Kiel
Working Papers

Kiel Institute
for the World Economy

Money Demand Stability and Inflation Prediction in the Four Largest EMU Countries

by Kai Carstensen, Jan Hagen, Oliver Hossfeld, Abelardo Salazar Neaves

No. 1443 | January 2008

Web: www.ifw-kiel.de

Kiel Working Paper No. 1443 | January 2008

Money Demand Stability and Inflation Prediction in the Four Largest EMU Countries*

Kai Carstensen, Jan Hagen, Oliver Hossfeld, Abelardo Salazar Neaves

Abstract:
In this paper we analyze the money demand functions of the four largest EMU countries and of the four-country (EMU-4) aggregate. We identify reasonable and stable money demand relationships for Germany, France and Spain as well as the EMU-4 aggregate. For the case of Italy, results are less clear. From the estimated money demand functions, we derive both EMU-4 and country-specific measures of money overhang. We find that the EMU-4 overhang measure strongly correlates with the countryspecific measures, particularly since the start of EMU, and is useful to predict country-specific inflation. However, it generally does not encompass country-specific money overhang measures as predictors of inflation. Hence, aggregate money overhang is an important, but by far not an exhaustive, indicator for the disaggregate level.

Keywords: Money demand, stability, money overhang, inflation forecast

JEL classification: E41, E52

Kai Carstensen
Ifo Institute for Economic Research
Poschingerstr. 5
81679 Munich
Germany
Email: carstensen@ifo.de

Oliver Hossfeld
Leipzig Graduate School of Management
Germany

Jan Hagen
European University Institute
Italy

Abelardo Salazar Neaves
University of Nottingham
UK

* We thank seminar participants in Kiel, Hamburg, Bayreuth, Frankfurt and Lille for many helpful comments and discussions. A first version of the paper was written while the authors were affiliated with the Kiel Institute for World Economics, which is gratefully acknowledged.

1 Introduction

Since the middle of 2001, M3 growth in the euro area has consistently exceeded the reference value of 4.5 percent set by the European Central Bank (ECB), while consumer price inflation remained near the target of 2 percent. These observations raise doubts about the stability of money demand as well as the information content of M3 growth for future inflation—two properties that were the main reasons named by the ECB to build its monetary policy strategy around a monetary aggregate. Hence, further analysis is clearly indicated.[1] While a wide range of recent studies deals with the money demand relationship in the euro area, it has been analyzed almost exclusively on the basis of aggregate euro area data.[2] At the first look, this may not be surprising since the ECB should be exclusively concerned with the development in the euro area as a whole. However, a disaggregate analysis on the basis of individual country data can lead to additional important insights both for the European Monetary Union (EMU) member countries and for the euro area as a whole.

As concerns the individual EMU member countries and their central banks, they should be interested in the timely detection of national imbalances. Assuming that monetary aggregates and, in particular, money overhang, which is defined as the deviation of actual M3 from the money demand equilibrium, carry important information with respect to the state of the monetary and financial system, they should closely track the evolution of these quantities at the country level. This is ever more important if one follows Milton Friedman's proposition that inflation is always and everywhere a monetary phenomenon because then money overhang may indicate future inflationary pressure for the respective country. But a sensible measure of excess money is not necessarily invariant to the country of interest. This obviously holds for the 4.5 percent reference value that

[1] See e.g. ECB (2003a, p.21) and Goodhart (2006).

[2] See Section 2 of this paper for a brief review of this literature.

was derived by the ECB from aggregate developments in the euro area and, thus, disregards any deviating developments in the individual member countries. It may also hold for more elaborate measures like the money overhang because the monetary and banking systems, the preferences of households and, hence, the money demand functions are probably not equal across countries.

As concerns the euro area as a whole, there are at least three reasons why national developments should be of interest. First, for the optimal conduct of monetary policy it may prove beneficial to use national information if the national monetary transmission mechanisms are asymmetric (de Grauwe and Senegas, 2003). Second, and related to the first point, inflation forecasts constructed by aggregating country-specific models outperform inflation forecasts constructed by using aggregate euro area data only (Marcellino et al., 2003). Similarly, country-specific inflation rates help to explain area-wide inflation even after controlling for aggregate macroeconomic information (Beck et al., 2006). This implies that if monetary developments have predictive content for inflation, it should pay off to augment the aggregate information set with national money overhang measures. Third, even if the national variables did not carry additional information over the aggregate ones, the construction of the ECB Governing Council would nevertheless entail considerable importance for national developments because the majority of the council members represent national central banks and may come into strong national pressure if the national developments diverge from the aggregate ones (Heinemann and Huefner, 2004). In such a situation, it is at least possible that they will feel committed to the countries they represent rather than to the euro area as a whole.

As a first illustration of the cross-country differences, compare euro area M3 growth with the growth of the contributions to M3 of the four largest countries in the EMU, see Figures 1 and 2. Figure 1 shows that, after a short drop in early 2004, euro area M3 is again growing excessively compared to the reference value defined by the ECB. For the single countries, a quite diverse picture emerges (see

Figure 2). In Germany, the M3 growth fluctuates around the (EMU-12) reference value over the whole EMU period without showing any sign of protracted excess money growth, especially since 2004. In France, the M3 growth exceeded the reference value between January 2000 and December 2002 and since the middle of 2004, but there were at least also short periods of low M3 growth. In contrast, Italy and particularly Spain experienced M3 growth rates in excess of the reference value for almost all the EMU Stage Three period. Hence, developments in the single countries exhibit different patterns than in the aggregate. This indicates that the countries may be subject to asymmetric shocks and exhibit different underlying trends and transmission mechanisms so that the area-wide reference value is of limited use to assess national M3 growth rates. Therefore, it may in fact be fruitful to analyze the monetary conditions within each country separately.

This is reinforced by previous empirical comparisons of national and aggregate money demand functions. Golinelli and Pastorello (2002), Dedola et al. (2001) and Wesche (1997) reject the hypothesis that aggregate and national money demand specifications and coefficient estimates conform with each other.[3] Therefore, Dedola et al. (2001) conclude that information from country-level analysis of money demand may therefore be useful for euro area monetary policymaking. This is corroborated in a more direct way by Wesche (1997) who finds that the average fit of the national money demand functions is better than the fit of the aggregate money demand function.

The present paper adds to this literature by assessing the forecasting power for national inflation rates of national, as opposed to aggregate, monetary indicators, particularly money overhang. To this end, we separately specify and estimate single country and aggregate money demand functions for the four largest countries

[3]Cassard et al. (1997) report that the aggregation restrictions for the core ERM countries cannot be rejected. However, they only analyze the small and not very recent sample from 1980 to 1990.

of the monetary union (EMU-4): Germany, France, Italy and Spain. As these four countries account for more than 70 percent of aggregate M3, the relationship between these four individual countries and the four-country aggregate should be a good indicator of the relationship between country-level data and the EMU-12 aggregate.[4] Then, we formally analyze the stability of the four disaggregate, as well as the EMU-4 aggregate, money demand functions because stability is often quoted as a precondition for good forecasting power. Finally, and most importantly, we assess to what extent the information content of measures of money overhang with respect to future national inflation rates differs between country-level measures and aggregate measures. In this regard, our data set allows for a first look at the question whether these indicator properties have changed since the introduction of the euro.

The remainder of this article is organized as follows. In Section 2, we present a brief review of the recent literature on euro area money demand. In Section 3, we analyze the long-run money demand functions of the four individual countries and the EMU-4 aggregate. The estimation results are used in Section 4 to construct and compare measures of money overhang and their information content with respect to future inflation. Section 5 concludes.

2 Recent Literature on Euro Area Money Demand

For the euro area, there is a large number of papers that estimate aggregate money demand functions and test their stability. Most of them exclusively use synthetic data for the pre-EMU period,[5] but the more recent papers add data

[4]Note, e.g., how closely the EMU-4 aggregate M3 growth tracks the EMU-12 aggregate M3 growth (Figure 1).

[5]See, e.g., Gottschalk (1999), Hayo (1999), Bruggemann (2000), Clausen and Kim (2000), Coenen and Vega (2001), Funke (2001), Müller and Hahn (2001), and Golinelli and Pastorello

on the first years of EMU.[6] Overviews are presented by Golinelli and Pastorello (2002) and Brand et al. (2002).

Almost all papers find euro area money demand to be stable until the EMU started in 1999, even though they differ in many respects (sample, variables, estimation procedure, geographic area, aggregation method). A further outstanding result for studies with sample periods ending prior to 1999 is the higher stability of the area-wide compared to the country-specific money demand functions. It is, however, not clear how this can be explained properly; whether it is just a "statistical artefact" (Müller and Hahn, 2001), the positive influence of the traditionally stable German money demand (Calza and Sousa, 2003), or the neutralization of currency substitution movements across the union. On the other hand, as argued by Müller and Hahn (2001) and Hayo (1999), it is not clear whether the better stability properties of aggregate euro area money demand have persisted since the introduction of the euro.

