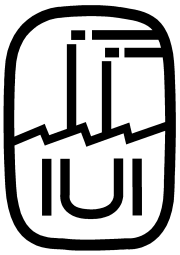

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On the Link between Exchange-Rate Regimes and Monetary-Policy Autonomy: The European Experience

by Jens Forssbæck and Lars Oxelheim

IUI, The Research Institute of Industrial Economics
P.O. Box 5501
SE-114 85 Stockholm
Sweden

On the Link between Exchange-Rate Regimes and Monetary-Policy Autonomy: The European Experience

Jens Forssbæck[a] and Lars Oxelheim[a, b, *]

[a] Institute of Economic Research, Lund University, P.O. Box 7080, S-220 07 Lund, Sweden

[b] The Research Institute of Industrial Economics (IUI), P.O. Box 5501, S-114 85 Stockholm, Sweden

Abstract

We investigate monetary-policy autonomy under different exchange-rate regimes in small, open European economies during the 1980s and 1990s. We find no systematic link between ex post monetary-policy autonomy and exchange rate regimes. This result is enforced for countries/periods with alternative nominal targets. Our interpretation of the results is that over the medium and long term following an 'independent' target for monetary policy, which does not deviate much from the targets of those countries to which one is closely financially integrated, is as constraining as locking the exchange rate to some particular level.

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* Corresponding author. Tel: +46-8-665 4527, fax: +46-8-665 4599, e-mail: larso@iui.se.

1. Introduction

The changing climate for policy-making pursuant to the globalization of financial markets during the last few decades has fostered a widespread belief that governments, particularly those of small economies, have essentially lost the power to pursue independent and sovereign economic policies. It is still widely held, however, that loss of the monetary-policy instrument is a major cost for a country assuming a rigid fixed exchange rate regime – or, in the European context, for countries joining the EMU. This paper addresses the contradictory content of the two arguments, and informs the re-awoken debate about the role of exchange rate regimes for economic growth and for the possibility to pursue independent stabilization policies, which has in part been set in motion by the recent enlargement of the EU to include 10 new member states.

The traditional Mundell-Fleming paradigm posits that under capital mobility, a country that wants to pursue an autonomous monetary policy, oriented toward the domestic economy, must allow its exchange rate to float. If, on the other hand, the country fixes its exchange rate, it must follow the monetary policy of the anchor country. Because monetary policy is determined abroad, the country has in this case effectively lost monetary policy autonomy.

In this paper, we analyze if monetary policy in our focus economies was 'determined' abroad—that is, was dominated by the policies of the larger benchmark countries, and whether the degree of dominance differed systematically depending on the exchange-rate regime pursued by the small country.

The motivation is, first, that the exchange rate regimes as such are by no means clear-cut: the existence of intermediate regimes along a gradual scale between 'fixed' and 'float', and the sometimes sharp discrepancy between official and actual exchange rate regimes, beg the question whether mainstream thinking in this area attaches too much weight to exchange

rate regimes. These arguments have spurred a wave of recent literature on exchange rate regime classification (Calvo and Reinhart, 2002; Bubula and Ötker-Robe, 2002; Reinhart and Rogoff, 2002), and on the link between 'de facto' exchange rate regimes and economic growth (Levy-Yeyati and Sturzenegger, 2001 and 2003; Bailliu et al., 2003; Eichengreen and Leblanc, 2003). Second, in the trilemma described by the traditional Mundell-Fleming conditions, monetary autonomy is essentially a residual product of capital mobility and the choice to stabilize or not to stabilize the exchange rate. However, the link between the exchange rate and other nominal variables runs both ways − price stability induces exchange rate stability as much as the pegging the exchange rate induces low inflation. Over the medium and long run, then, it could be argued that monetary autonomy is really a residual product of capital mobility and nominal variables in general. Increasing financial integration in combination with converging inflation rates and the pursuit of similar nominal stability targets in most industrialized countries may, for any practical intents and purposes and for any reasonable time horizon, constrain monetary policy as much as an explicit exchange rate peg. In the presence of capital mobility, a flexible exchange rate indeed offers – almost by definition – full theoretical monetary autonomy, but in light of the above arguments, there is reason to question the practical empirical relevance of such autonomy; see Svensson (1994), Borensztein et al. (2001), Frankel et al. (2001, 2002), Fratzscher (2002), Jos Jansen (2003) for various results on this. The question of autonomy may be reduced to the question of the potential presence of sharp asymmetric shocks to the real economy.

Our hypothesis is thus a weak empirical link between exchange rate regime and monetary policy autonomy. The general methodology used here has previously been used for similar purposes in the literature on monetary transmission and asymmetry within the European Monetary System (EMS).[1] Most of that literature, however, has been concerned

specifically with the so-called German-dominance hypothesis (GDH) and essentially attempted to answer the question if the EMS was a 'D-mark area'.

A number of studies focusing on the behavior only of interest rates, and covering primarily the 1980s (Karfakis and Moschos, 1990, Gardner and Perraudin, 1993), find various degrees of support for the hypothesis of German dominance, while others (Katsimbris and Miller, 1993) find that the EMS was essentially a symmetrically-working system. Some studies (Cohen and Wyplosz, 1989, Fratianni and von Hagen, 1990, Koedijk and Kool, 1992) devise models to assess the degree of autonomy in terms of more than a single variable (adding to interest rates primarily variables such as inflation rates and/or money-supply growth). These studies tend generally to assert a 'special role', though not strict dominance, to Germany. Among the more recent studies, which cover developments in the 1990s, most have focused either solely on monetary aggregates (Holmes, 1995), or on interest rates (Henry and Weidman, 1995, Hassapis *et al*., 1999, Uctum, 1999, and Bajo-Rubio *et al*., 2001). The inferences drawn from the empirical analyses in terms of symmetry/asymmetry within the EMS come out about fifty–fifty. Most of these studies analyze only the larger EMS countries like France, Italy and the UK (beside Germany), sometimes adding Belgium, Ireland and the Netherlands.[2] None of the studies include countries *outside* the EMS on the receiving end of 'dominance'.

