The EURO, Prudent Coherence?

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A flurry of recent articles has argued on the basis of constructed European wide monetary aggregates that the demand for EURO's will be more stable than the current demand for national currencies. In policy circles this seemingly moderating effect of monetary integration figures as an additional argument pro union. On the basis of the standard foreign exchange rate model we argue that once the uncoordinated country specific money supply system is abolished, the coherence between local monetary aggregates increases dramatically, leaving little room for a free ride on the law of large numbers. The only road towards stability is prudent monetary policy.

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1 Introduction

The coming of the EURO, the European currency unit, has put new life into money demand research. A recent, but by no means exhaustive, survey by the European Monetary Institute (Browne, Fagan and Henry, 1997) lists at least 15 articles that use artificially constructed monetary aggregates in the estimation of the European money demand function. This line of research started with the papers by Bekx and Tullio (1989) and Kremers and Lane (1990). Other notable papers in this line of research are Artis, Bladen-Hovell and Zhang (1992), Monticelli and Strauss-Kahn (1993), Cassard, Lane and Masson (1994), Artis (1996), Monticelli (1996), Tullio, De Souza and Giucca (1996), Wesche (1997), La Cour and MacDonald (1997) and Spencer (1997). From these studies a remarkable consensus has emerged on the degree of stability of the European demand for money. Taking the residual standard error as a rough-and-ready indicator of stability, a typical European average money demand function beats German money demand, generally perceived to be one of the world's most stable, by at least 30%. Furthermore, standard econometric stability tests fail to detect any signs of structural instability in European money demand functions.

On the basis of this apparent stability, these studies have been interpreted as providing support for the beneficial effects of monetary union. Monetary integration would stabilize the rather erratic monetary aggregates in Europe. This would make the life of European policy makers and monetary authorities a lot easier. Moreover, because of this stability, so the line of reasoning goes in Frankfurt, monetary targeting would be feasible. The Bundesbank, for example uses this result as an argument in its campaign for implementation of the current Bundesbank operational rules at the European level, rather than choosing for the pragmatic inflation targeting rule followed by e.g. the Bank of England.

In the Brussels' policy circles, the ostensible stability of European money demand has also been met with cautious optimism, instead of a more critical 'too-good-to-be-true' response. Doubts about whether these econometric exercises have been properly interpreted, however, are nagging. Are the area-wide money demand functions that have been estimated for countries which currently participate in the European Monetary System (EMS) representative for area-wide future money demand in the Economic and Monetary Union (EMU), or will this line of research fall victim to the Lucas critique? General concern that EMS-money demand may not be extrapolated to EMU has been voiced by a.o. Giovannini (1991). More concrete evidence for the non-applicability of the results has been given by Arnold (1997) on the basis of a comparison between regional money demands in the United States and national money demands in Europe. The residual cross-correlations between regions in the United States appear to be much higher than those between European nations. De Grauwe (1996) shows similar evidence for the regional differences in inflation between the German länder and the inflation differences in the EMS countries. This confirms the basic economic intuition that inside a monetary union, monetary developments to a large extent run in parallel. For EMU, this implies that the correlations between what are currently still national money demands will increase in Stage Three of the EMU project. Just like a regiment of soldiers that marches in lockstep across a bridge risks the collapse of the bridge, these higher correlations will tend to destabilize European wide money demand as constructed in the above mentioned studies. This unification coherence effect invalidates the operation of the law of large numbers, which is responsible for the current illusory findings of extreme European money demand stability. Thus a higher degree of monetary harmonization in Europe does not automatically lead to monetary stability, as one might have wished.

The increase in money demand and money supply coherence across the European nations and the resultant increased aggregate variability that we predict in this paper, is an application of the Hayeckian argument that policy centralization enhances the variability of policy outcomes. The statistical analysis by Arnold (1997) is in this respect rather suggestive. In the current paper we intend to provide support for these statistical based arguments by means of an economic analysis. Ex ante analysis of regime changes is notoriously difficult. Especially if similar type of regime changes have been very rare. But we will argue that the standard open economy model for exchange rate determination is well suited for analyzing the issue at hand. In particular, the model is approximately structurally invariant under the regime switch from managed float to monetary union. By interchanging the endogenous and exogenous variables, the model can be used to predict the main features of the future demand for money in Europe.

The standard foreign exchange rate model separates the three effects which come into play. The first effect is the effect of averaging due to the law of large numbers. It only works in the pre-union stage when monetary policy is more or less independent across countries. Hence, the variance of the average monetary aggregate will be lower than the variance of the constituent parts. In what sense this constitutes an economic benefit for the individual citizen is unclear. But in the presence of (indirect) currency substitution, competition in monetary policy between nations may keep the variability per country below the variability of a large monetary union. In any case, the law of large numbers effect is certainly lost due to unification. The pre-union variability of the average is an illusory predictor for the post union variability of the weighted union monetary aggregate. All that can be said is that it provides a nice textbook example for what the Lucas critique is all about.

