00 - 30/1/01	(0.003)	(0.17)	-0.06	(0.055)
LATIN AMERICA:				
Argentina				
crisis:	-0.019 **	-0.17	1.19 *	-0.02
1/1/94 - 30/6/95	(0.006)	(0.94)	(0.61)	(0.06)
currency board:	-0.018 **	0.003	0.84 **	0.03
1/7/95 - 30/1/01	(0.003)	(0.16)	(0.24)	(0.03)
Chile				
bands:	-0.005 **	0.08	0.57 **	-0.01
1/1/94 - 30/6/97	(0.002)	(0.18)	(0.25)	(0.02)
wide bands/float:	-0.005 *	-0.12	0.38 **	-0.01
1/7/97 - 30/1/01	(0.003)	(0.39)	(0.17)	(0.02)

	ECR adjustment α	transmission from: Euro area Γ^{EA}	USA Γ^{US}	Japan Γ^{Ja}
LATIN AMERICA (cont.):				
Mexico				
peg:	-0.011 **	0.20	0.39 **	0.08
1/1/93 - 30/11/94	(0.004)	(0.23)	(0.15)	(0.12)
crisis:	0.003	-0.01	0.61 **	0.21
1/12/94 - 30/6/95	(0.004)	(0.20)	(0.27)	(0.33)
float:	-0.005 **	-0.09	0.68 **	-0.09
1/7/95 - 30/1/01	(0.003)	(0.40)	(0.18)	(0.22)
SOUTHEAST/EAST ASIA:				
Hong Kong				
currency board:	-0.021 **	0.03	0.62 **	0.30 *
1/1/92 - 30/6/97	(0.003)	(0.05)	(0.05)	(0.17)
crisis:	-0.011 **	0.24	0.45 **	0.18
1/7/97 - 30/6/98	(0.005)	(0.23)	(0.19)	(0.15)
currency board:	-0.018 **	-0.01	0.83 **	0.12
1/7/98 - 30/1/01	(0.003)	(0.07)	(0.05)	(0.34)
Indonesia				
crawl:	-0.013 **	0.03	0.75 **	0.15 *
1/6/94 - 30/6/97	(0.002)	(0.08)	(0.08)	(0.08)
crisis:	-0.004	0.21	0.78	-0.31
1/7/97 - 30/6/98	(0.011)	(0.23)	(0.52)	(0.33)
float:	-0.005 *	0.04	0.74 **	-0.01
1/7/98 - 30/1/01	(0.0025)	(0.07)	(0.07)	(0.03)
Korea				
bands:	-0.006 **	-0.01	0.31 **	0.20 *
1/1/92 - 30/6/97	(0.001)	(0.15)	(0.10)	(0.11)
crisis:	-0.006 **	-0.23	2.21 **	0.30 *
1/7/97 - 30/6/98	(0.001)	(0.15)	(0.82)	(0.15)
float:	-0.009 **	0.03	0.48 **	0.18 *
1/7/98 - 30/1/01	(0.002)	(0.08)	(0.12)	(0.10)

	ECR adjustment α	transmission from: Euro area Γ^{EA}	USA Γ^{US}	Japan Γ^{Ja}
SOUTHEAST/EAST ASIA (cont.):				
Malaysia				
managed float:	-0.005 *	0.09	0.24 **	0.01
1/8/93 - 30/6/97	(0.0025)	(0.07)	(0.06)	(0.01)
crisis:	-0.005 *	0.08	0.26 *	0.12
1/7/97 - 30/6/98	(0.003)	(0.06)	(0.14)	(0.30)
managed float:	-0.006 **	0.08	0.27 **	0.21
1/7/98 - 30/1/01	(0.003)	(0.11)	(0.12)	(0.14)
Singapore				
managed float:	-0.005 **	-0.05	0.31 **	0.07
1/1/92 - 30/6/97	(0.002)	(0.08)	(0.12)	(0.08)
crisis:	-0.004 *	0.09	0.50 **	0.48 **
1/7/97 - 30/6/98	(0.002)	(0.15)	(0.04)	(0.05)
float:	-0.008 **	-0.03	0.32 **	0.15
1/7/98 - 30/1/01	(0.004)	(0.08)	(0.12)	(0.12)
Thailand				
peg:	-0.012 **	0.13	0.25 **	0.09
1/1/92 - 30/6/97	(0.003)	(0.19)	(0.08)	(0.12)
crisis:	-0.009	0.08	0.56 **	0.22
1/7/97 - 30/6/98	(0.005)	(0.32)	(0.23)	(0.15)
float:	-0.006 *	0.12	0.33 **	0.15
1/7/98 - 30/1/01	(0.003)	(0.15)	(0.05)	(0.12)