Our case countries are basically just a complete list of the developed European countries that fit the small-size criterion (GDP) and had their own currencies in the 1980s and 1990s—starting with Ireland (the smallest) and ranging up to the Netherlands (the largest). After that, there is a jump up to the medium-sized countries such as Spain. In addition to Ireland and the Netherlands, the focus countries are: Austria, Belgium, Denmark, Finland, Greece, Norway, Portugal, Sweden and Switzerland. Apart from the fact that they are small, which means that they can reasonably be expected to have a role of price-takers, or 'policy-takers', in

international markets, the choice of case countries is motivated by the fact that these countries have, collectively and at various intervals during the sample period (1979–2000), employed more or less every exchange-rate regime imaginable, from free float to full monetary union, with or without restrictions on capital movements or other foreign-exchange transactions. The countries also represent the full spectrum with regard to the level of ambition of exchange-rate policy, and 'reputation' in monetary matters: from hard-currency, low-interest-rate countries like Switzerland, the Netherlands and Austria, to countries which during part of the period investigated here had a near-emerging-market status (Greece and Portugal). The foreign benchmarks are Germany, the United States and a trade-weighted index of the relevant variables for all G5 countries.[3]

The paper is organized as follows. In Section 2, we introduce a simple illustrative model to give structure to the general reasoning behind the subsequent empirical sections, and make some further specifications of the analytic framework. The data are presented in Section 3. If the small countries' policies really *were* 'determined' abroad, then it is conceivable that a *statistical causal relationship* can be established, in the sense that the path of 'domestic' monetary-policy variables can be predicted by the 'foreign' counterparts. We use two different methods. In Section 4 we calculate the cross-country elasticities of changes in policy interest rates, while in Section 5 we apply bivariate Granger-causality tests both on interest rates and on monetary aggregates. The role of different exchange-rate regimes is here taken into account by splitting up the whole sample period into sub-periods for each focus country, according to an adapted version of the IMF's categorization of exchange-rate regimes.[4] Section 6 concludes.

2. The analytic framework

To clarify the logic behind our empirical tests, a rudimentary two-country money-market model is presented in this section. The model is to be understood as having a mainly illustrative, rather than analytic, purpose in the present context. In this section we also introduce the classification system used for exchange-rate regimes in the analysis to come.

2.1. A simple illustrative model

A standard (one-period) money-demand equation constitutes local (domestic) money-market equilibrium of a small country, *a*:

$$m - p = \beta y - \alpha i + \varepsilon , \tag{1}$$

where m, p, y and i are the natural logarithms of a representative monetary aggregate, the price level, real income and the alternative cost of holding money (that is, the interest rate), respectively; α and β are structural parameters, which are positive, and ε a stochastic error term. If capital controls are imposed that are a hundred percent effective, this market is completely shut off from the outside world, and the domestic central bank conducts an autonomous monetary policy based on domestic macroeconomic conditions.

Now suppose there is another country, *b*, and that capital flows freely between the two countries, there are no transaction costs, and agents are fully neutral as to the currency in which to hold liquid assets (that is, a two-currency scenario with perfect integration between the money markets for the respective currencies). Assume further that *b*'s money market is characterized by the same equilibrium condition as that of *a*.

Assuming instantaneous PPP (or, at the very least, that mean reversion toward PPP occurs off-parity),[5] the exchange rate between the currencies of *a* and *b* is determined by relative price developments:

$$e = (p_a - p_b) + v \tag{2}$$

where *v* is also a stochastic error term. International money-market equilibrium is then represented by:

$$(m_a - m_b) = e - \alpha(i_a - i_b) + \beta(y_a - y_b) + (\varepsilon_a - \varepsilon_b) - v \tag{3}$$

We now want to find out how foreign (*b*'s) monetary policy affects domestic (*a*'s) monetary policy under different exchange-rate regimes. Collecting the error terms, rearranging slightly and taking differences we get:

$$\Delta m_a = \Delta e + \Delta m_b + \beta\Delta(y_a - y_b) - \alpha\Delta(i_a - i_b) + \Delta u \tag{4}$$

Let's say for simplicity that changes in the nominal quantity of money do not result in any adjustment of real income (this assumption does not alter the qualitative implications of the model). The multiplier of 'domestic' (*a*'s) money supply over an innovation in 'foreign' (*b*'s) money supply can then be written as:

$$\frac{\Delta m_a}{\Delta m_b} = \frac{\Delta e}{\Delta m_b} + 1 - \frac{\alpha\Delta(i_a - i_b)}{\Delta m_b}, \tag{5}$$

with $\Delta u = 0$. With completely fixed rates of exchange between the currencies of *a* and *b*, Δe also equals zero.

In that situation, the right-hand side of the above equation is greater than zero if the absolute value of the interest-rate term is smaller than one, which is equivalent to $\alpha\Delta(i_a - i_b) < \Delta m_b$. That is, *b*'s money-supply change must be wholly or partially transmitted to changes in *a*'s money supply and/or must be offset by a change in the interest-rate differential. To put it differently, transmission effects on the money supply occur to the extent that the combined effect of changes in foreign monetary conditions is imperfectly reflected by a change in the domestic interest rate: $\Delta i_a < \alpha^{-1}\Delta m_b + \Delta i_b$. Of course, from the point of view of assessing domestic monetary-policy autonomy, it does not really make any difference if adjustment takes place through the money supply or via interest rates. The point is that in the case of perfect capital mobility and fixed exchange rates, an innovation in foreign monetary policy *must* be corresponded by similar changes in domestic monetary policy.

In the case of flexible exchange rates, it is easy to see that if the change in foreign money supply is allowed to be fully passed through to a change in the exchange rate, then no response is required in domestic monetary variables. A full pass-through, $\Delta e / \Delta m_b = -1$, means that a tightening of the foreign money supply results in a corresponding appreciation of foreign currency and vice versa. In other words, the sum of Δm_a and $\Delta(i_a - i_b)$ then equals zero.

A similar result can easily be shown to occur as a result of changes in the foreign interest rate. In general, the model illustrates the traditional hypothesis that the opportunity for the monetary authorities of a small country to pursue monetary policy which is autonomous vis-à-vis the outside world decreases with increasing capital mobility and with increasing rigidity of the exchange rate. In the case of perfectly flexible exchange rates, that opportunity is, in principle, always total. Changes in foreign monetary policy do not necessarily require

any response at all in domestic policy. In the case of full capital mobility and fixed exchange rates, the opportunity is zero. A change in foreign monetary policy must be fully responded to by changes in domestic money supply and/or interest rates.