Instead of this illusory aggregate effect, we recognize the following two post-union effects. As a result of the unitary monetary policy, we predict that the coherence in the movements of monetary aggregates across the union will increase dramatically. This second effect stands in sharp contrast to the prediction based on the effect of the pre-union average. The sharp increase in coherence stems from the quantitative importance of the exchange rate variability vis-a-vis the variability of the other variables in the model. Because exchange rate variability is driven to zero due to the monetary unification, the standard exchange rate model implies that the covariance between local monetary aggregates increases by about the amount of the drop in exchange rate variability.

The third effect that comes into play is the anti-inflationary stance of the future European Central Bank (ECB). The amount of monetary prudence exercised by the ECB will determine the amount of variability of the union wide monetary aggregates. But regardless of what the policy stance of the ECB will be, the coherence will increase. The extent of the increase in coherence is such that the average post-union monetary aggregate will be about as variable as the variability of the local monetary aggregates. We conclude therefore with the old adage that price stability will depend on prudent monetary policy. This is basically determined by the institutional design of the ECB, and has not much to do with the creation of the union as such. For example, the power balances within the board between local and EC appointees will be important for determining the policy decisions, see von Hagen and Süppel (1994). But this depends on the Maastricht treaty contents, and its interpretation, but not on the fact that there will be a single currency area. On this score the average of current local money demand has no predictive power whatsoever. Rather, a better predictor for things to come is to pick the individual country whose institutional central bank design best reflects the design of the ECB to be, and to extrapolate from there. We leave this exercise to the reader.

In the next section we identify the three effects discussed above. The third section provides the quantitative importance of the different effects. The last section concludes.

2 Analysis of the Monetary Unification

The analysis will be build on the Euler equations for international asset diversification and the local quantity equation. Consider the following two-period consumption-investment problem:

$$\max_{X,X_j,B,D} U(X) + \Sigma_j \pi_j W(X_j)$$

subject to

$$Y = PX + B + SD,$$

$$Y_j + RB + S_j ID = P_j X_j.$$

Here X denotes consumption with price P, Y is nominal income, B are domestic bonds with gross returns R, D are foreign bonds with gross returns I denominated in foreign currency, and S is the foreign exchange rate. The states of the world are indicated by subscript j, and state probabilities are π_j. The expected utility function is time additive; $U(X)$ is the first period utility, and $\Sigma_j \pi_j W(X_j)$ is the second period expected utility.

Let $K_j = W_{xj}/V_x$ be the intertemporal marginal rate of substitution or briefly the pricing kernel. The first order conditions imply the following two equalities if there exists an interior solution

$$E\left[K_j \frac{P}{P_j} R\right] = 1, \tag{1}$$

$$E\left[K_j \frac{P}{P_j} \frac{S_j}{S} I\right] = 1. \tag{2}$$

Denote foreign variables by a superscript star, except for foreign bonds and bond returns. Abroad a similar analysis yields

$$E\left[K_j^* \frac{P^*}{P_j^*} I\right] = 1, \tag{3}$$

$$E\left[K_j^*\frac{P^*}{P_j^*}\frac{S}{S_j}R\right]=1. \tag{4}$$

These equations can be used to derive a relation between the currency prices and country pricing kernels.

The following no-arbitrage analysis is a simplified version of Backus, Foresi and Telmer (1996). From (1) and (4) we have that

$$\Sigma_j\pi_j\left[K_j^*\frac{P^*}{P_j^*}\frac{S}{S_j}-K_j\frac{P}{P_j}\right]=0, \tag{5}$$

while (2) and (3) imply

$$\Sigma_j\pi_j\left[K_j^*\frac{P^*}{P_j^*}-K_j\frac{P}{P_j}\frac{S_j}{S}\right]=0. \tag{6}$$

How can (5) and (6) both be satisfied simultaneously? It is easy to see that a sufficient condition is:

$$\frac{K_j^*}{K_j}=\frac{P}{P_j}\frac{P_j^*S_j}{P^*S},\ \text{for all } j. \tag{7}$$

If markets are complete this is also necessarily the case (with $j=1,2$, (5) and (6) yield two linear equations in K_1^*/K_1 and K_2^*/K_2). If the set of markets is incomplete, the K_j^*/K_j ratios can still be chosen such that (5) and (6) hold and that no arbitrage opportunities exist.

We rewrite the no-arbitrage relation (7) in log-form

$$\Delta s=(\Delta p-\Delta p^*)+k^*-k, \tag{8}$$

where $\Delta x=\log(X_j/X)$. Combine (8) with the quantity equation $MV=PY$. Rework this definition into the logarithmic relative country version of the quantity equations in first differences

$$\Delta p-\Delta p^*=(\Delta m-\Delta m^*)+(\Delta v-\Delta v^*)-(\Delta y-\Delta y^*). \tag{9}$$

Define a relative country variable as $\Delta\widetilde{x}=\Delta x-\Delta x^*$. Combine (8) and (9) to get an expression for the forex returns

$$\Delta s=\Delta\widetilde{m}-\Delta\widetilde{y}+\Delta\widetilde{v}-\widetilde{k}. \tag{10}$$

Note that up to this point the expression for the exchange rate is derived from first principles and should therefore apply to any exchange rate regime.