Table 9: Effects of announcements of monetary policy surprises in the USA, Germany/euro area and Japan

	interest rate transmission for interest rate levels			interest rate transmission for first differences in ECM		
	from: Euro area $\beta^{EA}+\eta^{EA}$	USA $\beta^{US}+\eta^{US}$	Japan $\beta^{Ja}+\eta^{Ja}$	from: Euro area $\Gamma^{EA}+\eta^{EA}$	USA $\Gamma^{US}+\eta^{US}$	Japan $\Gamma^{Ja}+\eta^{Ja}$
DEVELOPED COUNTRIES						
Austria	1.13 **+	0.94 **+	0.26 **+	0.89 **+	0.05	0.04
1/1991-1/2001	(0.13)	(0.11)	(0.14)	(0.12)	(0.05)	(0.05)
Belgium	1.43 **	1.03 **+	0.26	0.93 **+	0.17 **+	0.09
1/1989-1/2001	(0.23)	(0.33)	(0.23)	(0.19)	(0.07)	(0.08)
Finland	1.35 **	1.14 **+	0.23	0.55 **+	0.19 *+	0.03
1/1989-1/2001	(0.08)	(0.21)	(0.14)	(0.12)	(0.09)	(0.08)
France	1.49 **+	0.77 **+	0.26	0.89 **+	0.18 **+	0.08
1/1989-1/2001	(0.08)	(0.14)	(0.19)	(0.27)	(0.06)	(0.09)
Greece	1.86 **+	1.17 **+	0.32	0.62 **	0.45 **+	0.09
1/1994-1/2001	(0.23)	(0.21)	(0.20)	(0.17)	(0.19)	(0.08)
Ireland	1.09 **	0.87 **+	0.33 *+	0.58 **+	0.18 **+	0.12
1/1989-1/2001	(0.09)	(0.23)	(0.15)	(0.20)	(0.07)	(0.14)
Italy	1.28 **+	0.87 **+	0.22	0.72 **+	0.23 *+	0.11
1/1989-1/2001	(0.22)	(0.21)	(0.17)	(0.14)	(0.11)	(0.12)
Netherlands	1.22 **	0.99 **+	0.35 **+	0.76 **+	0.28 **+	0.12 **+
1/1989-1/2001	(0.07)	(0.09)	(0.12)	(0.07)	(0.08)	(0.05)
Portugal	1.65 **	0.97 **+	0.24	0.54 **	0.19 **+	0.08
1/1993-1/2001	(0.19)	(0.17)	(0.21)	(0.20)	(0.08)	(0.07)
Spain	1.31 **+	0.88 **+	0.33 *+	0.43 **+	0.19 **+	0.09 *+
1/1989-1/2001	(0.09)	(0.14)	(0.16)	(0.17)	(0.08)	(0.05)
Denmark	1.33 **+	0.88 **+	0.35	0.83 **+	0.11	-0.09
1/1993-1/2001	(0.09)	(0.08)	(0.23)	(.17)	(0.12)	(0.13)
Norway	1.13 **+	1.27 **+	0.36	0.42 **+	0.19 *+	0.04
1/1993-1/2001	(0.24)	(0.16)	(0.32)	(0.14)	(0.09)	(0.07)
Sweden	1.27 **+	0.87 **+	0.36	0.47 **+	0.27 **+	-0.09
1/1993-1/2001	(0.09)	(0.21)	(0.27)	(0.08)	(0.09)	(0.14)
UK	1.29 **+	1.71 **+	0.22	0.32 *+	0.27 *+	0.08
1/1989-1/2001	(0.11)	(0.21)	(0.23)	(0.16)	(0.13)	(0.10)
Australia	0.68 **+	0.83 **+	0.75 **+	0.21	0.29 **+	0.09
1/1989-1/2001	(0.12)	(0.05)	(0.32)	(0.19)	(0.09)	(0.11)
Canada	0.65 *	1.41 **+	0.29	0.07	0.68 **+	-0.07
1/1989-1/2001	(0.21)	(0.03)	(0.23)	(0.11)	(0.15)	(0.09)
EMERGING MARKETS						
Czech Republic	1.60 **+	1.75 **+	0.72	0.74 **+	0.61 **+	-0.23
1/1993-1/2001	(0.09)	(0.15)	(0.55)	(0.27)	(0.25)	(0.12)
Hungary	3.68 **+	3.22 **+	n/a	0.66 **+	0.73 **+	n/a
1/1995-1/2001	(0.55)	(0.35)		(0.30)	(0.22)	
Poland	5.03 **+	4.47 **+	1.21 **+	1.15 **+	0.78 **+	0.12
1/1993-1/2001	(0.17)	(0.36)	(0.45)	(0.15)	(0.33)	(0.18)
Argentina	1.35 **+	2.10 **+	1.20 **+	-0.27	1.23 **+	0.22
1/1994-1/2001	(0.11)	(0.23)	(0.35)	(0.25)	(0.22)	(0.19)
Chile	0.56	1.98 **	0.31	0.45	0.68 **+	-0.12
1/1994-1/2001	(0.44)	(0.27)	(0.29)	(0.63)	(0.09)	(0.18)
Mexico	0.66 *+	1.41 **+	0.30	0.25	0.71 **+	0.31
1/1993-1/2001	(0.33)	(0.22)	(0.19)	(0.20)	(0.14)	(0.25)
Hong Kong	0.33	1.08 **	0.35	0.12	1.01 **	0.15
1/1992-1/2001	(0.35)	(0.25)	(0.22)	(.11)	(0.12)	(0.11)
Indonesia	0.98 *+	3.74 **+	1.12 *	0.14 *	1.68 **+	0.32 *
1/1994-1/2001	(0.45)	(0.91)	(0.46)	(0.07)	(0.26)	(0.16)
Korea	0.45 *	2.22 **	0.98 **+	0.03	0.65 **	0.45 **+
1/1992-1/2001	(0.22)	(0.21)	(0.33)	(0.06)	(0.11)	(0.17)
Malaysia	0.66 **	1.21 **	1.11 **	0.22 *+	0.63 **+	0.24
1/1993-1/2001	(0.37)	(0.09)	(0.33)	(0.10)	(0.14)	(0.23)
Singapore	0.47 **+	0.68 **+	0.79 **+	0.12	0.59 **+	0.34 **+
1/1992-1/2001	(0.04)	(0.03)	(0.04)	(0.08)	(0.12)	(0.14)
Thailand	1.32 **+	1.65 **	1.55 **	0.32	0.78 **+	0.41 **+
1/1992-1/2001	(0.11)	(0.17)	(0.32)	(0.31)	(0.21)	(0.17)