Obviously, this simple theoretical model does not, as such, contain any information on causal relationships in either direction—the model is entirely symmetrical. But suppose country *b* is very large (or is interpreted as the rest of the world). Suppose further that, in the case of fixed exchange rates, *a* pegs to *b*'s currency, rather than vice versa, so that it is up to *a* to adjust monetary policy to maintain the peg. Under these conditions it seems reasonable to assume that the relationship between money-market conditions in *a* and in *b* is not symmetrical. In the relationship between *a* and *b*, *a* is then a policy-taker—that is, *a* is too small to influence *b*, whereas *b* can (and will) influence *a*. We arrive at a hypothesis, which can be tested empirically: an assumed asymmetric relationship between *a* and *b*

2.2. Exchange-rate regimes

In the analysis in Sections 4 and 5, we use sub-periods for each case country based on a classification of exchange-rate regimes. The classification scheme captures the main choice between fix and float, but also leaves room for some nuance. Because many of the countries have been involved in the exchange-rate cooperation within the European Monetary System (EMS), this in-between situation should be reflected in the classification. Moreover, it is appropriate to let the imposition of capital controls be an aspect of the formal institutional arrangements of exchange-rate management. Based on these considerations, a framework for the classification of exchange-rate regimes is depicted in the matrix in Table 1.

[Table 1]

The matrix categorizes exchange-rate arrangements according to two dimensions: what is the principal regime pursued for the exchange rate, and are restrictions on capital movements imposed to support the regime? The categorization matrix is based on the classifications made in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*, and covers the main types of arrangements that have been in place in the survey countries since March 1979, when the European Monetary System was introduced.

At the time, some of the countries' currencies were essentially floating ('flexible/managed float') and, hence, belonging to our first main regime type. The EMS is categorized as a 'cooperative, semi-fixed' regime. Central parity rates of each currency within the system were adopted, but realignments of those parity rates were possible—indeed, realignments were quite frequent in the early years of the EMS. Several of the countries that were not in the EMS had pegged their currencies to some anchor currency or weighted average of currencies. This third category is called a 'unilaterally inflexible' regime.

The difference between categories 2 and 3 is the cooperation component of the EMS. Through this component all members of the exchange-rate mechanism (ERM) of the EMS automatically received help from the other members to keep the exchange rate stable should it approach the outer margins of the central parity rate. This was supposed to make the cooperative regime somewhat less of a strain to enforce than a unilateral peg.

In 1999, finally, stage three of the European Economic and Monetary Union went into force, by which the currencies of six of the eleven countries included in the study were irrevocably fixed with respect to one another and with respect to the other currencies that partake in the union. This is the maximum degree of inflexibility imaginable. The degree of rigidity, that is the degree of assumed infraction on national monetary autonomy, of each regime thus increases left to right. Under a floating exchange rate, monetary autonomy is, in

principle, total. Under EMU even *formal* monetary autonomy, or monetary sovereignty, has been given up.

We see that the classification is based on some of the features in the model above—specifically, the degree of capital mobility (are capital controls imposed or not?), whether the small countries' exchange rates are fixed or flexible, and the degree to which it is up to the small country itself to enforce the exchange-rate peg.[6] Applying this categorization scheme to our case countries, we end up with sub-periods for each country as listed in Table 2. The classifications deviate in certain instances from the official descriptions.[7] The basis for this re-classification is a 'soft' de facto policy analysis, which follows the general logic of classifications made in, e.g., Calvo and Reinhart (2002), Reinhart and Rogoff (2002), and Levy-Yeyati and Sturzenegger (2001, 2003).

[Table 2]

3. Data[8]

If we want to assess the behavior of monetary policy, the dependent variable should be one that reflects policy, with due consideration taken to the issue of comparability over time and across countries. The correct variable to observe may be the primary policy instrument, over which the monetary authorities *do* have direct control, for example a policy interest rate. It may also be the operational variable, over which the monetary authorities *seek* to exert control in order to steer monetary policy in the desired direction to reach its final goals, for example price or exchange-rate stability.

Unfortunately, the correct variable to observe is not the same in all countries, nor has it remained the same over time within any given country. It is not even always clear what the 'correct' variable is, particularly in historical data. Sometimes it is not revealed, and even where it is, it is not necessarily the officially declared targets that matter most at any given moment—there is a considerable discretionary element involved. That the choice of variable can critically influence the results is shown by previous research on the subject.[9]

The most important indicator is obviously some interest rate (see, for instace, Choi and Ratti, 2000). Most previous studies use one-month, three-month, or some unspecified (short-term) interest rate. Other research (see, e.g., Borio, 1997), however, suggests that a shorter-term interest rate (such as the *overnight* rate) would, on balance, be a more appropriate indicator of monetary policy. In this paper, we study policy interest rates in Section 4, and interbank interest rates for overnight and up to one-week contracts, according to availability, in Section 5.

In addition, monetary aggregates may be an important complementary indicator. This is particularly true in the early periods covered here, when interest rates were typically regulated and monetary targeting was more common. Some of our case countries used monetary aggregates as explicit target variables even into the 1990s (notably Switzerland, which did so during the entire period covered). The question is whether to choose a narrow or a broad aggregate. We have chosen to use a narrow aggregate (monetary base and M0 are used, according to availability). The main reason is that narrower measures of money are more easily compared over time and across countries. The more components that are put into the aggregate, the more acute the definition and comparability problems become, and the more likely the aggregate is to be influenced by factors such as changes over time or differences across countries in regulation, financial structure, etc.

Because of the potential speed of transmission and, particularly in dealing with short-term interest rates, the case can effectively be made for using data of higher frequency than monthly (see, e.g., Bajo-Rubio *et al*., 2001). Going back over twenty years—considerably longer than any available high-frequency study—even monthly data takes some effort to come by, let alone data of higher frequency. Thus, due mainly to data-availability constraints, a priority for consistency of data over time and across countries, and a focus on general patterns over the short-to-medium term rather than on day-to-day events, we use monthly data.[10]

Finally, knowing what to compare with is obviously a major consideration. In terms of relating the degree of monetary-policy autonomy to the degree of rigidity of the exchange-rate regime, some tradeoff must be made. Theory, or common wisdom, does not predict that a country pegging its currency to, say, the DEM will be subject to asymmetric influence by US monetary policy but only, in principle, by the policy of the anchor country. The difficulty, in practice, is the multitude of different anchors used by the different case countries over time. The ideal way of dealing with the problem of knowing what to compare with would have been to measure variability vis-à-vis *the actual anchors used in each country in each sub-period*. Problems of comparison would have remained, however, and it is not evident that such an approach—to the extent that it would at all be possible to reconstruct time series with indicators for each exact anchor—would provide better grounds for analysis than a more general benchmark. Several previous papers have thus proxied a 'global policy' as the benchmark (see Frankel et al., 2002; Fratzscher, 2002). This paper extends the convention and follows a multi-benchmark approach, arguing that the accumulated indications given by benchmarking with *all three* of Germany, the United States and the G5 index should provide grounds for some passably solid conclusions as to the degree of 'foreign' influence over our case countries' monetary policies. The G5 indicator index is composed of the relevant

indicators for the US, Japan, Germany, the United Kingdom and France. The weights used are based on the size of each G5 country's global trade in goods and services, and are computed according to:

$$y_{G5} = \sum_i \left(\frac{(X+M)_i}{\sum_i (X+M)_i} y_i \right); i = \text{DE, FR, JP, UK, US}$$

where y = the relevant indicator (interest-rate or money-supply changes), and $X + M$ = exports + imports of goods and services. In the data series, trade weights are adjusted yearly.