The more conventional derivation starts from (9) and imposes (relative) PPP, which is a somewhat more specific no-arbitrage assumption. This yields directly $\Delta s = \Delta\widetilde{m} - \Delta\widetilde{y} + \Delta\widetilde{v}$, but one looses the insight that deviations (from PPP) perturb the relative intertemporal marginal rates of substitution $\widetilde{k}$ in a specific way. To make the concept of velocity v operational, however, we will still have to take a shortcut. Present day monetary theory does not yield a standard structural velocity specification.[1] For this reason we take the direct macro approach and assume that velocity is a stable function of the interest rate and income. Of course, this will be the Achilles heel to our analysis of regime change. In the end, though, we can relax the stability of the country velocity specifications somewhat, since we only need the relative country variables. The log-velocity specification is then as follows

$$v = \lambda(R-1) + \tau y + \varepsilon,$$

and in relative country variable notation

$$\widetilde{v} = \lambda\widetilde{R} + \tau\widetilde{y} + \widetilde{\varepsilon}, \tag{11}$$

where $\widetilde{\varepsilon}$ is the unexplained part of the relative velocity.

Substitute (11) in (10) to arrive at our final specification

$$\Delta s = \Delta\widetilde{m} + (\tau - 1)\Delta\widetilde{y} + \lambda\Delta\widetilde{R} - \widetilde{k} + \Delta\widetilde{\varepsilon}. \tag{12}$$

Equation (12) is amenable to regression analysis, where the last two terms $\Delta\widetilde{\varepsilon} - \widetilde{k}$ are the unobserved residual. In the empirical section a panel estimation procedure will be used to estimate the coefficients $\tau-1$ and λ. In the rest of this section we assume that the homogeneity property of s with respect to $\widetilde{m}$ is satisfied, but the empirical analysis does not impose this neutrality restriction. The coefficients are, however, restricted to be identical across countries. The reason for this restriction is that the structural model is not country specific. The arguments on which the above specification is build applies to any pair of countries. The cross country coefficient restriction is also instrumental for the empirical analysis.

Once we know the coefficients we can investigate the implications of a monetary union. To this end rearrange (12) to obtain

$$\Delta\widetilde{m} = \Delta s + (1-\tau)\Delta\widetilde{y} - \lambda\Delta\widetilde{R} + u, \tag{13}$$

[1]Standard theoretical approaches are the monetary overlapping generations model, a transactions technology approach whereby money enters the utility function indirectly via leisure time, the cash-in-advance constraint based analysis, and the decentralized exchange model. But neither approach generates a canonical expression for velocity.

where $u = \widetilde{k} - \Delta\widetilde{\varepsilon}$. To describe the coherence and prudence effects under monetary union we first need to analyze how the $Var[\Delta\widetilde{m}]$ is affected by monetary unification. Evidently, we have the following pre-union decomposition

$$\begin{aligned} Var[\Delta\widetilde{m}] &= Var[\Delta s - \lambda\Delta\widetilde{R}] + (1-\tau)^2 Var[\Delta\widetilde{y}] \\ &\quad +2Cov\left[\Delta s - \lambda\Delta\widetilde{R}, (1-\tau)\Delta\widetilde{y}\right] \\ &\quad +2Cov\left[\Delta s - \lambda\Delta\widetilde{R} + (1-\tau)\Delta\widetilde{y} + u, u\right] \end{aligned} \tag{14}$$

Given the panel estimates for the coefficients, estimates for all the terms in (14) can be easily constructed from the observed m, s, R and y variables. The last component on the RHS is constructed by taking the difference between $Var[\Delta\widetilde{m}]$ and the first three components on the RHS.

In the empirical section we will show that the main component of $Var[\Delta\widetilde{m}]$ is $Var[\Delta s]$. The variation in $\Delta\widetilde{R}$ and $\Delta\widetilde{y}$ are orders of magnitude smaller than the $Var[\Delta s]$. This is essentially the news dominance feature of foreign exchange rate movements. Having established this, what does it imply for monetary union? Evidently $Var[\Delta s] = 0$ under monetary union, and $Var[\Delta\widetilde{R}]$ will be approximately equal to 0. Hence, (14) reduces to

$$Var[\widetilde{\Delta m}] = (1-\tau)^2 Var[\Delta\widetilde{y}] + 2Cov[(1-\tau)\Delta\widetilde{y} + u, u] \tag{15}$$

This variance will likely be much smaller than $Var[\Delta\widetilde{m}]$ for the pre-union situation as given in (14), because $Var[\Delta s]$ has disappeared from the RHS in (15).

Regarding $Var[\Delta\widetilde{y}]$, Artis and Zhang (1995) and Fatás (1997) conclude that countries participating in the exchange rate mechanism of the EMS show a stronger business cycle synchronization than countries which did not participate. This suggests that under monetary union $Var[\Delta\widetilde{y}]$ would be reduced still further. Though this would alleviate the problem of asymmetrical real shocks, one of the big problems of the EMU, it also introduces the Hayeckian type problem that the centralization of monetary policy will enhance the amplitude of the European business cycle. The likely reduction in $Var[\Delta\widetilde{y}]$ thus strengthens the conclusion that $Var[\widetilde{\Delta m}]$ has to come down.