The stability issue has received particular attention since M3 growth started to accelerate in 2001. Due to the strong M3 growth, Kontolemis (2002) finds evidence for money demand instability in the third quarter of 2001, the last observation in his sample. In a comprehensive stability analysis Bruggemann et al. (2003) apply the fluctuation and Nyblom–type stability tests proposed by Hansen and Johansen (1999) and obtain mixed results but finally conclude that there are some specifications of long-run money demand that seem to be stable. This result is challenged by Carstensen (2006b) and Greiber and Lemke (2005). They argue that conventional money demand functions become unstable during the recent period of strong M3 growth and should be augmented with measures of macroeconomic or financial uncertainty, which account for the observation reported by the ECB (2003b) that, following the terrorist attacks of September 2001 and the

(2002).

[6]See, e.g., Brand and Cassola (2000), Calza et al. (2001), Kontolemis (2002), Bruggemann et al. (2003), Greiber and Lemke (2005), and Carstensen (2006b).

burst of the new economy bubble, large funds were reallocated into safe and liquid assets that are part of M3. However, these augmented specifications seem to be unable to explain the very recent increase in M3 growth since the middle of 2004 (ECB, 2005, Alves et al., 2006). In contrast, Dreger and Wolters (2006) are still able to find a stable money demand function using data until the end of 2004. Therefore, the question whether long-run money demand is stable in the euro area remains unsettled.

3 Cointegration and Stability of Money Demand

In this section, we present estimated long-run money demand functions of the EMU-4 countries and of the EMU-4 aggregate for the sample from 1979Q4, after the start of EMS I, to 2004Q4.[7] We used the data set of Golinelli and Pastorello (2002) extended until 2004Q4. Details are given in the Appendix.

Including pre-EMU data in the analysis is standard in the literature even though the introduction of the euro may have created a structural break in relationships like money demand. However, the limited amount of observations since 1999 prevents the exclusive use of post-EMU data. To check for the potential stability problem, we report a number of stability tests. Moreover, a money demand instability will bias the forecasting results against the national money overhangs because it is well documented that aggregate money demand is more stable than national ones. If national money overhangs nevertheless turn out to be important, this is an even stronger result.

This also holds for another problem with our approach. Money balances are measured according to the residence concept, which means that money holdings of all residents of the EMU are taken into account. Hence, cross-border money holdings within the EMU are included in the national M3 series. To the extent

[7]Since we used up to two lags for the VAR models, the effective sample start for all countries is set to 1980Q2.

that, e.g., French agents hold deposits in Italy or cash associated with Germany, the information content of national M3 for home inflation should be reduced. While cross-border money holdings do not appear to be extremely important in our sample[8], this again leads to unstable national money demand functions. Thereby, it introduces a bias against, and reinforces any forecasting success of, national monetary indicators.

Following the literature, we assumed that real money demand depends on real GDP as the transaction variable and one or more indicators of the opportunity costs of holding M3 like an interest rate or inflation rate. Since there are various such indicators available, we examined a large number of different specifications for each country, of which we only report the most promising ones.

For each set of variables, we first performed a cointegration analysis. To this end, we set up a VAR model with a lag order selected by the Bayesian information criterion (BIC) and the Hannan-Quinn criterion (HQ) [9] and tested for cointegration by means of the Bartlett corrected trace test (Johansen, 2002) and the Saikkonen-Lütkepohl (2000) S&L-test. Then we estimated the long-run money demand parameters both with the full information maximum likelihood (FIML) method of Johansen (1988) and, as a robustness check, with fully-modified ordinary least squares (FM-OLS) proposed by Phillips and Hansen (1990). Finally, we analyzed the stability of the resulting cointegration relationships with the help of several stability tests that are designed for cointegrated models: the eigenvalue fluctuation and Nyblom-type tests for constancy of the cointegrating vector by Hansen and Johansen (1999) based on the VAR model, and the $SupF$, $MeanF$ and L_c stability tests by Hansen (1992) based on FM-OLS.

[8]As an example, by the end of 2004 German non-banks received only 5% of their total credit volume from foreign banks (EMU-4 and other countries). Hence, the fraction coming from France, Italy, and Spain should be even smaller. More detailed statistics are, however, not available.

[9]We use the BIC and HQ due to their consistency in nonstationary systems as shown in, e.g., Paulsen (1984).

We did this not only because it is generally advisable to formally investigate the stability of the cointegrating relationships, as emphasized, inter alia, by Bruggeman et al. (2003), but particularly because our sample includes the start of EMU that may induce a break in the variables, specifically so in M3.

As a general result, it was not possible to find the same specification leading to sensible and stable results for all countries and the EMU-4 aggregate.

However, the cointegration tests in Table 1 indicate that there exists one long-run relationship within the set of variables analyzed for each country.[10] The corresponding long-run parameters are displayed in Table 2. They appear sensible and are grossly in line with the previous literature. In particular, the income elasticity is near one and the effect of the opportunity cost variables is negative. Only for Italy, the large estimate for the income elasticity and the differences between FIML and FM-OLS indicate some problems.[11] Next, we will give a more detailed description of the country-specific results.

3.1 Germany

For Germany, we specified a VAR model including real M3, real GDP and the long-term interest rate. Both the BIC and the HQ criteria indicated a lag order of one (Table 1, column 3). Since the cointegration tests typically lack power in overparameterized models (Lütkepohl and Saikkonen, 1999), we selected this very parsimonious model. Both the Bartlett corrected trace test (Johansen, 2002) and the Saikkonen-Lütkepohl (2000) S&L-test indicated a cointegration rank of

[10]For France and Italy, the S&L-test even indicates two long-run relationships. However, if we impose a cointegration rank of two, we obtain for both countries two irreducible cointegration vectors (Davidson, 1998) the linear combination of which almost exactly resemble the cointegration vector estimated under the assumption of one long-run relationship.

[11]Given these estimates, it is not surprising that the economically interesting hypothesis of a unit income elasticity is rejected for France and Italy (Table 1, bottom panel). In addition, the exclusion of the opportunity cost variables from the cointegration space is strongly rejected for all countries.

one.

In the next step, we estimated the cointegration parameters. Due to the known fragility of the point estimates obtained by the Johansen procedure, we present a second set of estimates obtained by fully-modified ordinary least squares estimation (hereafter FM-OLS) proposed by Phillips and Hansen (1990). The FM-OLS estimates are very similar to those obtained by the Johansen procedure. From this we conclude that the estimation results of the parsimonious model are robust and not specific to the estimation method. Moreover, the point estimates of the Johansen procedure remained almost unchanged when we increased the lag order of the VAR. This further corroborates our results.

The parameter estimates are displayed in Table 2. They appear sensible and are in line with the previous literature. The income elasticity is slightly above one, which is a typical finding for Germany (see Lütkepohl and Wolters, 2003, and the references therein). The semi-elasticity of the long-term interest rate is significantly negative, as expected, and comparable to estimates obtained by Hubrich (1999) and Beyer (1998).

For Germany, the $supQ$ statistic of the VAR model indicates instability at the 5 percent level. This is probably due to the German unification because the reported maximum of 2.34 is attained as a single peak in 1991Q1. We checked that adding a dummy variable for this period leaves the estimates nearly unchanged. In addition, all the other stability tests are not significant and the literature typically reports stable money demand specifications for Germany, see Lütkepohl and Wolters (2003), Scharnagl (1998) and the references therein. Therefore, we do not put much weight on this single test result and assume a stable money demand function for Germany.

3.2 France

For France, Spain and Italy, it was much more difficult to find sensible and stable money demand functions over the full sample. This resembled the previous empirical results for these countries.

In the final specification we included real M3, real GDP and the spread between the long-term and the short-term interest rate. The spread measures the opportunity costs of holding M3, where the long-term rate proxies the return on alternative funds and the short-term interest proxies the own rate of broad money (Gottschalk, 1999, Clausen and Kim, 2000, Müller and Hahn, 2001). Additionally, we had to include the German short-term interest rate to account for currency substitution effects.[12]

The cointegration tests for France are displayed in Table 1, column 4. We chose a lag order of one as indicated by the BIC an HQ criterion. This is, again, a very parsimonious specification. At the 5 percent level, both tests select cointegration rank 1, while the S&L test indicates cointegration rank 2 at the 10 percent level. This seems to reflect the difficulty to decide whether the spread is stationary or not. We decided to impose cointegration rank 1 because the significance of the largest eigenvalue is confirmed by both tests and the significance

[12] Most of the previous studies (Cassard et al., 1995, Clausen, 1998, Wesche, 1998, Fagan and Henry, 1999, Müller, 2003) encounter difficulties in finding a stable money demand relationship because 1987 seems to be a structural break. The main goal of the French monetary policy was to fight the "French disease" of chronically high inflation and repeated devaluations. The Banque de France therefore decided to follow Germany's monetary policy to import its credibility in fighting inflation since the beginning of the 1980s. In 1987 the parity between the French Franc and the German Mark changed for the last time according to the ERM system and simultaneously, capital restrictions have been eliminated completely. Investors were able to move at will all their capital from France to another country. In other words, the demand for French Francs could have been subject to considerable changes in a short period of time, one example being the speculative attack that several European countries suffered in 1992.

of the second largest eigenvalue is much more unclear.[13] Imposing cointegration rank 1 led to the estimates of the long-run coefficients presented in Table 2. The estimates are both significant and economically sensible. The income elasticity is roughly 1.4, which compares well to previous estimates.[14] Both the French spread and the German interest rate have the expected negative sign. Moreover, the parameter estimates are neither sensitive to adding more lags to the VAR model nor changing the estimation method to FM-OLS.