4. Results of the analysis of cross-country responsiveness of policy interest-rate changes

In this section, we calculate the responsiveness of policy interest-rate changes, that is the responsiveness to changes in the interest rate that is set directly by the monetary authority (central bank). This requires that we make the *a-priori* assumption that a benchmark country 'leads' monetary policy with respect to the small focus countries. We then analyze how responsive the small countries' policy interest rates are to changes in the benchmark countries' policy interest rates. This is done by calculating the elasticity of policy-interest-rate changes and the average lag for each focus country and sub-period. The definitions are as follows:

$$\text{Elasticity} = \frac{\Delta I_a}{\Delta I_b} \cdot \frac{I_b}{I_a}, \tag{6}$$

where the upper-case *I*'s refer to the levels (not the logarithms) of the policy interest rates (which makes this equation equivalent to the logarithmic multiplier in equation 5). The elasticity measures the average percentage response in the small country's (a) policy interest rate to a one percentage point change in the benchmark country's (b) policy interest rate. The average lag is defined as the average number of periods that pass between a change in the benchmark country's policy interest rate and the next change in the policy interest rate of the small country.[11] Thus, we have two measures: one that measures the responsiveness in terms of the *magnitude* of the response, and one that captures the *time* aspect of responsiveness.

We calculated elasticities and lags for each sub-period of each case country on monthly data vis-à-vis Germany and the United States.[12] The specific interest rates used varied as no country exhibited a consistent time series of one single representative policy interest rate over the entire 22-year period. Over most of the 1980s, discount rates as reported in IMF *International Financial Statistics* were used. In later sub-periods, various central-bank rates were used, with (pair-wise) comparability as a primary selection criterion. Since the early-to-mid-1990s, most countries included (with the exception mainly of Switzerland) have had a specific interest rate—usually a repurchase rate—as explicit primary policy instrument, which facilitated the job of matching different rates in later periods.

The results are summarized in Table 3a–b.[13] Judging by the averages in this table, we find that exchange-rate regime is not a good predictor of policy autonomy. However, we do see that German policy innovations generate a quicker response than US innovations for all regimes, though not necessarily elasticities closer to one. The focus countries' policy interest rates were particularly responsive under a cooperative regime with no capital controls. Since the policy interest rate is the same since January 1999 for all EMU countries, the elasticity of policy interest rates of all EMU countries with respect to Germany is (trivially) unity with lag

time zero in the last period. We also note that changes in the US policy rate had a large impact with an average lag of about 1½ months during the first two years of EMU (recall the *a-priori* assumption), indicating a relatively far-gone 'global' co-dependence of the euro bloc.

[Table 3 (a–b)]

An additional summary of the effect of exchange rate regimes is presented in Table 4a–b, which shows the results of pairwise 2-sample t-tests performed across all regimes to test if average elasticities for regime sub-samples deviate from each other.

[Table 4 (a–b)]

These tests reinforce the impression that exchange rate regime is not a determinant of interest rate policy autonomy. The general rule is that the average elasticities for different regimes do *not* deviate significantly from each other; and where they do, it appears as though it could just be the effect of capital controls. In the case of comparisons vis-á-vis German interest rates we note a significant deviation in 4 out of 15 cases. All the four deviant cases concern comparisons of regimes with capital controls with regimes without such controls. A similar observation can be made when analysis of elasticities of policy interest rates vis-á-vis US interest rates are made. Here we find three significant deviations out of 21 comparisons. All three appear in comparisons between the EMU regime and regimes with capital controls. In contrast we find, for instance, that average elasticities for floating and unilaterally pegged exchange rates, respectively, under capital mobility do not deviate from each other whether measured against Germany or against the US.

A possible explanation of the result that flexible exchange rates do not seem to allow for increased monetary-policy autonomy is that the pursuit of other stability targets curtails the leeway for domestic interest-rate policy as effectively, or almost as effectively—at least in the medium-to-long run—, as an explicit exchange-rate target. We will return to this discussion in the next section, which looks at *market* interest rates.

5. Results of causality tests of market interest-rate changes and money-growth rates

In this section, we calculate the multipliers from equation 5 and their equivalents for market interest rates on the basis of bivariate Granger causality tests[14] in order further to empirically assess our hypothesis of asymmetry in the transmission of monetary-policy indicators between the benchmark countries and the focus countries. The Granger-causality technique (with variations) is applied for similar purposes in for instance Fratianni and von Hagen (1990), Karfakis and Moschos (1990), Katsimbris and Miller (1993), Henry and Weidman (1995), Hassapis *et al*. (1999), and Uctum (1999) (see Section 1 above).

The choice of lag-length is a crucial step in the choice of model to be evaluated, particularly in a simple bivariate setting such as that used here. We here apply a model-determination procedure based on the Granger concept of causality and the final prediction error (mean square prediction error, or FPE) criterion, as originally proposed by Hsiao (1981). The advantage of the FPE as compared to most other criteria is that it does not require that the number of lags of the variables that enter into the model be the same.[15] The basic estimated equation takes the form,

$$X_t = \alpha + \sum_{m=1}^{m^*} \beta_m X_{t-m} + \sum_{n=1}^{n^*} \gamma_n Y_{t-n} + \delta Z_{t-1} + v_t \quad (7)$$

where X and Y are first-differences of the logs of the tested variables, m^* and n^* are the 'optimal' lags as chosen by the model-selection criterion and Z is the error-correction term (whose coefficient is zero in case the two tested series are not cointegrated in levels). If the model-selection procedure implies a one-way model, just one equation is estimated; if a bilateral system is implied by the procedure, two equations are estimated, and if the procedure implies non-causality between the variables, then, of course, no equation is estimated. The models were estimated with Generalized Least Squares (GLS) regressions. We then calculated multipliers based on the regression parameters from the above models.[16]

These multipliers (whose interpretation is equivalent to the elasticities calculated in Section 4) are summarized in Tables 5 and 6.[17] From Table 5 we can see that 5 out of 9 average multipliers for exchange rate regimes that are combined with capital controls are significantly different from unity, whereas none out of 11 is significantly different when no capital controls are in force. However, we note much higher standard errors in periods without than in periods with capital controls. Table 6 indicates a similar pattern when long-run multipliers for money-supply growth rates are analyzed. The pattern is not as conclusive as in the case of market interest rates, since we here find some significant deviations also for regimes where no capital controls were applied. An overall impression is also the existence of a US or 'global' rather than a strict European influence over our focus countries.