The conclusion that $Var[\Delta\widetilde{m}]$ will be lower under EMU also hinges on a number of empirical assessments about the magnitude of the relationships between the variables. We discuss some statistical issues concerning these empirical assessments.. Suppose that we can assume that, if anything, the differences in real growth rates do not increase, and that the fluctuations in u do not increase either, then $Var[\Delta\widetilde{m}]$ must come down. Recall that $u = \widetilde{k} - \Delta\widetilde{\varepsilon}$, where $\widetilde{k}$ stands for the relative country difference in the intertemporal marginal rate of substitution, and $\Delta\widetilde{\varepsilon}$ is the change in the relative country difference in velocity in so far this is not captured by $\lambda\Delta\widetilde{R}+\tau\Delta\widetilde{y}$. A priori it seems unlikely that unification will increase the variability of the real variable $\widetilde{k}$. Neither is it likely that velocity differences between countries will start to vary more due to the unification. These assumptions concerning $\widetilde{k}$ and $\Delta\widetilde{\varepsilon}$ will be our maintained hypotheses and go untested in the analysis below. Thus assuming that u does not thwart the structural invariance we are seeking, it follows that unification lowers the variability of the country differential money growth rates.

There are some econometric concerns which warrant treatment. Note that u consists in two components, i.e. it is the difference between the numeraire country $k - \Delta\varepsilon$ and the other country variable $k^* - \Delta\varepsilon^*$. Because the numeraire country residual variable shows up in all equations of the panel, the cross-country residuals are not uncorrelated. This problem will be salvaged by the inclusion of time dummies. The time-specific effect reduces this cross-country correlation of the residuals by a factor of $1/(n-1)$, where n is the number of countries.

Another econometric issue is the nonstationarity of some of the variables. Typically s, $\widetilde{m}$, and $\widetilde{y}$ are nonstationary variables, while the first differences of these variables are stationary. In contrast, the interest differential $\widetilde{R}$ is stationary. Hence, a simple level regression of s on $\widetilde{m}$, $\widetilde{y}$ and $\widetilde{R}$, suffices to back out consistent coefficient estimates, albeit with different rates of convergence. If one were to proceed with the difference specification in (12), one would have to model both the long-run and the short-run dynamics through the error-correction specification. But the short-run dynamics are not of immediate concern for our analysis, we only need the long-run coefficients for (14), and hence the former level regression procedure suffices.

Lastly, we touch upon the issues of omitted variable and simultaneity bias. The usage of a panel may, to some extent, redress these curses. This mitigation occurs if the correlation between residual and explanatory variables is policy dependent and hence is different across countries. In fact, the differences in time series versus cross section estimates of the coefficients point in this direction. Another reason for why a potential bias in the estimate of e.g. λ may not overly concern us, is that the $Var[\Delta\widetilde{R}]$ are relatively small compared to $Var[\Delta s]$. Lastly, if the relation between the omitted variable and included variable is stable across the regime change, then the omitted variable bias is a virtue since it captures both the effect of how the dependent variable changes due to changes in the dependent variable, and the effect of the concomitant changes in the omitted variable.

With these caveats in mind we can now explore the economic implications of the predicted decline in $Var[\widetilde{\Delta m}]$ due to unification. By definition the following decomposition holds

$$Var[\widetilde{\Delta m}] = Var[\Delta m] + Var[\Delta m^*] - 2Cov[\Delta m, \Delta m^*]. \tag{16}$$

Our prediction is that $Var[\widetilde{\Delta m}]$ will decline substantially, as the variability of all three independent variables in (14) will be reduced. Suppose that $Var[\Delta m]$ and $Var[\Delta m^*]$ settles somewhere in the neighborhood of their pre-union average $(Var[\Delta m] + Var[\Delta m^*])/2$, say, on the grounds that the union's monetary policy stance will be somewhere in between the pre-union positions of the member countries (this is one of the possible prudence scenarios). Conditional on this assumption, the pre- and post-union sum $Var[\Delta m] + Var[\Delta m^*]$ will not change by much. Therefore the covariance $Cov[\Delta m, \Delta m^*]$ has to go up. This implies an increase in the coherence of money supply movements across nations. The corollary of this effect is that the apparent law of large numbers effect for the pre-union monetary aggregates:

$$Var\left[\frac{1}{n}\Sigma_{i=1}^{n}\Delta m_i\right] < \min_i Var[\Delta m_i],$$

will not be present in the post-union data as the correlation between the Δm_i will tend to 1; the LHS in (16) will become very small, and $Var[\Delta m] \approx Var[\Delta m^*]$. Hence our claim that the averaging effect is illusory, and that rather the reverse can be expected as the empirical evidence by De Grauwe (1996) and Arnold (1997) shows. Our exchange rate model predicts that all Δm_i will start to behave very similarly due to unification.