For France, the *SupF* test signals instability. While this is, again, only one test out of six, it is more worrisome because the recursive F tests on which the *SupF* test is based start to rise at the sample end and, hence, indicate that the instability occurred recently and may even be related to the start of the EMU. On the other hand, the parameter estimates are reasonable and compare well with findings in the literature.[15] We will come back to this issue when the forecasting potential of the French money overhang in the EMU sample is assessed.

---

[13]If we suspect that the spread is in fact stationary, we should impose cointegration rank 2. For identification, we then have to impose at least one restriction per cointegration vector. We achieve this by searching for two irreducible cointegration vectors (Davidson, 1998). It turns out that the first cointegration vector, $v_1 = mr - \underset{(-24.24)}{1.366}\ yr + \underset{(3.86)}{0.014}\ st_D$, is interpretable as a money demand function, while the second cointegration vector, $v_2 = spread$, is simply made up by the spread. The overidentifying restrictions are clearly accepted. This implies that any linear combination of the two cointegration vectors is also stationary. Hence, the linear combination $v_1 + 0.017 v_2 = mr - \underset{(-24.24)}{1.366}\ yr + \underset{(n.a.)}{0.017}\ spread + \underset{(3.86)}{0.014}\ st_D$ is also stationary and almost exactly resembles the cointegration vector estimated under the assumption of cointegration rank 1, which would therefore be even stationary if cointegration rank 2 was the right choice.

[14]Recent studies obtain estimates of 1.2 (Cassard et al., 1995), 1.59 (Cassard et al., 1997), 1.51 (Elyasiani and Zadeh, 1999) and 1.53 (Bahmani-Oskooee and Chomsisengphet, 2002).

[15]For evidence in favor of a stable money demand function, see Cassard et al. (1995, 1997), Wesche (1998) and Bahmani-Oskooee and Chomsisengphet (2002). On the other hand, Fagan and Henry (1998) do not even find cointegration, Clausen (1998) does not find a sensible relationship, and Müller (2003) obtains a stable relationship, but identifies this as a money supply function.

3.3 Spain

The Spanish money demand function includes three variables: real M3, real GDP and inflation. While inflation represents the opportunity costs of holding money instead of real assets, it is not the most common measure of opportunity costs in empirical money demand functions. However, replacing the inflation rate with the short-term or the long-term interest rate leads to positive parameter estimates, which indicates that both interest rates are highly correlated with the own rate of M3. Juselius and Toro (2005) identify such a money demand function including only real M3, real GDP and the own rate of M3, but this specification lacks a measure of opportunity costs that we deem essential to compare the Spanish money demand function with those of the other EMU-4 countries. Alternatively, some authors include the spread between the long-term and the short-term interest rate as a measure of opportunity costs (e.g., Camarero et al., 2002, Ordonez, 2003), but in our case the spread turns out to be stationary and, hence, need not be included in the long-run analysis of money demand. Therefore, we include real M3, real GDP and inflation.[16]

The cointegration tests for Spain are displayed in Table 1, column 4. Following the BIC and the HQ, we picked a lag order of two. Then the trace and S&L tests indicate a cointegration rank of 1 and 0, respectively. Since at least one test rejects the null of no cointegration, we imposed cointegration rank 1. This led to the estimates of the long-run coefficients presented in Table 2. The estimates are both significant and economically sensible. However, there are slight differences between the Johansen and the FM-OLS estimates. While this may be taken as a sign of caution, the estimates are nevertheless economically sensible. For example, the estimates of the income elasticity of 1.17 (Johansen) and 1.41 (FM-OLS) are in the wide range of previous studies, that includes estimates as low

[16]For the same reason, Wolters et al. (1998) successfully use the same set of variables in their analysis of the German money demand function.

as 0.44 (Juselius and Toro, 2005) up to 1.67 (Vega, 1998). As for the previous countries, the long-run parameter estimates are robust to changing the lag order. Hence, the problem of diverging Johansen and FM-OLS estimates cannot be traced back to the specification of the VAR.

Of the stability tests, only the eigenvalue fluctuation test rejects the stability of the money demand function at the 10 percent level. However, the eigenvalues are a convolution of the adjustment parameters and the long-run parameters, while the Nyblom tests are directly related to the long-run parameters. Since the latter are not significant, we conclude that it is most likely that the adjustment parameters have changed over time, while the long-run money demand function has remained stable.

It is difficult to relate this result to the literature as most of the previous studies have focused on the broader monetary aggregate ALP that is explained by Vega (1998). Generally, they indicate that it seems to be challenging to find a long-run money demand equation, which is attributed to the growing openness of the Spanish financial system to international markets (see Vega, 1998).

3.4 Italy

For Italy, it is notoriously difficult to find a proper money demand function that is beyond dispute. This corresponds to previous findings in the literature. Juselius (1998) does not find a plausible money demand function for Italy, which she attributes to financial innovations and changes in the Italian exchange rate mechanism in 1983. Gennari (1999) accounts for the structural change by including a logistic smooth transition function in her cointegrated VAR model but some stability tests remain significant. Muscatelli and Spinelli (2000) come up with a specification that appears to be stable, but they use a very long sample of annual data from 1861 to 1996. In a single-equation framework, Nielsen et al. (2004) obtain a stable money demand function only after including various dummies and interactions into the long-run relationship to account for currency substitution and institutional changes. However, such a conditional modelling has its own drawbacks, particularly the implicit assumption of weak exogeneity of the regressors, and cannot be extended to our system approach because including dummies and interactions invalidates the use of the conventional critical values for the cointegration and stability tests in the VAR model.

Nevertheless, we report a cointegrating vector that resembles the ones obtained for the other countries. The variables included are real M3, real GDP and the spread between the long-term and short-term interest rates. The results of the cointegration tests for Italy are displayed in Table 1, column 5. With a lag order of one as suggested by the BIC, the Johansen test indicates cointegration rank 1. Surprisingly, the S&L test indicates cointegration rank 2, which would only be possible if real M3 and real GDP were cointegrated and the spread was stationary. The latter, however, is strongly rejected by a KPSS test of the spread. Therefore, we imposed a cointegration rank of 1 as the more sensible choice.[17]

The estimated cointegration parameters presented in Table 2 are both sensible and statistically significant. At first sight, the income elasticity of about 2.9 seems implausibly high but for Italy this is not an unusual result. For example, Muscatelli and Spinelli (2000) obtain values close to 2 for the sample from 1861 to 1996. However, the FM-OLS results are pronouncedly different. While the income elasticity of roughly 1.3 is still in the wide range of estimates reported in the related literature[18], it is much smaller than the Johansen estimate. More-

[17]In addition, various additional unit root tests cannot reject the null hypothesis of a unit root in the spread. However, if we impose cointegration rank 2, we can obtain the two irreducible cointegration vectors $v_1 = mr - \underset{(-12.75)}{1.907}\ yr$ and $v_2 = spread$. Hence, their linear combination $v_1 + 0.053 v_2 = mr - \underset{(-12.75)}{1.907}\ yr + \underset{(n.a.)}{0.053}\ spread$ is also stationary and almost exactly resembles the cointegration vector estimated under the assumption of cointegration rank 1, which would therefore be even stationary if cointegration rank 2 was the right choice.

[18]Gennari (1999) obtains an estimate of 1.15 in a similar VAR model that is, however, augmented with a logistic trend to account for a structural change in the long-run parameters.

over, the coefficient of the spread becomes insignificant. These differences can be interpreted as an indicator for a potential, and not very surprising, instability of the Italian money demand function.

This is confirmed by the formal stability tests. The eigenvalue fluctuation test is significant at the 5 percent level. 3 other tests are significant at the 10 percent level. While this reinforces the lack of robustness between estimation methods and resembles the results in the literature, it is at least not overwhelming evidence for structural instability. In addition, the estimated cointegration parameters are quite sensible and a look at the evolution of the cointegration residual reveals that it is mainly the beginning of the sample that seems to be problematic. We take this as an encouragement that our Italian money demand function is not totally spurious, and that the use of money overhang derived from it may have some value, especially at the sample end. Still, we do not claim that our money demand function is beyond dispute.