[Table 5]

[Table 6]

Tables 7 (a-c) and 8 (a-c) show the result of pairwise 2-sample t-tests which are performed across all regimes to test if average long-run multipliers from regime sub-samples deviate from each other. Table 7 reinforces the impression of no clear relation between exchange rate regime and monetary policy autonomy. However, as opposed to the case of policy interest rates, it is the lack of system rather than the existence of a system in the deviations that provides us with this conclusion. The same conclusions largely apply to Table 8 as well, though here we can find some signals that the long-run multipliers for responses to US and the G5 money-supply growth have not deviated much regardless of exchange rate regime.

[Table 7 (a–c)]

[Table 8 (a–c)]

Those of our sample countries which during the last sub-period adhered to the EMU are only tested vis-à-vis G5 and the US (with a common monetary policy, it is not meaningful to test for autonomy vis-à-vis Germany). Multipliers both for interest rates and money-supply growth indicate strong transmission both from G5 and the United States. These results suggest a strong 'world' influence over ECB's monetary policy in the first two years of EMU. However, in the case of testing vis-à-vis G5 this is of course very much a two-way street since both Germany and France are part of both the euro area and the G5 group.

6. Conclusion

We find little difference in the degree of nominal monetary-policy autonomy enjoyed by those countries that pursue flexible exchange-rate regimes as compared to those that have kept their exchange rates fixed. This supports some previous findings for other countries and over different time periods (see Fratzscher, 2002; Frankel et al., 2002). The latter countries are not exposed to greater foreign influences in any systematic way. A reasonable conclusion from the results reached here is that over the medium (and long) term following an 'independent' target for monetary policy (an inflation target, say), which does not deviate much from the targets of those countries to which one is closely financially integrated, is as constraining as locking the exchange rate to some particular level. Thus, if price-level changes do not differ significantly over the medium-to-long term, then no change in the 'fundamental' rate of exchange between the two currencies occurs (*cf.* the source of exchange-rate changes in the simple model at the beginning of the chapter).

Another way of putting it is that purchasing-power parity may not hold in the short run because exchange rates fluctuate with market sentiment; but in terms of a central bank setting interest rates to control price developments in the medium or long run, it does hold. No *exploitable* degree of autonomy other than that which results in a deviant inflation rate is possible for the type of time horizons central banks work with. Actual nominal exchange-rate fluctuations in the short run and—particularly—exchange rate regimes pursued, on the other hand, are of secondary importance in terms of autonomy.

It is also worth repeating that our results are based on actual outcomes in terms of transmission of policy. By not having the opportunity to compare with the hypothetical ex ante preferred policy, we may be exaggerating the role of actual, historical autonomy at the expense of the potential for autonomy. It is, in principle, possible that monetary policy has

been highly influenced by foreign policy for other reasons than strict ‘economic necessity’. It is also possible that in the shorter term, a flexible exchange rate presents monetary authorities with more leeway for deviation, and that under asymmetric shocks to the real economy, such autonomy would be useful.

Finally, certain short-comings to estimating the multipliers just pairwise the way we have done here, warrant a few suggestions of how this research could be developed. First, if transmission runs in some more intricate way between the variables, the bivariate approach will not give an adequate representation of actual co-dependencies. Also, if some important influencing variable is left out (for instance, a possible effect of real shocks), the results may overstate the relationship between the variables that are kept in. Second, by splitting up the full sample period into shorter periods, some of these sub-periods become too short to get reliable results. Moreover, the role of exchange rates may not be accurately reflected just by splitting up the whole sample period into discrete sub-periods according to exchange-rate regime for each country: since exchange-rate variability moves along a gradual scale, the choice of where to draw the line between different regime types will always contain a discretionary element. The same argument of discretion can, in principle, be made when it comes to capital controls.

Appendix A. Data specifications and sources

The following data and sources were used for the analysis in Section 5.

Market interest-rate series:

Country	Series	Source(s)
Austria (AT)	Day-to-day money-market rate 1979:03–1998:12	IMF *International Financial Statistics* / Oesterreichisches Nationalbank
	Overnight interbank-deposit rate 1999:01–2000:11	Reuters
Belgium (BE)	Call-money rate 1979:03–1991:01;);	IMF *International Financial Statistics*
	One-week treasury-certificate rate 1991:02–2000:11	Banque Nationale de Belgique
Denmark (DK)	Call-money rate 1979:03–1996:12	IMF *International Financial Statistics*
	'Tomorrow/next' deposit rate 1997:01–2000:11	Danmarks Nationalbank
Finland (FI)	Liquidity credit rate 1979:03–12	OECD *Main Economic Indicators*
	Call-money rate 1980:01–1993:11	Bloomberg
	Overnight interbank-deposit rate 1993:12–2000:11	Suomen Pankki / Reuters
France (FR)	Call-money rate 1979:03–1998:12	IMF *International Financial Statistics*
	EONIA 1999:01–2000:11	ECB
Germany (DE)	Day-to-day money-market rate 1979:03–1998:12	IMF *International Financial Statistics*
	EONIA 1999:01–2000:11	ECB
Greece (GR)	Overnight interbank-deposit rate 1985:01–2000:11[a]	Bank of Greece
Ireland (IE)	Overnight call-money rate 1979:03–12	OECD *Main Economic Indicators*
	Overnight interbank-deposit rate / DIBOR 1980:01–2000:11	Bloomberg / Central Bank of Ireland
Japan (JP)	Overnight interbank deposit rate 1979:03–2000:11	Bank of Japan
Netherlands (NL)	Overnight interbank-deposit rate	De Nederlandsche Bank / Reuters
Norway (NO)	Call-money rate 1979:03–1985:12	IMF *International Financial Statistics*
	NIBOR 'tomorrow/next' rate 1986:01–2000:11	Norges Bank
Portugal (PT)	1–5-day interbank deposit rate 1983:01–1998:12[b]	Banco de Portugal
	'Tomorrow/next' deposit rate 1999:01–2000:11	Banco de Portugal
Sweden (SE)	Overnight interbank-deposit rate	Sveriges Riksbank
Switzerland (CH)	Call-money rate, Zürich (1979:03–1980:01;);).	OECD *Main Economic Indicators*
	Day-to-day money-market rate 1980:02–2000:11	Schweizerische Nationalbank
United Kingdom (UK)	Overnight interbank rate/SONIA 1979:03–2000:11	Bank of England
United States (US)	Federal funds rate 1979:03–2000:11	Federal Reserve

Notes: [a] No market interest rate available before 1985. [b] No market interest rate available before 1983.