As a rough approximation to the unification effect we might set the LHS in (16), i.e. $Var[\Delta\widetilde{m}]$, equal to 0. This more or less implies that Δm and Δm^* become perfectly correlated, i.e. the coherence is complete. But independent of this complete coherence is the level of the variability of Δm and Δm^* that will be experienced in the monetary union. Regardless unification, the following expression for Δm holds

$$\Delta m = \Delta p + \Delta y - \Delta v.$$

It is well known that most of the variation in Δm ends up in Δp. Hence, it depends on the monetary prudence exercised by the ECB what level of inflation variability will be experienced. But since this prudence effect is more or less independent from the coherence effect, the increase in coherence has to occur regardless the level of prudence, and we can leave aside the predictions concerning the future prudence of the ECB. The independence between the coherence and prudence effects also implies that there is no free lunch for the ECB from the unification, as the other studies have suggested on the basis of the variance of the average effect. Thus prudence has to be brought about in the hard way, by proper monetary policy. Whether there is any role for monetary targeting under the new regime remains to be seen. In any case, European money demand studies using constructed monetary aggregates under the old regime are of little use.

3 Empirical Validation

For the empirical implementation we will base ourselves on the long-term relationship between the variables. Short-run relations between the instruments of monetary policy and monetary targets like inflation are rather opaque, depending on institutional details and specific circumstances which are difficult to model, but monetarists maintain that the equilibrium transmission mechanism is stable and fairly transparent. For this reason central bankers of stable monetary regimes are mostly unperturbed by short run deviations between monetary targets and realizations. Instead, policy decisions are based on medium-run developments, exploiting the known long-run equilibrating responses between the different variables. The knife thus cuts both ways, for several reasons we do not know much about the short run relations between the various monetary variables, and hence policy bases itself on longer term developments. Therefore, from a future EURO policy point of view, the stability and coherence will not be issues to worry about on a day by day basis.

Within the setting of the foreign exchange market there are two specific arguments for focussing on the medium to longer term relations between the variables. *First*, under a free float regime the spot exchange rate incorporates the expectations regarding future deviations between domestic and foreign money growth. Hence, the relation between the relative money supply and the spot rate at any point in time can be rather loose, especially for the econometrician who does not observe these expectations. Empirically, Meese and Rogoff (1983) demonstrated that the fundamentals based foreign exchange rate model have no superior forecasting power over the simple no change forecast derived from the martingale feature of asset market pricing. Turning this evidence around, one could say that as an equilibrium relation the fundamentals based models, like the levels version of (12), is not rejected, but also that it contains no information about how the exchange rate will move during the next specific instant. *Second*, in fixed or managed exchange rate systems, like the ERM, exchange rate adjustments may reflect a divergence of money growth and inflation which developed in the past. Because governments have committed to certain exchange rate targets, it is public knowledge that adverse movements in the underlying variables have to be countered sooner or later to satisfy the long-run equilibrium relation between the fundamentals and the exchange rate. This induces the stationary autoregressive behavior between the set of fundamentals which is so typical for the target zone models. For example, the German interventions on behalf of the French Franc after the demise of the Lira and the Pound in 1992 induced short-term volatility in the money figures. The interventions, however, did not lead to increased exchange rate variability, because the interventions countered the expected changes in the exchange rates, and these therefore did not materialize at that time.[2] But if no corrective action is undertaken on the level of the fundamentals, then eventually exchange rate adjustments will do the job. For both reasons, we do not expect our model to be applicable in the short-run. We do expect, however, that systematic deviations between domestic and foreign money growth will either be foreshadowed in the forex markets or be corrected through realignments. So that (12) in levels still holds in the long run.

The panel procedure is especially suited to capture the long run equilibrium relation, because short run deviations, which differ per country depending on its foreign exchange rate regime, are averaged out across countries. A time series analysis for a specific exchange rate is therefore less well suited for finding the long run coefficients, because a particular country may stay on the same regime during the entire sample. In other words, the panel procedure is less prone to the Peso problem. Apart from having to estimate

[2] We note that such sizable shifts between 'nickels and dimes' has no significance for the case of monetary union, except perhaps during the transition phase when exhange rates have been irrevocably fixed, but national denominations still circulate.

the coefficients of the exchange rate equation (12), we also need the various second moments for (14) per pairs of countries. For the same reason as that the time series analysis per exchange rate is not simple, it is not an easy job to disentangle the variability in the persistent innovations from the variability in the short run disturbances for the relative country variables. But it is a straightforward exercise to show that the identification of the persistent factors versus the transitory components in the disturbances is facilitated by computing the variances over longer horizons. For this reason we will compute the variances and covariances using a multiperiod horizon, so that the transitory factors only play a minor role.