Note: Standard errors are in parentheses. ** and * indicate significance at the 1% and 10% level, respectively.
+ means that the coefficient of monetary surprises is different from the coefficient of monetary policy shocks.

European Central Bank Working Paper Series

For a complete list of Working Papers published by the ECB, please visit the ECB's website (http://www.ecb.int).

68 "The performance of forecast-based monetary policy rules under model uncertainty" by A. Levin, V. Wieland and J. C.Williams, July 2001.

69 "The ECB monetary policy strategy and the money market" by V. Gaspar, G. Perez-Quiros and J. Sicilia, July 2001.

70 "Central Bank forecasts of liquidity factors: Quality, publication and the control of the overnight rate" by U. Bindseil, July 2001.

71 "Asset market linkages in crisis periods" by P. Hartmann, S. Straetmans and C. G. de Vries, July 2001.

72 "Bank concentration and retail interest rates" by S. Corvoisier and R. Gropp, July 2001.

73 "Interbank lending and monetary policy transmission – evidence for Germany" by M. Ehrmann and A. Worms, July 2001.

74 "Interbank market integration under asymmetric information" by X. Freixas and C. Holthausen, August 2001.

75 "Value at risk models in finance" by S. Manganelli and R. F. Engle, August 2001.

76 "Rating agency actions and the pricing of debt and equity of European banks: What can we infer about private sector monitoring of bank soundness?" by R. Gropp and A. J. Richards, August 2001.

77 "Cyclically adjusted budget balances: An alternative approach" by C. Bouthevillain, P. Cour-Thimann, G. van den Dool, P. Hernández de Cos, G. Langenus, M. Mohr, S. Momigliano and M. Tujula, September 2001.

78 "Investment and monetary policy in the euro area" by B. Mojon, F. Smets and P. Vermeulen, September 2001.

79 "Does liquidity matter? Properties of a synthetic divisia monetary aggregate in the euro area" by L. Stracca, October 2001.

80 "The microstructure of the euro money market" by P. Hartmann, M. Manna and A. Manzanares, October 2001.

81 "What can changes in structural factors tell us about unemployment in Europe?" by J. Morgan and A. Mourougane, October 2001.