Money-supply series:

Country	Series	Source(s)
Austria (AT)	Central bank money 1978:03–1979:12;	IMF *International Financial Statistics*
	Reserve money 1980:01–1998:11	IMF *International Financial Statistics*
	M1 1998:12–2000:11	Oesterreichisches Nationalbank
Belgium (BE)	Reserve money and/or M1 1979:03–1998:12[a]	IMF *International Financial Statistics* / Banque Nationale de Belgique
	M1 1999:01–2000:11	Banque Nationale de Belgique
Denmark (DK)	Reserve money 1979:03–1998:12	IMF *International Financial Statistics*
	M1 1999:01–2000:11	Danmarks Nationalbank
Finland (FI)	Reserve money 1979:03–1998:12	IMF *International Financial Statistics*
	M1 1999:01–2000:11	Suomen Pankki
France (FR)	Reserve money 1979:03–1998:12	IMF *International Financial Statistics*
	M1 1999:01–2000:11	Banque de France
Germany (DE)	Reserve money 1979:03–1998:12	IMF *International Financial Statistics*
	M1 1999:01–2000:11	Deutsche Bundesbank
Greece (GR)	Reserve money 1979:03–1999:04	IMF *International Financial Statistics*
	Monetary base 1999:05–2000:11	Bank of Greece
Ireland (IE)	Reserve money 1979:03–1999:12	IMF *International Financial Statistics*
	M1 2000:01–2000:11	Central Bank of Ireland
Japan (JP)	Reserve money 1979:03–1998:12	IMF *International Financial Statistics*
	M1 1999:01–2000:11	Bank of Japan
Netherlands (NL)	Reserve money 1979:03–1998:12	IMF *International Financial Statistics*
	M1 1999:01–2000:11	De Nederlandsche Bank
Norway (NO)	Reserve money 1979:03–1998:11	IMF *International Financial Statistics*
	M1 1998:12–2000:11	Norges Bank
Portugal (PT)	Reserve money 1979:03–1998:12	IMF *International Financial Statistics*
	M1 1999:01–2000:11	Banco de Portugal
Sweden (SE)	Reserve money 1979:03–1998:12	IMF *International Financial Statistics*
	M0 1999:01–2000:11	Sveriges Riksbank
Switzerland (CH)	Reserve money 1979:03–1999:01	IMF *International Financial Statistics*
	M1 1999:02–2000:11	Schweizerische Nationalbank
United Kingdom (UK)	M0 1979:03–2000:11	Bank of England
United States (US)	Reserve money 1979:03–1998:12	IMF *International Financial Statistics*
	M1 1999:01–2000:11	Federal Reserve

Notes: [a] Figures for 1980–1991 refer to M1 growth. Figures for 98:10–99:12 are estimates.

Dummy variables:

- Austria: none;
- Belgium: 1993:08–1994:01;
- Denmark: 1979:12, 1993:08–10, 1995:03–04;
- Finland: 1979:10–11, 1980:04–05, 1981:09–10, 1982:05–06, 1982:10–12, 1986:03–05, 1991:11–1992:01, 1992:09–11;
- Greece: 1994:05–06, 97:10–11, 1998:03–05;
- Ireland: 1983:04–05, 1986:08–09, 1992:11, 1993:02–03;
- Netherlands: none;
- Norway: 1981:10–11, 1982:05–06, 1982:08–11, 1986:05–06, 1987:11–1988:01, 1992:12–1993:01;
- Portugal: 1980:02–04, 1982:06–08, 1983:06–08, 1983:10–11, 1986:08–1987:01, 1988:02–03, 1993:07–08, 1995:04–05;
- Sweden: 1981:09–11, 1982:10–1983:01, 1992:11–1993:02;
- Switzerland: none;
- All benchmarks: none.

Trade and GDP data (to calculate trade-weights for the G5 index):

All trade and GDP data from IMF *International Financial Statistics*.

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Table 1. Exchange-rate regimes

		Exchange rate			
		Flexible / managed float	*Cooperative / semi-fixed*	*Unilaterally inflexible*	*Superfix (EMU)*
Restrictions on capital movements	*Yes*	1a	2a	3a	– –
	No	1b	2b	3b	4
		→ *Degree of rigidity*			

Table 2. Summary of external-policy arrangements

	Category						
	1a: flexible exchange rate w/ capital ctrls	*1b: flexible exchange rate, no capital ctrls*	*2a: cooperative regime w/ capital ctrls*	*2b: cooperative regime, no capital ctrls*	*3a: unilateral fix w/ capital ctrls*	*3b: unilateral fix, no capital ctrls*	*4: monetary union (no capital ctrls)*
AT					**P1:** START–1991:10	**P2:** 1991:11–1998:12	**P3:** 1999:01–FINISH
BE	**P1:** START–1990:02					**P2:** 1990:03–1998:12	**P3:** 1999:01–FINISH
DK			**P1:** START–1988:09	**P2:** 1988:10– 1993:07 **P4:** 1999:01–FINISH		**P3:** 1993:08–1998:12	
FI		**P3:** 1992:09–1996:09			**P1:** START–1990:12	**P2:** 1991:01–1992:08 **P4:** 1996:10–1998:12	**P5:** 1999:01–FINISH
GR[b]	**P1:** START–1994:04	**P2:** 1994:05–1995:01 **P4:** 1998:03–2000:12				**P3:** 1995:02–1998:02	
IE		**P3:** 1993:08–1998:12	**P1:** START–1992:12	**P2:** 1993:01–93:07			**P4:** 1999:01–FINISH
NL					**P1:** START–1985:12	**P2:** 1986:01–1998:12	**P3:** 1999:01–FINISH
NO		**P3:** 1992:12–FINISH			**P1:** START–1990:05	**P2:** 1990:06–1992:11	
PT			**P2:** 1992:04–1992:11	**P3:** 1992:12–1993:07	**P1:** START–1992:03	**P4:** 1993:08–1998:12	**P5:** 1999:01–FINISH
SE		**P3:** 1992:11–FINISH			**P1:** START–1989:06	**P2:** 1989:07–1992:10	
CH[c]		**P0:** START–FINISH					