Some intuition for the results to come can be given graphically. Figure 1 plots time series for the income velocity of money for fourteen European countries and eight U.S. regions over the period 1974 to 1988.[3] The velocities of the nine European countries plotted in Figure 1a wander in all directions. In contrast, Figure 1b suggests that the velocities of the five 'core' countries Austria, Belgium, France, Germany and The Netherlands, share a common downward trend. Finally, Figure 1c shows that within the United States, even short-run fluctuations are to a large extent synchronized, witness the sharp drop in velocity in 1986. This suggests that as countries or regions move closer towards monetary union, the coherence effect will increase. This coherence effect is, however, independent of the overall stance of monetary policy, for which we reserved the term prudence.

Before we can proceed with the variance decomposition based on equation (14), we need to estimate the parameters of the monetary exchange rate model. We use annual data covering the period 1975 to 1995. The data were take from European Economy. The sample consists of all countries of the European Union, except Luxemburg, but including The United States and Japan, i.e. 15 countries in total. For each country, we have taken the relevant broad monetary aggregate, which is either M2, M3 or M4 (for Britain). Real income is measured by GDP. We use the short-term three months interest rate to construct the interest differential (comparable yearly rates were not sufficiently well available). Missing interest rate data for Sweden, Spain and Greece at the beginning of the sample were 'constructed' by using the relationship between the discount rate, which was available over

[3]The scale difference between the European and the U.S. series is due to the choice of monetary aggregate. For the European countries, we use a broad monetary aggregate, the U.S. series are based on demand deposits only. We are interested in the coherence, not the scale. The sample period is constrained by the availability of the U.S. data.

Figure 1: Coherence in velocity

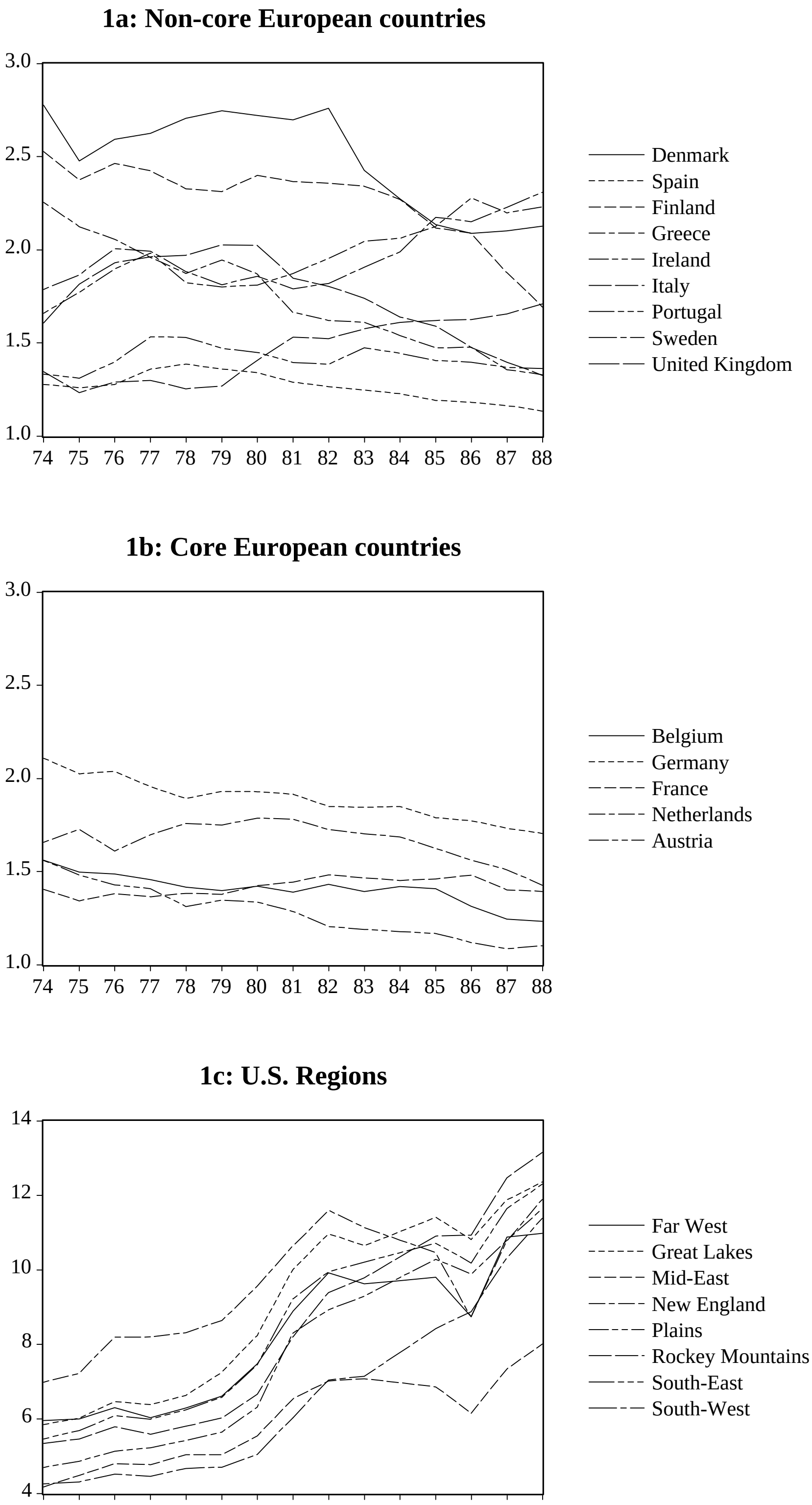

Table 1: Estimates

equation 17	
	coefficient
β	0.85
$(\tau - 1)$	-1.70
λ	0.50

the whole period, and the short term interest rate. The alternative solution, to drop these countries from our sample, hardly affects the following results. Exchange rates are end of year quotes. Data for s, $\widetilde{m}$ and $\widetilde{y}$ are taken in deviation from their mean in the panel estimation procedure to account for scale differences between the country variables.