82 "Economic forecasting: some lessons from recent research" by D. Hendry and M. Clements, October 2001.

83 "Chi-squared tests of interval and density forecasts, and the Bank of England's fan charts" by K. F. Wallis, November 2001.

84 "Data uncertainty and the role of money as an information variable for monetary policy" by G. Coenen, A. Levin and V. Wieland, November 2001.

85 "Determinants of the euro real effective exchange rate: a BEER/PEER approach" by F. Maeso-Fernandez, C. Osbat and B. Schnatz, November 2001.

86 "Rational expectations and near rational alternatives: how best to form expecations" by M. Beeby, S. G. Hall and S. B. Henry, November 2001.

87 "Credit rationing, output gap and business cycles" by F. Boissay, November 2001.

88 "Why is it so difficult to beat the random walk forecast of exchange rates?" by L. Kilian and M. P. Taylor, November 2001.

89 "Monetary policy and fears of financial instability" by V. Brousseau and C. Detken, November 2001.

90 "Public pensions and growth" by S. Lambrecht, P. Michel and J.-P. Vidal, November 2001.

91 "The monetary transmission mechanism in the euro area: more evidence from VAR analysis" by G. Peersman and F. Smets, December 2001.

92 "A VAR description of the effects of monetary policy in the individual countries of the euro area" by B. Mojon and G. Peersman, December 2001.

93 "The monetary transmission mechanism at the euro-area level: issues and results using structural macroeconomic models" by P. McAdam and J. Morgan, December 2001.

94 "Monetary policy transmission in the euro area: what do aggregate and national structural models tell us?" by P. van Els, A. Locarno, J. Morgan and J.-P. Villetelle, December 2001.

95 "Some stylised facts on the euro area business cycle" by A.-M. Agresti and B. Mojon, December 2001.

96 "The reaction of bank lending to monetary policy measures in Germany" by A. Worms, December 2001.

97 "Asymmetries in bank lending behaviour. Austria during the 1990s" by S. Kaufmann, December 2001.

98 "The credit channel in the Netherlands: evidence from bank balance sheets" by L. De Haan, December 2001.

99 "Is there a bank lending channel of monetary policy in Spain?" by I. Hernando and J. Martínez-Pagés, December 2001.

100 "Transmission of monetary policy shocks in Finland: evidence from bank level data on loans" by J. Topi and J. Vilmunen, December 2001.

101 "Monetary policy and bank lending in France: are there asymmetries?" by C. Loupias, F. Savignac and P. Sevestre, December 2001.

102 "The bank lending channel of monetary policy: identification and estimation using Portuguese micro bank data" by L. Farinha and C. Robalo Marques, December 2001.

103 "Bank-specific characteristics and monetary policy transmission: the case of Italy" by L. Gambacorta, December 2001.

104 "Is there a bank lending channel of monetary policy in Greece? Evidence from bank level data" by S. N. Brissimis, N. C. Kamberoglou and G. T. Simigiannis, December 2001.

105 "Financial systems and the role of banks in monetary policy transmission in the euro area" by M. Ehrmann, L. Gambacorta, J. Martínez-Pagés, P. Sevestre and A. Worms, December 2001.

106 "Investment, the cost of capital, and monetary policy in the nineties in France: a panel data investigation" by J.-B. Chatelain and A. Tiomo, December 2001.

107 "The interest rate and credit channel in Belgium: an investigation with micro-level firm data" by P. Butzen, C. Fuss and P. Vermeulen, December 2001.

108 "Credit channel and investment behaviour in Austria: a micro-econometric approach" by M. Valderrama, December 2001.

109 "Monetary transmission in Germany: new perspectives on financial constraints and investment spending" by U. von Kalckreuth, December 2001.

110 "Does monetary policy have asymmetric effects? A look at the investment decisions of Italian firms" by E. Gaiotti and A. Generale, December 2001.

111 "Monetary transmission: empirical evidence from Luxembourg firm level data" by P. Lünnemann and T. Mathä, December 2001.

112 "Firm investment and monetary transmission in the euro area" by J.-B. Chatelain, A. Generale, I. Hernando, U. von Kalckreuth and P. Vermeulen, December 2001.

113 "Financial frictions and the monetary transmission mechanism: theory, evidence and policy implications" by C. Bean, J. Larsen and K. Nikolov, January 2002.

114 "Monetary transmission in the euro area: where do we stand?" by I. Angeloni, A. Kashyap, B. Mojon, D. Terlizzese, January 2002.