Table 3. Responsiveness of policy interest rates, summary

a. Average elasticity of interest-rate changes for all countries/sub-periods according to exchange-rate regime; standard deviations in parentheses

		Exchange rate			
		Flexible / managed float	*Cooperative / semi-fixed*	*Unilaterally inflexible*	*Superfix (EMU)*
Restrictions on capital movements	*Yes*	*vis-à-vis DE* *.12 (.75)* *vis-à-vis US* *.38 (1.05)*	*vis-à-vis DE* *.38 (1.73)* *vis-à-vis US* *.61 (1.81)*	*vis-à-vis DE* *.29 (.94)* *vis-à-vis US* *.37 (1.30)*	*– –*
	No	*vis-à-vis DE* *.69 (1.96)* *vis-à-vis US* *.77 (3.80)*	*vis-à-vis DE* *1.16 (5.46)* *vis-à-vis US*[a] *0.69 (1.82)*	*vis-à-vis DE*[b] *.73 (1.17)* *vis-à-vis US* *.62 (2.20)*	*vis-à-vis DE* *1.00 (0.00)* *vis-à-vis US* *1.83 (2.17)*

b. Average lag (number of months)

		Exchange rate			
		Flexible / managed float	*Cooperative / semi-fixed*	*Unilaterally inflexible*	*Superfix (EMU)*
Restrictions on capital movements	*Yes*	*vis-à-vis DE* *3.75* *vis-à-vis US* *6.59*	*vis-à-vis DE* *2.91* *vis-à-vis US* *2.96*	*vis-à-vis DE* *3.92* *vis-à-vis US* *6.34*	*– –*
	No	*vis-à-vis DE* *3.79* *vis-à-vis US* *5.65*	*vis-à-vis DE* *1.13* *vis-à-vis US*[a] *4.33*	*vis-à-vis DE*[b] *3.84* *vis-à-vis US* *5.71*	*vis-à-vis DE* *0.00* *vis-à-vis US* *1.57*

Notes: [a] IE P2 and PT P3 have been left out of the calculation of averages, since no changes in the US rate were undertaken during those periods. [b] FI P4 has been left out of the calculation of averages, since no changes in the German rate were undertaken during that period.

Table 4. Elasticities of policy interest rate changes: comparisons of mean elasticities (t-statistics)

a. Vis-à-vis German interest rates

Regime	*1b*	*2a*	*2b*	*3a*	*3b*
1a	1.99**	.96	1.33	1.13	3.35***
1b		.90	.78	1.94*	.18
2a			.86	.41	1.39
2b				1.59	.74
3a					3.00***

b. Vis-à-vis US interest rates

Regime	*1b*	*2a*	*2b*	*3a*	*3b*	*4*
1a	.79	.85	.92	.05	.18	3.28***
1b		.31	.09	1.26	.34	.82
2a			.16	1.10	.03	1.84*
2b				.95	.13	1.44
3a					1.15	3.15***
3b						1.58

* /**/***) Null that sample means are equal is rejected at 10/5/1 % significance level.

Table 5. Long-run multipliers for market interest-rate changes (standard errors in parentheses)[a]

		Exchange rate			
		Flexible / managed float	*Cooperative / semi-fixed*	*Unilaterally inflexible*	*Superfix (EMU)*
Restrictions on capital movements	*Yes*	vis-à-vis DE .22 (.21) vis-à-vis G5 .00 (.00) vis-à-vis US -.03 (.12)	vis-à-vis DE -.08 (3.61) vis-à-vis G5 -.50 (.91) vis-à-vis US -.08 (1.14)	vis-à-vis DE .45 (.80) vis-à-vis G5 -.45 (.81) vis-à-vis US .08 (.12)	– –
	No	vis-à-vis DE 1.74 (6.76) vis-à-vis G5 1.23 (2.82) vis-à-vis US .31 (3.78)	vis-à-vis DE .84 (1.40) vis-à-vis G5 2.14 (3.26) vis-à-vis US .26 (3.78)	vis-à-vis DE .43 (.83) vis-à-vis G5 1.11 (1.13) vis-à-vis US -.67 (1.129)	vis-à-vis DE 1.00 (0.00) vis-à-vis G5 2.21 (3.65) vis-à-vis US 1.92 (2.12)

Note: [a] The average multipliers shown in this table are potentially influenced by a number of outliers in the country-by-country results. We therefore made the same calculations (including the 2-sample t-tests shown in Table 7) with outliers suppressed from the sample. These calculations show that the results are qualitatively robust to the inclusion or non-inclusion of outliers.

Table 6. Long-run multipliers for money-supply growth rates (standard errors in parentheses)[a]

		Exchange rate			
		Flexible / managed float	*Cooperative / semi-fixed*	*Unilaterally inflexible*	*Superfix (EMU)*
Restrictions on capital movements	*Yes*	vis-à-vis DE .04 (.05) vis-à-vis G5 .24 (.31) vis-à-vis US .09 (.27)	vis-à-vis DE .14 (.19) vis-à-vis G5 .08 (.15) vis-à-vis US .06 (.13)	vis-à-vis DE .05 (.11) vis-à-vis G5 .22 (.41) vis-à-vis US .25 (.18)	– –
	No	vis-à-vis DE .02 (.52) vis-à-vis G5 .17 (83.80) vis-à-vis US .16 (7.33)	vis-à-vis DE -.06 (.07) vis-à-vis G5 0.22 (1.01) vis-à-vis US .18 (.42)	vis-à-vis DE 1.86 (8.48) vis-à-vis G5 .42 (8.85) vis-à-vis US .11 (5.69)	vis-à-vis DE – – vis-à-vis G5 .57 (10.70) vis-à-vis US .11 (1.19)

Note: [a] The average multipliers shown in this table are potentially influenced by a number of outliers in the country-by-country results. We therefore made the same calculations (including the 2-sample t-tests shown in Table 8) with outliers suppressed from the sample. These calculations show that the results are qualitatively robust to the inclusion or non-inclusion of outliers.