The panel estimation consists of a levels regression between s, $\widetilde{m}$, $\widetilde{y}$, $\widetilde{R}$ and the time dummies d_t, as discussed in the previous section:

$$s = c + \beta\widetilde{m} + (\tau - 1)\widetilde{y} + \lambda\widetilde{R} + d_t + e. \tag{17}$$

Table 1 reports the estimation results. All three coefficient estimates do have the anticipated sign. The estimate of β conforms surprisingly well with the monetary exchange rate model, i.e. the exchange rate is close to being linearly homogeneous in the relative quantity of money. Univariate time series analyses report a wide diversity of β estimates. Because the panel incorporates a large number of countries with quite different monetary policy regimes, the panel is much more informative about the long-run equilibrium relation (17). The estimated coeficients are robust to omitting individual countries and years from the sample. We also note that the parameter estimates are invariant under the change of numeraire, e.g. if the US were used instead of Germany.

The estimates for β, τ, and λ are subsequently used for a variance decomposition based on (14). As we argued above, one needs to worry about the 'long and variable lags'. In order to identify the persistent factors and keep the contribution of the transitory elements to a minimum, we base the calculations of the second moments on non-overlapping four-year period growth rates for all the variables concerned. For our sample period this leaves five observations per exchange rate. Nevertheless, this loss in precision is acceptable, given that so many countries are present in the sample. Table 2 reports for all rates the following terms in the decomposition: $\beta^2 Var[\Delta\widetilde{m}]$,

Table 2: Variance decomposition

	(a)	(b)	(c)	(d)	(e)	(f)
BE	28	95	22	67	-155	129
DK	192	126	111	-9	-36	173
ES	155	566	47	-120	-337	436
FI	248	299	213	-227	-36	239
FR	97	211	27	68	-209	153
GR	563	775	37	48	-297	1504
IR	211	156	107	-22	-31	297
IT	287	609	53	233	-609	279
NL	23	7	22	-17	10	103
AU	35	2	20	-5	18	139
PO	609	3301	23	408	-3124	932
SE	73	185	105	61	-279	121
UK	178	232	115	135	-304	309
US	71	1463	112	243	-1747	107
JP	95	419	61	-168	-218	152
r_s with (a)		0.61^*	0.33	0.11	-0.42	$0.52^{*\circ}$
t_{r_s}		2.81	1.27	0.39	1.66	2.20

column (a) - $\beta^2 Var[\Delta\widetilde{m}]$

column (b) - $Var[\Delta s - \lambda\Delta\widetilde{R}]$

column (c) - $(1-\tau)^2 Var[\Delta\widetilde{y}]$

column (d) - $2Cov\left[\Delta s - \lambda\Delta\widetilde{R}, (1-\tau)\Delta\widetilde{y}\right]$

column (e) - $2Cov\left[\Delta s - \lambda\Delta\widetilde{R} + (1-\tau)\Delta\widetilde{y} + u, u\right]$

column (f) - $index(M/M^*)$

*significant at a 5% level

$^\circ r_s$ with (b), all others with (a)

$Var[\Delta s - \lambda\Delta\widetilde{R}]$, $(1-\tau)^2 Var[\Delta\widetilde{y}]$, and $2Cov\left[\Delta s - \lambda\Delta\widetilde{R}, (1-\tau)\Delta\widetilde{y}\right]$. The numbers for the last element $2Cov\left[\Delta s - \lambda\Delta\widetilde{R} + (1-\tau)\Delta\widetilde{y} + u, u\right]$ on the RHS of (14) are constructed from the other elements. Table 2 also reports Spearman's rank correlations r_s between column (a) and the columns (b), (c), (d) and (e); t-statistics t_{r_s} are in the last row. The final column (f) gives the 1995 value of M/M^{GE} indexed with base year 1974, as an indicator of long-run monetary divergence. The rank correlation r_s is in this case between columns (b) and (f).