115 "Monetary policy rules, macroeconomic stability and inflation: a view from the trenches" by A. Orphanides, December 2001.

116 "Rent indices for housing in West Germany 1985 to 1998" by J. Hoffmann and C. Kurz., January 2002.

117 "Hedonic house prices without characteristics: the case of new multiunit housing" by O. Bover and P. Velilla, January 2002.

118 "Durable goods, price indexes and quality change: an application to automobile prices in Italy, 1988-1998" by G. M. Tomat, January 2002.

119 "Monetary policy and the stock market in the euro area" by N. Cassola and C. Morana, January 2002.

120 "Learning stability in economics with heterogenous agents" by S. Honkapohja and K. Mitra, January 2002.

121 "Natural rate doubts" by A. Beyer and R. E. A. Farmer, February 2002.

122 "New technologies and productivity growth in the euro area" by F. Vijselaar and R. Albers, February 2002.

123 "Analysing and combining multiple credit assessments of financial institutions" by E. Tabakis and A. Vinci, February 2002.

124 "Monetary policy, expectations and commitment" by G. W. Evans and S. Honkapohja, February 2002.

125 "Duration, volume and volatility impact of trades" by S. Manganelli, February 2002.

126 "Optimal contracts in a dynamic costly state verification model" by C. Monnet and E. Quintin, February 2002.

127 "Performance of monetary policy with internal central bank forecasting" by S. Honkapohja and K. Mitra, February 2002.

128 "Openness, imperfect exchange rate pass-through and monetary policy" by F. Smets and R. Wouters, February 2002.

129 "Non-standard central bank loss functions, skewed risks, and certainty equivalence" by A. al-Nowaihi and L. Stracca, March 2002.

130 "Harmonized indexes of consumer prices: their conceptual foundations" by E. Diewert, March 2002.

131 "Measurement bias in the HICP: what do we know, and what do we need to know?" by M. A. Wynne and D. Rodríguez-Palenzuela, March 2002.

132 "Inflation dynamics and dual inflation in accession countries: a "new Keynesian" perspective" by O. Arratibel, D. Rodríguez-Palenzuela and C. Thimann, March 2002.

133 "Can confidence indicators be useful to predict short term real GDP growth?" by A. Mourougane and M. Roma, March 2002.

134 "The cost of private transportation in the Netherlands, 1992-1999" by B. Bode and J. Van Dalen, March 2002.

135 "The optimal mix of taxes on money, consumption and income" by F. De Fiore and P. Teles, April 2002.

136 "Retail bank interest rate pass-through: the new evidence at the euro area level" by G. de Bondt, April 2002.

137 "Equilibrium bidding in the eurosystem's open market operations" by U. Bindseil, April 2002.

138 "New" views on the optimum currency area theory: what is EMU telling us?" by F. P. Mongelli, April 2002.

139 "On currency crises and contagion" by M. Fratzscher, April 2002.

140 "Price setting and the steady-state effects of inflation" by M. Casares, May 2002.

141 "Asset prices and fiscal balances" by F. Eschenbach and L. Schuknecht, May 2002.

142 "Modelling the daily banknotes in circulation in the context of the liquidity management of the European Central Bank", by A. Cabrero, G. Camba-Mendez, A. Hirsch and F. Nieto, May 2002.

143 "A non-parametric method for valuing new goods", by I. Crawford, May 2002.

144 "A failure in the measurement of inflation: results from a hedonic and matched experiment using scanner data", by M. Silver and S. Heravi, May 2002.

145 "Towards a new early warning system of financial crises", by M. Fratzscher and M. Bussiere, May 2002.

146 "Competition and statility – whats special about banking?", by E. Carletti and P. Hartmann, May 2002.

147 "Time-to-build approach in a sticky price, stricky wage optimizing monetary model, by M. Casares, May 2002.

148 "The functional form of yield curves" by V. Brousseau, May 2002.

149 "The Spanish block of the ESCB-multi-country model" by A. Estrada and A. Willman, May 2002.

150 "Equity and bond market signals as leading indicators of bank fragility" by R. Gropp, J. Vesala and G. Vulpes, June 2002.

151 "G-7 Inflation forecasts" by F. Canova, June 2002.

152 "Short-term monitoring of fiscal policy discipline" by G. Camba-Mendez and A. Lamo, June 2002.

153 “Euro area production function and potential output: a supply side system approach” by A. Willman, June 2002.

154 “The Euro bloc, the Dollar bloc and the Yen bloc: How much monetary policy independence can exchange rate flexibility buy in an interdependent world? by M. Fratzscher, June 2002.