Table 7. Long-run multipliers for market interest-rate changes: comparisons of mean mutlipliers (t-statistics)

a. Vis-à-vis German interest rates

Regime	*1b*	*2a*	*2b*	*3a*	*3b*
1a	-3.96***	1.51	-7.50***	-5.01***	-4.28***
1b		4.29***	1.34	5.27***	4.88***
2a			-2.49**	-3.91***	-3.41***
2b				4.08***	4.08***
3a					.55

b. Vis-à-vis G5 interest rates

Regime	*1b*	*2a*	*2b*	*3a*	*3b*	*4*
1a	-7.70***	9.68***	-11.65***	9.76***	-17.31***	-1.71*
1b		1.15	-2.92***	15.76***	1.04	-3.70***
2a			-12.49***	-.87	-21.26***	-12.00***
2b				18.32***	6.09***	-.16
3a					-3.18***	-18.39***
3b						-6.59***

c. Vis-à-vis US interest rates

Regime	*1b*	*2a*	*2b*	*3a*	*3b*	*4*
1a	-1.56	.80	-1.32	-13.49***	8.88***	-16.13***
1b		1.70*	.13	1.67*	6.21***	-5.27***
2a			-1.35	-3.88***	6.78***	-13.07***
2b				1.29	4.75***	-4.61***
3a					16.33***	-24.01***
3b						-19.95***

* /**/***) Null that sample means are equal is rejected at 10/5/1 % significance level.

Table 8. Long-run multipliers for money-supply growth rates: comparisons of mean multipliers (t-statistics)

a. Vis-à-vis German money-supply growth

Regime	*1b*	*2a*	*2b*	*3a*	*3b*
1a	.71	-8.95***	15.55***	-2.34**	-3.80***
1b		-3.80***	1.39	-1.88*	-5.22***
2a			9.92***	8.97***	-3.46***
2b				-9.65***	-2.27**
3a					-5.96***

b. Vis-à-vis G5 money-supply growth

Regime	*1b*	*2a*	*2b*	*3a*	*3b*	*4*
1a	.01	8.02***	.32	.54	-.37	-.54
1b		.02	-.01	-.02	-.08	-.06
2a			-2.30**	-5.94***	-.67	-.78
2b				-.13	-.24	-.33
3a					-.63	-.89
3b						-.18

c. Vis-à-vis US money-supply growth

Regime	*1b*	*2a*	*2b*	*3a*	*3b*	*4*
1a	-.19	1.58	-2.49**	-11.68***	-.07	-.33
1b		.25	-.02	-.33	.15	.10
2a			-4.22***	-16.63***	-.16	-.72
2b				-3.23***	.12	.55
3a					.70	3.21***
3b						.00

* /**/***) Null that sample means are equal is rejected at 10/5/1 % significance level.

Notes

[1] Providing a definitive estimation of the degree of monetary policy autonomy based on international transmission of monetary policy indicators would require information not only about the outcome but also about the ex ante preferred path of policy. What we measure here is thus the *ex post, realized* autonomy − in line with our intent to investigate the practical empirical relevance of the conventional wisdom − rather than the *potential* for autonomy. Alternative approaches to measuring monetary-policy autonomy are based on parity conditions (Oxelheim, 1990), central-bank reaction functions, see Clarida, Galí & Gertler (1998, 2000), or on target-zone models, see Bertola & Svensson (1993), Svensson (1994) and Fratzscher (2002).

[2] The exception to the rule is Bajo-Rubio *& al*. (2001), which includes also Spain and Portugal.

[3] The G5 countries are: France, Germany, Japan, the United Kingdom and the United States.

[4] Exchange-rate flexibility has generally not been taken explicitly into account in the literature cited above. Of course, given that the principal aim of most of the contributions in the area has been to find out how the EMS worked, it is not surprising that the exchange-rate regime has been taken for granted (never mind that the *de-facto* regimes pursued by participants in the system and the actual degrees of exchange-rate variability differed widely).

[5] For a similar model with the explicit consideration of sticky prices and persistent deviations from PPP, see, for instance, Rose (1996).

[6] Cf. the categorizations made by Helpman (1981), who also distinguishes between a float, a fix, and a cooperative regime, and of Levy-Yeyati and Sturzenegger (2001, 2003), who similarly distinguish between float, fix, and an intermediate regime.

[7] E.g., Austria and the Netherlands, during their membership in the EMS, are classified as 'unilateral pegs', because in fact their exchange rates were pegged to the DEM, rather than adhering to the central parity rates of the cooperative system.

[8] The exact data series used in Section 5, along with sources, are listed in Appendix A.

[9] See, for instance, Uctum (1999).

[10] Using monthly data if one month is a longer time horizon than that at which agents form their expectations can present temporal-aggregation problems. One way to remedy this is, as noted, to run the model on daily data. In the absence of such data, a possible solution could be to include a moving-average (MA) term. However, we still

could not be certain if the aggregation problems are solved. Moreover this would present us with problems of interpretation.

[11] The indications of 'average lag' may be a bit misleading since an *active* but *gradual* interest-rate policy by the small country with frequent policy-rate changes in periods where few changes are made in the benchmark-country rate will give the impression of a 'long lag', while, in effect, the indicator simply reflects the average of several changes spread over a long time. It is not evident that this type of policy is necessarily less responsive to foreign influences than one which follows a different strategy; the frequency of interest-rate changes by the central bank also depends on the bank's exact operational framework.

[12] Conveniently calculating elasticities and, especially, lags requires that the interest rates used are of the sort that are changed every once in a while, and not from each period to the next; this explains why we could not include the G5 average in this exercise: with a five-country average as benchmark the 'leading' changes were simply too frequent.

[13] Country by country results are available from the authors on request.

[14] Roughly stated, a time series, X, is said to be Granger-caused by another time series, Y, if the value of the first series at time t can be established as being best predicted by past values (of itself and) of the second series. Unilateral (one-way) causality from Y to X is said to obtain if Y Granger-causes X and X does not Granger-cause Y; bilateral causality (feedback) between X and Y is said to obtain if Y Granger-causes X and X Granger-causes Y; 'autonomy' (non-causality) of Y vis-à-vis X (and of X vis-à-vis Y) is said to obtain if Y does not Granger-cause X and X does not Granger-cause Y.

[15] A similar motivation for the use of the FPE criterion is given, for instance, in Erenburg & Wohar (1995) and Bajo-Rubio & Montávez-Garcés (1999).

[16] For more details on how to compute multipliers, see, e.g., Lütkepohl (1991) or Gardner & Perraudin (1993).

[17] Again, country by country results are not reported, but are available on request.