The results show that the three countries with lowest exchange rate variability vis-a-vis Germany -Austria, Belgium, and The Netherlands- also have the lowest variability in the money growth differential. In contrast, countries like Italy, Greece and Portugal combine high exchange rate variability with high variability in the money growth differential. The combination of high exchange rate variability and low variability in the money growth differential in the United States and Japan does not invalidate our argument, since we only argue that a lack of monetary coherence will be reflected in the exchange rate, not that real exchange rate fluctuations are impossible. Taking all countries together, Table 2 shows that $Var[\Delta s - \lambda\Delta\widetilde{R}]$ is the only component in the variance decomposition which is significantly related to $\beta^2 Var[\Delta\widetilde{m}]$, as indicated by the rank correlations. The last column in Table 2 shows that our other indicator of (a lack of) monetary coherence is also significantly related to $Var[\Delta s - \lambda\Delta\widetilde{R}]$.

In addition to the results for the individual countries we investigated three country groupings: A small group, consisting of Austria, Belgium, France and The Netherlands; a medium-sized group also including Finland, Ireland, Italy, Portugal and Spain; and a large group including all EU-members (with the exception of Luxemburg). The small group consists of countries having a track record of exchange rate stability vis-a-vis Germany, while the medium-sized group includes all likely EMU-entrants. The numbers in Table 3 are averages of the numbers for the individual countries from Table 2. The results for the country groupings confirm the difference between the 'core' countries and the other European countries which we observed in Figure 1. Table 3 shows a striking difference between the small group and the other two groupings: In the small group the variability of $\Delta s - \lambda\Delta\widetilde{R}$, $\Delta\widetilde{m}$ and $\Delta\widetilde{y}$ is much lower than in the other groups.

What would an EMU deliver in terms of coherence? Due to the unification $Var[\Delta s - \lambda\Delta\widetilde{R}]$ and $Cov\left[\Delta s - \lambda\Delta\widetilde{R}, (1-\tau)\Delta\widetilde{y}\right]$ drop out. But since $\Delta s -$

Table 3: Average EMU variance decomposition

	(a)	(b)	(c)	(d)	(e)	(f)
small EMU	46	79	23	28	-84	131
medium EMU	188	583	60	43	-497	301
large EMU	208	505	69	48	-415	370

column (a) - $\beta^2 Var[\Delta\widetilde{m}]$
column (b) - $Var[\Delta s - \lambda\Delta\widetilde{R}]$
column (c) - $(1-\tau)^2 Var[\Delta\widetilde{y}]$
column (d) - $2Cov\left[\Delta s - \lambda\Delta\widetilde{R}, (1-\tau)\Delta\widetilde{y}\right]$
column (e) - $2Cov\left[\Delta s - \lambda\Delta\widetilde{R} + (1-\tau)\Delta\widetilde{y} + u, u\right]$
column (f) - $index(M/M^*)$

$\lambda\Delta\widetilde{R}$ is also part of $Cov\left[\Delta s - \lambda\Delta\widetilde{R} + (1-\tau)\Delta\widetilde{y} + u, u\right]$, we assume that this covariance drops out as well, to stay on the safe side (note that the column (e) entries in both tables are negative, except for Austria and The Netherlands; so that retaining a part of these negative covariances would only reinforce our conclusions). Thus our post union equation (15) is reduced to $Var[\Delta\widetilde{m}] = (1-\tau)^2 Var[\Delta\widetilde{y}]$. Hence we can focus on columns (a) and (c) to distill the union coherence effect. Consider the case of a small EMU. From Table 3 we find that for the small EMU $\beta^2 Var[\Delta\widetilde{m}]$ goes from 46 in the pre union situation to 23, a decrease of 50%. This increases the coherence between the local inflation rates by the same percentage, cf. (16). For the medium and large EMU variants the predicted increase in coherence is even larger, see also column (c) in Table 2 for the individual countries.[4] Note that these predictions are conditional on the past level of $(1-\tau)^2 Var[\Delta\widetilde{y}]$. If EMU would lead to stronger business cycle synchronization, $\beta^2 Var[\Delta\widetilde{m}]$ would go down even more.

4 Conclusions

We do not know what monetary policy the European Central Bank will adopt in the future, nor how this will affect money demand in Europe. The ECB

[4]Sweden is the only EU country for which $(1-\tau)^2 Var[\Delta\widetilde{y}]$ exceeds $\beta^2 Var[\Delta\widetilde{m}]$.

might be able to copy the Bundesbank's prudent monetary management and Germany's history of money demand stability. But then again, it might not. We do know, however, that inside the EMU changes in monetary policy and money demand will start to affect all countries simultaneously, whatever course they take. This coherence effect invalidates European money demand studies, which have a built-in bias towards stability due to the law of large numbers. Our evidence indicates that this bias would be least severe for European money demand studies which include only those countries which have effectively operated as a monetary union. For example, a study of German-Dutch money demand from March 1983 onwards, when the guilder was last devalued, would not fall victim to our critique (compare the figures 23 and 22 from the columns (a) and (c) in Table 2, the predicted increase in coherence is, in this case, minimal). Unfortunately, such a study would have very limited relevance for monetary policy in the EMU. As the recent survey by Browne, Fagan and Henry, (1997) shows, most European money demand studies use a large group of countries (always including Italy) and a sample period starting in the 1970s. Since these samples lack exchange rate stability vis-a-vis Germany, we cannot use these to make inferences on money demand stability inside the future EMU.

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