3.5 The EMU-4 Aggregate

Finally, we report a money demand system based on our EMU-4 aggregate time series. In terms of M3, the four countries included make up for almost three quarters of the euro area aggregate. We used a specification including real money (M3), real GDP and the long-term interest rate. This specification was found to behave best among a wide range of specifications we worked on. Probably not surprisingly, this is the same specification that turned out stable for the Germany data.

In accordance with the BIC and the HQ we specified a VAR with two lags. Both the trace test and the S&L-test indicate the presence of one cointegration relationship in our system, see Table 1, column 2. The parameter estimates

In single-equation approaches, Nielsen et al. (2004) obtain 0.62 for the sample 1972Q1 to 1998Q4, and Bagliano and Favero (1992) obtain 1.57 for the sample 1964Q2 to 1986Q2.

of the cointegrating vector reported in Table 2 are economically sensible and significantly different from zero. Moreover, they are only slightly affected by changing the estimation method from Johansen to FM-OLS. This leads us to conclude that our parameter estimates are reasonably robust.

The income elasticity of money demand is estimated to lie around unity at 0.99 while the semi-elasticity of money demand with respect to the long-term interest rate is estimated at -0.03. These values accord with those found in the literature in both sign and approximate size. For example, Carstensen (2006b) obtains Johansen estimates of 1.25 and -0.019 for the income and interest rate parameters, respectively.[19]

All the stability tests reported in Table 3 indicate that the EMU-4 money demand relationship is stable at the 5 percent level.

The parameter estimates and the stability tests also allow us to assess the question whether the reported relationships can truly be interpreted as money demand (as opposed to money supply) functions. While a formal identification is beyond the scope of the paper, the parameter estimates and the stability results indicate that our interpretation as money demand functions is sensible. In particular, we find evidence for exactly one cointegrating relationship involving the real monetary aggregate, real GDP and measures of the opportunity costs of holding money, throughout. This warrants the interpretation of the reported relationships as money demand functions in accordance with Müller (2003). Moreover, the stability of these relationships (at least for the EMU-4 aggregate, Germany and Spain) ties in well with Hayo (1999), who highlights stability as a precondition for the identification of relationships including monetary aggregates as money demand functions. Finally, Bischoff and Belay (2001) argue that the identifica-

[19]For more results, see the survey table in Golinelli and Pastorello (2002, p.378). Note that interest rates are expressed in percentage points (e.g., 5.0 mean 5 percent) in our data set, and, hence the interest rate parameters in the literature have to be divided by 100 if the interest rates used there are expressed in fractions (e.g., 0.05 mean 5 percent).

tion problem is less central than previously emphasized, "regardless of the way the monetary authority determines money supply, as long as the money supply mechanism depends on at least one variable not in the money demand function." Given the compactness of the relationships identified here, this condition is very likely to be met by the broad-based two-pillar framework within which the ECB conducts EMU monetary policy.

To summarize, the estimation and testing results imply that the long-run relationships estimated for the EMU-4 aggregate, Germany and Spain can be interpreted as stable money demand functions while this is less obvious for France and especially Italy. While the stability problems pertaining to France and Italy are not very surprising given the results in the literature (see Calza and Sousa, 2003), it is a bit unexpected to find EMU-4 money demand to be stable because recent studies (Carstensen, 2006b, Greiber and Lemke, 2005) indicate instability at the EMU-12 level. While we can only speculate on the reasons, it seems to us that the inclusion of a full "M3 growth cycle" can be crucial. By this we mean that the strong and persistent deviation of M3 growth from the reference value lasted until 2004. Stability tests applied to shorter samples might indicate instability too often, while with the benefit of hindsight the deviation might not appear as persistent. We leave this for further research. Since our main focus is on using the money overhang derived from these money demand functions, we do not try to further analyze this issue here. Instead, we take the forecasting power of the overhang measures for national inflation rates as our ultimate criterion whether it makes sense to consider national monetary developments or not.

The results of the stability tests also imply that the the start of the EMU did not change the money demand functions for the EMU-4 aggregate, Germany and Spain, while there is at least one test that indicates a structural shift for France. For Italy, this question is difficult to answer because the money demand function does not appear to be very stable over a larger part of the sample.

As regards the monetary pillar of the ECB strategy, our results so far approve the stability of the aggregate money demand function, which is deemed an essential prerequisite for using money aggregates for monetary policy analysis. Hence, from this perspective we do not find evidence against the monetary pillar. However, monetary variables should also have good leading indicator properties for future inflation (Masuch et al., 2003). In this respect, it is interesting whether country-specific variables or aggregate variables are better suited. If money demand stability was a necessary condition, we would expect that the EMU-4 aggregate should be a fairly good leading indicator for aggregate but also for country-specific inflation. In addition, country-specific variables should perform particularly well in Germany (where money demand is remarkably stable) and particularly bad in Italy (where it is difficult to find a stable money demand function). In the following Section, we further analyze this question.

4 Money Overhang and Inflation in the EMU-4

In this section, we analyze the monetary stance of the EMU-4 countries by means of the money overhang series calculated from the estimated long-run money demand relationships and check the leading indicator properties of the money overhang for future inflation. A stable long-run money demand function should give rise to stable and good leading indicator properties of money overhang. Hence, we should expect that the EMU-4 aggregate should be a fairly good leading indicator for aggregate but probably also for country-specific inflation. In addition, country-specific variables should perform particularly well in Germany and Spain (where money demand is stable) and particularly bad in Italy (where it is difficult to find a stable money demand function).

4.1 Money as an Inflation Predictor in the Euro Area

There has been a long discussion concerning the relevance of money growth, or a related monetary measure, as a predictor of future inflation. While there is strong evidence against the relevance of money growth in the US (Friedman and Kuttner, 1992, Estrella and Mishkin, 1997, Stock and Watson, 1999), the results are much more mixed for the euro area. For simple money growth, it is typically difficult to establish a good leading indicator property for future inflation (Gerlach and Svensson, 2003). This changes if one relates low-frequency movements in money growth to inflation (Neumann and Greiber, 2004, Assenmacher-Wesche and Gerlach, 2006a, b). The drawback of the low-frequency approach is, however, that it typically entails using symmetric filters, which may be unproblematic for ex-post analyses but is unfavorable for true (real-time) forecasting. Instead, several studies use measures derived from the money demand function like the money overhang and the money gap of the P-star model (Nicoletti-Altimari, 2001, Trecroci and Vega, 2002, Gerlach and Svensson, 2003). The results confirm the relevance of these measures as indicators of future inflation. In this paper, we focus on the money overhang because it is directly derived from our estimated money demand functions, while the calculation of the money gap requires additional, potentially controversial assumptions regarding the long-run output growth path and the equilibrium interest rate. In addition, Carstensen (2006a) reports that, among various monetary measures, the money overhang can best explain the interest rate setting of the ECB.

4.2 Money Overhang

A positive overhang indicates excess money and, thus, a soft monetary stance that, according to the monetarist view, results in future inflation. A negative overhang indicates a tight monetary stance. However, it is not obvious what a non-zero overhang at the euro area level means for the individual countries because the monetary stances and the transmission mechanisms may differ from country to country.

Therefore, we constructed three different measures of money overhang for the EMU-4 countries. The first measure, ov_{EMU-4}, is simply the money overhang of the EMU-4 aggregate and is, thus, the same for all four countries. It signals the aggregate money supply situation. The second measure, ov^i_{EMU-4}, where $i = D, F, ES, IT$, is a semi country-specific money overhang that uses the country data but the EMU-4 specification and parameters. It is calculated as

$$ov^i_{EMU-4} = m^{real}_{t,i} - (\beta_{1,EMU-4} y_{t,i} + \beta_{2,EMU-4} r^l_{t,i}), \qquad i = D, F, ES, IT.$$

This measure indicates how the single countries "contribute" to the aggregate money overhang but neglect that money demand functions differ between the countries. Finally, the third measure, ov_i, is a fully country-specific money overhang that uses the country data, specification and parameters. It signals the country-specific monetary situation, but is not necessarily consistent with the aggregate picture.

The three measures of money overhang are displayed in Figure 3.[20] In most cases, there seems to be an overall correspondence between the aggregate measure, ov_{EMU-4}, and the fully country-specific measure, ov_i. To further investigate this issue, the correlations between the three measures are reported in the top panel of Table 4 for each country and for both the pre-EMU and the EMU samples. In almost all cases, the three overhang measures are significantly and positively correlated, but the correlation is sometimes considerably below one. The correlations increase from the first to the second sample, which indicates a closer relationship of the monetary developments since the start of EMU. From this perspective, we can conclude that the aggregate money overhang is a good indicator of the monetary situation in the single countries.

[20] To construct the Spanish overhang we used year-on-year instead of quarter-on-quarter inflation because the former is much less volatile and improves readability of the graph.

4.3 The Information Content of Money Overhang for Future Inflation

This does not mean, however, that the money overhang measures are necessarily also a very good indicator of current and future inflation. To analyze this, we present the (unconditional) correlation of the current measures of money overhang with current, 1-year-ahead and 2-year-ahead inflation in the second to fourth panels of Table 4. The most striking result is the apparent decline of the information content of money overhang for inflation from the pre-EMU to the EMU sample. While this may partly be due to the short EMU sample, it is surprising that there are many significant and positive correlations between the money overhang measures and inflation in the pre-EMU sample (in 27 out of 36 times) but only two in the EMU sample (in France). This seems to indicate that monetary developments have been of less importance in the euro area since the start of EMU than before.

Since unconditional correlations may provide an incomplete picture when different variables and their lags are collinear, we estimated simple inflation forecasting equations for several forecast horizons h: 1-quarter-ahead ($h = 1$), 1-year-ahead ($h = 4$) and 2-year-ahead ($h = 8$). Following Stock and Watson (1999), we specified

$$\pi_{t+h}^{h} - \pi_t = a + b(L)\Delta\pi_t + c(L)x_t + \varepsilon_{t+h},$$

where π_{t+h}^{h} is the annualized h-quarter inflation rate, $\pi_t = \pi_t^1$, and x_t is one of the three money overhang measures. The lag order was set to four since the data are quarterly. In Table 5, we report the test statistics and p-values of the hypothesis that the money overhang measures can be excluded from the equations. Since the 24 observations of the EMU sample were not enough to estimate the equations, we performed the tests both for the pre-EMU and for the full sample.

The test results indicate that the money overhang measures are not very useful to predict 1-quarter-ahead inflation. In contrast, they do have predictive power for 1-year-ahead and 2-year-ahead inflation. This resembles the findings of Nicoletti-Altimari (2001) who attests money overhang good leading indicator properties for inflation in the medium run. The aggregate EMU-4 money overhang is significant for all countries at horizons of one and two years, while the fully country-specific overhang measures are mainly significant for the two-year horizon. The semi country-specific overhang is only significant for France and Italy, perhaps reflecting currency substitution effects.

In contrast to the unconditional correlation analysis above, the predictive power does not generally decrease in the full sample. Whether this would change if the EMU sample was analyzed separately, must be left for future research because the 24 observations since the start of EMU do not seem sufficient to estimate the forecasting equations.

To gain further insights, we performed a recursive out-of-sample forecasting exercise for the last six years before the start of EMU (1993-1998) and the first six years since the start of EMU (1999-2004), using the forecasting equations specified above. In Table 6, the root mean-squared prediction errors (RMSPE) for the pre-EMU and EMU samples are displayed. There are several interesting findings. First, with the exception of Spain, the 1-year-ahead and 2-year-ahead inflation forecasts are generally more precise in the EMU sample than in the pre-EMU sample. However, this does not necessarily mean that the overhang measures have become better suited to forecast inflation, but may simply reflect the lower inflation rates in the EMU sample. Second, for France, Spain and Italy the EMU-4 overhang measure performs worst in the pre-EMU sample but much better in the EMU sample. While this may indicate an increased importance of area-wide developments for the single countries, there is always at least one of the country-specific overhang measures that remains well-suited for each countries even in the EMU sample. Hence, country-specific developments still play a role. Third, the aggregate EMU-4 overhang performs very well for Germany even in the pre-EMU sample. This may reflect the special role of Germany as the anchoring country of the EMS. However, in the EMU sample, the country-specific overhang measures perform roughly as well. Finally, there is no general pattern in the forecasting results that parallels the degree of money demand stability found in the previous section.

So far, we have shown that both country-specific and aggregate monetary information can be valuable to predict future inflation, particularly at horizons of one and two years. In a final exercise, we try to answer more directly the important question whether country-specific overhang measures contain information that is not already contained in the aggregate overhang measure and vice versa. To this end, we computed forecast encompassing tests as proposed by Harvey et al. (1998). A forecast f_{1t} is said to encompass a forecast f_{2t}, if the second forecast does not contain useful information absent in the first forecast. This implies that an optimal composite forecast $f_{ct} = (1-\lambda)f_{1t}+\lambda f_{2t}$, $0 \leq \lambda \leq 1$, attaches a weight $\lambda = 0$ to the second forecast. For inference, we estimated an analogous equation with the forecast errors of the first and second forecasts e_{1t} and e_{2t}, respectively,

$$e_{1t} = \lambda(e_{1t} - e_{2t}) + \varepsilon_t$$

and test the null hypothesis of $\lambda = 0$ against $\lambda > 0$.

The estimated encompassing coefficients together with their autocorrelation-consistent t statistics are presented in Table 7. For each forecast horizon, the first two rows report the results for regressions of the aggregate measure, ov_{EMU-4}, on ov^i_{EMU-4} and ov^i, while rows 3 and 4 report the results for regressions of the country-specific measures, ov^i_{EMU-4} and ov^i, on ov_{EMU-4}. In many cases, neither the aggregate measure encompasses both country-specific measures nor vice versa. Hence, both aggregate and country-specific measures contain mutually independent information that is useful to forecast inflation. For example, consider the 2-year-ahead forecasts, where the country-specific measures add useful information in 11 out of 16 cases and the aggregate measure adds useful information in 8 out of 16 cases.

This general picture does not change when we follow Harvey et al. (1998) and replace the potentially oversized t test with the modified Diebold-Mariano (MDM) test that exhibits more stable sizes, however at the cost of reduced power. While, not surprisingly, less significant test results are found, both aggregate and country-specific information remain important. For the 2-year-ahead forecasts, the the country-specific measures add useful information in 10 out of 16 cases and the aggregate measure adds useful information in 5 out of 16 cases.

Overall, the forecasting results support the tentative results derived from the analysis of the money demand functions. The aggregate EMU-4 money overhang has substantial forecasting ability for inflation in all countries, which was expected because of the stability of the aggregate money demand function. At the same time, country-specific overhang measures add useful information that is not contained in aggregate monetary developments, even after the start of the EMU. This is particularly surprising for France and especially Italy, where the national money demand functions do not appear to be stable by all criteria.

5 Summary and Conclusion

In this paper, we estimate and analyze the aggregate and individual long-run money demand functions of the four largest economies in the euro area. While we find a stable money demand function for the EMU-4 aggregate, it is somewhat more difficult to do the same for the individual countries. We end up with sensible money demand functions for Germany, France and Spain. Formal tests reveal at least a reasonably high degree of stability for all these long-run relationships, eben if some doubts for France remain. In the case of Italy, the formal stability tests are less supportive but the cointegration relationships are comparable to previous results in the literature.

Based on the estimated parameters of the money demand functions, we derive measures of money overhang for each country. These measures are typically highly correlated, particularly in the EMU sample. This implies that a measure of aggregate money overhang is also a good indicator of country-specific money overhang.

This finding is confirmed when we analyze the information content of the money overhang measures with respect to future inflation. Both aggregate and country-specific measures can be used to predict future inflation. At the horizon of two years, the aggregate measure seems even better suited than the country-specific measures. However, it is uncertain whether this predictive ability of money overhang has remained stable in the EMU period. While forecasting regressions cannot sensibly be performed in the short EMU sample, simple correlation coefficients between the money overhang measures and inflation indicate that the relationship was strong in the pre-EMU period, but weak in the EMU period. On the other hand, recursive out-of-sample forecasts indicate that there is predictive ability by both the aggregate and the country-specific money overhang measures. Forecast encompassing tests show that, with respect to inflation forecasting, country-specific overhang measures add significant information to the aggregate overhang measure, especially at the two-year horizon.

We may thus conclude that it is possible to come up with stable and sensible money demand relationships for both the EMU-4 aggregate and the individual countries except for Italy. Derived from these relationships, the aggregate and country-specific money overhangs possess non-negligible forecasting power for future inflation. Since these measures generally do not encompass each other, forecasts and forecast-based decisions should be based on both of them as far as national developments are of concern.

As regards monetary policy in the EMU, the importance of national developments for policy decisions is not obvious. However, at least the public discussion in the single countries indicates that the ECB council members are always and particularly confronted with the (inflation) developments in their home countries. Given the emphasis of the current monetary policy strategy on monetary variables and the just confirmed forecasting power of national money overhang, a careful screening of the national monetary trends appears to be sensible. But even if the ECB really disregards any national development, it is still useful from an informational point of view not to stick with area-wide monetary indicators alone but supplement them with a national indicator like the money overhang. In addition, the finding that the predictive content of the area-wide money overhang differs from country to country indicates that the monetary transmission mechanism is not fully symmetric. This implies again that the ECB should also consider national developments in their monetary analysis to better understand the disaggregate situation and to detect national imbalances that may have repercussions on the area-wide monetary stance.

All this does not imply, however, that the monetary pillar in its present form and especially the reference value of 4.5 percent M3 growth, which was based on average area-wide trends, are of any use for the individual countries. In contrast, the country-specific money overhangs are based on national characteristics and are, thus, much better suited for disaggregate analyses and forecasts than simple M3 growth rates.

References

Alves, N., C. R. Marques and J. Sousa (2006) Some issues concerning the use of M3 for monetary policy analysis in the euro area. Banco de Portugal Economic Bulletin **12**, 1-15.

Angeloni, I., C. Cottarelli and A. Levy (1994) Cross-border deposits, aggregation, and money demand in the transition to EMU. Journal of Policy Modeling **16**, 27-54.

Assenmacher-Wesche, K., and S. Gerlach (2006a) Interpreting euro area inflation at high and low frequencies. CEPR Discussion Paper No. 5632.

Assenmacher-Wesche, K., and S. Gerlach (2006b) Understanding the link between money growth and inflation in the euro area. CEPR Discussion Paper No. 5683.

Bagliano, F.-C., and C. A. Favero (1992) Money demand instability, expectations and policy regimes: a note on the case of Italy 1964-1986. Journal of Banking and Finance **16**, 331-349.

Bahmani-Oskooee, M., and S. Chomsisengphet (2002) Stability of M2 money demand function in industrial countries. Applied Economics **34**, 2075-2083.

Beck, G. W., K. Hubrich and M. Marcellino (2006) Regional inflation dynamics within and across euro area countries and a comparison with the US. ECB Working Paper No. 681.

Beyer, A. (1998) Modelling money demand in Germany. Journal of Applied Econometrics **13**, 57-76.

Bischoff, C. W., and H. Belay (2001) The Problem of Identifcation of the Money Demand Function. Journal of Money, Credit and Banking **33**, 205-215.

Brand, C., and N. Cassola (2000) A money demand system for euro area M3. ECB Working Paper No. 39.

Brand, C., D. Gerdesmeier and B. Roffia (2002) Estimating the Trend of M3 Income Velocity Underlying the Reference Value for Monetary Growth. ECB Occasional Paper No. 3.

Bruggemann, A. (2000) The stability of EMU-wide money demand functions and the monetary policy strategy of the European Central Bank. Manchester School **68**, 184-202.

Bruggemann, A., P. Donati and A. Warne (2003) Is the demand for euro area M3 stable?. ECB Working Paper No. 255.

Calza, A., D. Gerdesmeier and J. Levy (2001) Euro area money demand: Measuring the opportunity costs appropriately. IMF Working Paper No. 01/179.

Calza, A., and J. Sousa (2003) Why has broad money demand been more stable in the euro area than in other economies? A literature review. In: O. Issing, eds., Background studies for the ECB's evaluation of its monetary policy strategy, ECB, Frankfurt, 229-243.

Camarero, M., J. Ordonez and C. R. Tamarit (2002) Monetary transmission in Spain: a structural cointegrated VAR approach. Applied Economics **34**, 2201-2212.

Carstensen, K. (2006a) Estimating the ECB policy reaction function. German Economic Review **7**, 1-34.

Carstensen, K. (2006b) Stock market downswing and the stability of European Monetary Union money demand. Journal of Business and Economic Statistics **24**, 395-402.

Cassard, M., T. D. Lane and P. R. Masson (1995) ERM Money Supplies and the Transition to EMU. In: P. R. Masson, eds., France: Financial and Real Sector Issues, IMF, Washington, 112-145.

Cassard, M., T. D. Lane and P. R. Masson (1997) Core ERM money demand and the effects on inflation. Manchester School **65**, 1-24.

Clausen, V. (1998) Money demand and monetary policy in Europe. Weltwirtschaftliches Archiv **134**, 712-740.

Clausen, V., and J.-R. Kim (2000) The long–run stability of European money demand. Journal of Economic Integration **15**, 486-505.

Coenen, G., and J.-L. Vega (2001) The demand for M3 in the euro area. Journal of Applied Econometrics **16**, 727-748.

Davidson, J. (1998) Structural relations, cointegration and identification: some simple results and their application. Journal of Econometrics **87**, 87-113.

Dedola, L., E. Gaiotti, L. Sillipo (2001) Money Demand in the Euro Area: Do National Differences Matter?. Banca d'Italia Working Paper No. 405.

de Grauwe, P., and M.-A. Senegas (2003) Common monetary policy with transmission asymmetry and uncertainty: Is there a case for using national data in EMU?. manuscript.

Dreger, C., and J. Wolters (2006) Investigating M3 money demand in the euro area – new evidence based on standard models. DIW Discussion Paper No. 561.

ECB (1999) Definitions of euro area monetary aggregates. ECB Monthly Bulletin **February**, 31.

ECB (2003a) Background studies for the ECB's evaluation of its monetary policy strategy. ECB, Frankfurt.

ECB (2005) Money demand and uncertainty. ECB Monthly Bulletin **October**, 57-73.

Elliott, G., T. J. Rothenberg and J. H. Stock (1996) Efficient tests for an autoregressive unit root. Econometrica **67**, 813-836.

Elyasiani, E., and A. H. M. Zadeh (1999) Econometric tests of alternative scale variables in money demand in open economies–international evidence from selected OECD countries. Quarterly Review of Economics and Finance **39**, 193-211.

Estrella, A., and F. S. Mishkin (1997) Is there a role for monetary aggregates in the conduct of monetary policy?. Journal of monetary economics **40**, 279-304.

Fagan, G., and J. Henry (1998) Long run money demand in the euro area: Evidence for area wide aggregates. In: Lütkepohl, H., and J. Wolters, eds., Money Demand in Europe, Physica Verlag, Heidelberg, 218-240.

Friedman, B. M., and K. N. Kuttner (1992) Money, income, prices, and interest rates. American Economic Review **82**, 472-492.

Funke, M. (2001) Money demand in Euroland. Journal of International Money and Finance **20**, 701-713.

Gennari, E. (1999) Estimating money demand in Italy 1970-1994. EUI Working Paper No. 99/7.

Gerlach, S., and L. E. O. Svensson (2003) Money and inflation in the euro area: a case for monetary indicators?. Journal of Monetary Economics **50**, 1649-1672.

Golinelli, R., and S. Pastorello (2000) The Euro Area Country Database: A Statistical Appendix. Mimeo, University of Bologna, available at http://www2.dse.unibo.it/golinelli/research/appendix.pdf.

Golinelli, R., and S. Pastorello (2002) Modelling the demand for M3 in the euro area. European Journal of Finance **8**, 371-401.

Goodhart, C. A. E. (2006) The ECB and the conduct of monetary policy: Goodhat's law and lessons from the euro area. Journal of Common Market Studies **44**, 757-778.

Gottschalk, J. (1999) On the monetary transmission mechanism in Europe. Journal of Economics and Statistics **219**, 357-374.

Greiber, C., and W. Lemke (2005) Money demand and macroeconomic uncertainty. Deutsche Bundesbank Discussion Paper No. 26/2005.

Hansen, B.E. (1992) Tests for Parameter Instability in Regressions with I(1) Processes. Journal of Business and Economic Statistics **10**, 321-335.

Hansen, H., and S. Johansen (1999) Some tests for parameter constancy in cointegrated VAR-models. Econometrics Journal **2**, 306-333.

Harvey, D. I., S. J. Leynourne and P. Newbold (1998) Tests for forecast encompassing. Journal of Business and Economic Statistics **16**, 254-259.

Hayo, B. (1999) Estimating a European demand for money. Scottish Journal of Political Economy **46**, 221-244.

Heinemann, F., and F. P. Hüfner (2004) Is the view from the Eurotower purely European? National divergence and ECB Interest rate policy. Scottish Journal of Political Economy **51**, 544-558.

Hubrich, K. (1999) Estimation of a German money demand system - long-run analysis. Empirical Economics **24**, 77-99.

Johansen, S. (1988) Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control **12**, 231-255.

Johansen, S. (2002) A Small Sample Correction of the test for Cointegration Rank in the Vector Autoregressive Model. Econometrica **70**, 1929-1962.

Juselius, K. (1998) Changing monetary transmission mechanisms within the EU. Empirical Economics **23**, 456-481.

Juselius, K., and J. Toro (2005) Monetary transmission mechanisms in Spain: the effect of monetization, financial deregulation, and the EMS. Journal of International Money and Finance **24**, 509-531.

Kontolemis Z.G. (2002) Money demand in the euro area: Where do we stand (today)?. IMF Working Paper No. 02/185.

Lütkepohl, H. (1998) A money demand system for German M3. Empirical Economics **23**, 371-386.

Lütkepohl, H., and P. Saikkonen (1999) Order Selection in Testing for the Cointegrating Rank of a VAR process. In: R.F Engle and H. White, eds., Cointegration, Causality and Forecasting - A Festschrift in Honour of Clive W.J. Granger, Oxford University Press, Oxford, 168-199.

Lütkepohl, H., and J. Wolters (2003) Transmission of German Monetary Policy in the Pre-Euro Period. Macroeconomic Dynamics **7**, 711-733.

Marcellino, M., J. H. Stock and M. W. Watson (2003) Macroeconomic forecasting in the euro area: country specific versus area-wide information. European Economic Review **47**, 1-18.

Masuch, K., S. Nicoletti-Altimari, H. Pill and M. Rostagno (2003) The role of money in monetary policy making . In: O. Issing, eds., Background studies for the ECB's evaluation of its monetary policy strategy, ECB, Frankfurt, 187-228.

Monticelli, C. (1996) EU-wide money and cross border holdings. Weltwirtschaftliches Archiv **132**, 215-235.

Müller, C. (2003) Money Demand in Europe. Physica- Verlag, Germany.

Müller, C., and E. Hahn (2001) Money demand in Europe: Evidence from the past. Kredit und Kapital **34**, 48-75.

Muscatelli, V. A., and F. Spinelli (2000) The long-run stability of the demand for money: Italy 1861-1996. Journal of Monetary Economics **45**, 717-739.

Nicoletti-Altimari, S. (2001) Does money lead inflation in the Euro area?. ECB Working Paper No. 63.

Nielsen, H., G. Tullio and J. Wolters (2004) Currency substitution and the stability of the Italian demand for money before the entry into the monetary union, 19721998. International Economics and Economic Policy **1**, 73-85.

Neumann, M. J. M., and C. Greiber (2004) Inflation and core money growth in the euro area. Bundesbank Discussion Paper 36/2004, Series 1.

Ordonez, J. (2003) Stability and non-linear dynamics in the broad demand for money in Spain. Economics Letters **78**, 139-146.

Paulsen, J. (1984) Order determination of multivariate autoregressive time series with unit roots. Journal of Time Series Analysis **5**, 115-127.

Phillips, P.C.B., and B.E. Hansen (1990) Statistical inference in instrumental variables regression with I(1) processes. Review of Economic Studies **57**, 99-125.

Saikkonen, P., and H. Lütkepohl (2000) Testing for the cointegrating rank of a VAR process with an intercept. Econometric Theory **16**, 373-406.

Scharnagl, M. (1998) The stability of German money demand: not just a myth. Empirical Economics **23**, 355-370.

Stock, J.H., and M.W. Watson (1999) Forecasting inflation. Journal of Monetary Economics **44**, 293-335.

Trecroci, C. and J. L. Vega (2002) The information content of M3 for future inflation. Weltwirtschaftliches Archiv **158**, 22-53.

Wesche, K. (1997) The stability of European money demand: an investigation of M3H. Open Economies Review **8**, 371-391.

Wolters, J., T. Teräsvirta, and H. Lütkepohl (1998) Modeling the demand for M3 in the unified Germany. Review of Economics and Statistics **80**, 399-409.

Appendix

A Construction of the Data

We start out from the 'Euro Area Countries Database' constructed and used by Golinelli and Pastorello (2002, hereafter GP). This database comprises quarterly, country-level time series for the monetary aggregate M3, real GDP, a GDP deflator, the Harmonized Index of Consumer Prices (HICP), as well as short-term and long-term interest rates for the period 1978Q1 to 1998Q4. (Due to the introduction of the EMS in 1979, we restrict the sample start to 1979Q4.) We carefully update the series for France, Germany, Italy and Spain until 2004Q4, using data from the same sources as GP, OECD's Main Economic Indicators (MEI), IMF's International Financial Statistics (IFS) database as well as data from national central banks (NCBs). In the following, we go through the crucial steps of the updating procedure by variable.[21]

Monetary series in the GP data set are based on the Euro Area definitions of the broad aggregate M3, as put forward in ECB (1999), for all countries of our interest. As a consequence, we update the series for M3 with data on the contributions to Euro Area M3 published by the national central banks. For France and Italy contributions to M3 include cash in circulation, for Germany, this is the case only until the end of 2001. We add cash in circulation, published separately by the Bundesbank, where appropriate. For Spain data about contributions to M3 were available only in disaggregated form. We add up all relevant components to get contributions to Euro Area M3 as an aggregate. Growth rates and levels of GP's series and of those time series used for updating are very similar over the overlapping horizon for all countries. We update the series using the growth rates of the new series. To get real money balances, we deflate M3 series using the respective HICP deflator.

[21]We refer the reader to GP (2002) and in particular to their separate data appendix, GP(2000), for further details on the initial construction of the database.

One issue that used to be raised frequently in the context of Euro Area money demand, is the treatment of cross-country holdings of components of M3.[22] These may pose a problem to the extent that they were not included in most pre-EMU national aggregates, but are taken into account in series calculated using the Euro Area resident concept underlying the ECB's definition of monetary aggregates. The use of series constructed in accordance with ECBs definitions of national contributions to Euro Area M3 over the whole sample period ensures that data consistency problems of this type do not materialize in our study.

As their measure of real output, GP use quarterly, seasonally adjusted GDP that is deflated with the GDP deflator (base year 1995). The data are taken from the OECD Main Economic Indicators (MEI) for all countries. We updated our series from the same source, again using the growth rates of the new series. We only had to account for the change in the base year in the MEI, which occurred in the meantime.

In line with GP, we use 3-month treasury bill rates as the short-term interest rate and 10-years government bond yields as the long-term interest rate. All data are taken from IMF International Financial Statistics (IFS). The spread is constructed as the difference between the long-term and short-term interest rates. The interest rates and the spread are expressed as percentage values.

HICP series are updated with correspondent observations from the MEI data set. Annualized rates of inflation are obtained as four times the quarter-on-quarter percentage change of the respective HICP. Data on quarterly exchange rates (last month of quarter) are taken from the IFS database.

In the construction of four-country (EMU-4) aggregates of Germany, France, Spain and Italy, we closely follow the aggregation approach put forward by Golinelli and Pastorello (2002) for the construction of their area-wide (EMU-12) aggregates. Series for real M3 and real GDP are obtained by simply adding up

[22]See e.g. Angeloni et al. (1994) and Monticelli (1996) for early studies on the implications of cross-country holdings for the stability of (synthetic) area-wide money demand relationships.

the respective single-country data series, which are all denoted in euro. EMU-4 time series for the interest rates and the inflation rate are constructed as a weighted average of single-country data, where time-variable shares of national real GDP are used as weights. The EMU-4 interest rate spread is constructed as the difference of the long-term and short-term interest rates.

All variables used, except for the interest rates, are in logs. We tested all series for non-stationarity, applying various unit root tests like the DF-GLS test of Elliott et al. (1996) and the common ADF and Phillips-Perron tests. Not surprisingly, real M3, real GDP and the interest rates were found to be integrated of order 1 for all countries. However, the results for the interest rate spreads and the inflation rates are not always clear-cut. The implications of possibly stationary spreads for the money demand functions of France and Italy are discussed below.[23]

[23] Unit root test results are not reported here for brevity. They are available from the authors upon request.

Table 1: Cointegration Tests

	EMU-4	Germany	France	Spain	Italy
VAR lag order					
BIC	2	1	1	2	1
HQ	2	1	1	2	2
Trace statistics (Bartlett corrected)					
rank$\leq$ 0	28.32 **	27.48 *	48.90 **	33.36 **	30.68 **
	(0.073)	(0.090)	(0.039)	(0.019)	(0.039)
rank$\leq$ 1	6.76	3.64	20.22	3.86	11.24
	(0.606)	(0.930)	(0.407)	(0.915)	(0.197)
rank$\leq$ 2	0.70	0.00	4.15	0.32	2.77
	(0.404)	(0.977)	(0.891)	(0.569)	(0.102)
rank$\leq$ 3	-	-	0.31	-	-
			(0.581)		
Saikkonen & Lütkepohl test					
rank$\leq$ 0	21.66 **	28.85 ***	37.81 **	14.00	21.40 **
	(0.039)	(0.003)	(0.029)	(0.331)	(0.043)
rank$\leq$ 1	5.01	4.33	19.66 *	3.62	9.93 **
	(0.335)	(0.422)	(0.075)	(0.526)	(0.049)
rank$\leq$ 2	-	-	5.03	-	-
			(0.333)		
Test of unit income elasticity					
LR statistic	0.001	1.013	6.818 ***	1.940	6.718 ***
	(0.980)	(0.314)	(0.009)	(0.164)	(0.009)

Note: *,**,*** denote significance at the 10%, 5%, and 1% level, respectively.

Table 2: Estimation Results

	EMU-4		Germany		France		Spain		Italy	
	Johansen	FM-OLS	Johansen	FM-OLS	Johansen	FM-OLS	Johansen	FM-OLS	Johansen	FM-OLS
yr	0.994	1.058	1.138	1.163	1.379	1.400	1.162	1.416	2.886	1.308
	(8.65)	(8.16)	(13.00)	(11.47)	(24.02)	(27.37)	(18.52)	(15.35)	(6.47)	(6.80)
lt	-0.030	-0.023	-0.055	-0.046	-	-	-	-	-	-
	(-5.10)	(-3.68)	(-7.34)	(-5.39)						
$spread$	-	-	-	-	-0.017	-0.020	-	-	-0.162	-0.019
					(-2.43)	(-3.28)			(-3.35)	(-0.092)
st_D	-	-	-	-	-0.012	-0.003	-	-	-	-
					(-2.56)	(-0.64)				
$inflation$	-	-	-	-	-	-	-0.026	-0.009	-	-
							(-7.42)	(-1.94)		

Note: Asymptotic t-values in brackets below the estimates.

Table 3: Stability Tests

Test	EMU-4	Germany	France	Spain	Italy
Eigenvalue fluctuation	1.15	0.73	1.03	1.31 *	1.42 **
Nyblom (supQ)	1.17	2.34 **	0.90	0.69	1.88 *
Nyblom (meanQ)	0.22	0.64	0.36	0.21	0.69 *
$SupF$	9.29	9.70	22.68 ***	4.61	8.51
$MeanF$	3.66	3.14	4.82	2.23	4.43
L_c	0.19	0.26	0.25	0.20	0.50 *

Note: The eigenvalue fluctuation and Nyblom-type tests for constancy of the cointegrating vector by Hansen and Johansen (1999) are based on the VAR models. The $SupF$, $MeanF$ and L_c stability tests by Hansen (1992) are based on FM-OLS. *,**,*** denote significance at the 10%, 5%, and 1% level, respectively.

Table 4: Correlations between measures of money overhang and inflation

	Germany		France		Spain		Italy	
Sample end:	1998Q4	2004Q4	1998Q4	2004Q4	1998Q4	2004Q4	1998Q4	2004Q4
Correlation between different overhang measures								
ov_{EMU-4} and ov^i_{EMU-4}	0.07	0.91	0.81	0.87	0.52	0.66	0.80	0.99
	(0.32)	(11.03)	(7.43)	(6.06)	(2.96)	(4.05)	(6.46)	(34.23)
ov_{EMU-4} and ov_i	0.73	0.75	0.32	0.83	0.67	0.83	0.43	0.91
	(6.81)	(5.10)	(1.83)	(5.29)	(4.88)	(10.36)	(2.26)	(9.90)
ov^i_{EMU-4} and ov_i	0.32	0.89	0.33	0.70	0.08	0.70	0.83	0.92
	(1.92)	(6.17)	(1.91)	(3.92)	(0.38)	(4.42)	(6.65)	(9.08)
Correlation between overhang measures and inflation								
ov_{EMU-4} and $\pi_{t,i}$	0.60	-0.06	0.43	0.17	0.34	0.03	0.44	0.03
	(4.49)	(-0.56)	(2.70)	(1.23)	(2.24)	(0.37)	(2.74)	(0.28)
ov^i_{EMU-4} and $\pi_{t,i}$	-0.23	-0.12	0.63	0.13	-0.36	-0.10	0.71	0.01
	(-1.22)	(-1.11)	(4.56)	(0.99)	(-2.27)	(-1.03)	(6.06)	(0.08)
ov_i and $\pi_{t,i}$	0.43	-0.11	0.42	0.07	0.60	0.09	0.72	0.00
	(2.37)	(-0.97)	(2.90)	(0.63)	(4.60)	(0.69)	(7.25)	(-0.03)
Correlation between overhang measures and inflation (lead 4)								
ov_{EMU-4} and $\pi_{t,i}$	0.40	0.03	0.33	0.15	0.29	0.02	0.35	0.00
	(3.80)	(0.31)	(2.14)	(1.56)	(1.97)	(0.21)	(2.26)	(0.00)
ov^i_{EMU-4} and $\pi_{t,i}$	-0.20	0.06	0.52	0.15	-0.47	-0.05	0.67	-0.04
	(-0.89)	(0.75)	(3.55)	(1.62)	(-2.64)	(-0.53)	(4.23)	(-0.52)
ov_i and $\pi_{t,i}$	0.29	0.06	0.50	0.09	0.47	0.04	0.74	-0.02
	(2.27)	(0.75)	(3.55)	(0.81)	(2.59)	(0.34)	(6.23)	(-0.19)
Correlation between overhang measures and inflation (lead 8)								
ov_{EMU-4} and $\pi_{t,i}$	0.09	-0.05	0.21	0.05	0.15	-0.01	0.21	-0.07
	(0.98)	(-0.38)	(1.41)	(0.52)	(1.19)	(-0.10)	(1.61)	(-0.88)
ov^i_{EMU-4} and $\pi_{t,i}$	-0.20	0.00	0.43	0.13	-0.55	-0.23	0.58	-0.10
	(-0.96)	(0.01)	(2.86)	(1.22)	(-3.28)	(-2.30)	(3.15)	(-1.24)
ov_i and $\pi_{t,i}$	0.05	-0.07	0.42	-0.05	0.42	-0.07	0.69	-0.13
	(0.38)	(-0.63)	(3.59)	(-0.38)	(2.02)	(-0.88)	(5.00)	(-1.84)

Note: The correlations are reported together with t statistics (in brackets) from a regression of one variable on the other.

Table 5: Results of the forecasting regressions

	Germany		France		Spain		Italy	
Sample end:	1998Q4	2004Q4	1998Q4	2004Q4	1998Q4	2004Q4	1998Q4	2004Q4
1-quarter-ahead inflation prediction								
ov_{EMU-4}	6.14	7.41	6.15	8.46	2.32	5.02	13.46	18.94
	(0.19)	(0.12)	(0.19)	(0.08)	(0.68)	(0.29)	(0.01)	(0.00)
ov^i_{EMU-4}	1.83	3.17	4.77	7.51	1.94	2.35	7.50	10.68
	(0.77)	(0.53)	(0.31)	(0.11)	(0.75)	(0.67)	(0.11)	(0.03)
ov_i	2.99	3.70	4.19	3.16	8.70	8.38	6.17	8.31
	(0.56)	(0.45)	(0.38)	(0.53)	(0.07)	(0.08)	(0.19)	(0.08)
1-year-ahead inflation prediction								
ov_{EMU-4}	43.89	30.76	14.94	16.41	9.50	13.26	10.82	17.33
	(0.00)	(0.00)	(0.01)	(0.01)	(0.09)	(0.02)	(0.06)	(0.00)
ov^i_{EMU-4}	1.90	5.21	9.49	18.63	4.32	3.40	16.19	25.68
	(0.86)	(0.39)	(0.09)	(0.00)	(0.50)	(0.64)	(0.01)	(0.00)
ov_i	6.52	7.22	7.50	8.45	8.53	12.17	19.97	33.72
	(0.26)	(0.20)	(0.19)	(0.13)	(0.13)	(0.03)	(0.00)	(0.00)
2-year-ahead inflation prediction								
ov_{EMU-4}	122.13	97.55	11.35	11.40	16.53	20.51	15.16	18.00
	(0.00)	(0.00)	(0.04)	(0.04)	(0.01)	(0.00)	(0.01)	(0.00)
ov^i_{EMU-4}	1.85	4.40	15.41	26.89	7.12	4.70	18.51	26.78
	(0.87)	(0.49)	(0.01)	(0.00)	(0.21)	(0.45)	(0.00)	(0.00)
ov_i	9.94	12.47	14.40	19.62	23.05	22.93	25.18	51.49
	(0.08)	(0.03)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: The χ^2 statistics are reported together with p-values in brackets.

Table 6: Root mean-squared prediction error of the forecasting exercise

	Germany		France		Spain		Italy	
sample start:	1993Q1	1999Q1	1993Q1	1999Q1	1993Q1	1999Q1	1993Q1	1999Q1
sample end:	1998Q4	2004Q4	1998Q4	2004Q4	1998Q4	2004Q4	1998Q4	2004Q4
1-quarter-ahead inflation prediction								
ov_{EMU-4}	2.34	1.66	1.40	1.81	1.52	2.23	1.28	2.12
ov^{i}_{EMU-4}	2.46	1.66	1.45	1.81	1.58	2.41	1.41	2.17
ov_i	2.42	1.61	1.31	1.96	1.71	2.43	1.26	2.13
1-year-ahead inflation prediction								
ov_{EMU-4}	1.15	0.89	1.28	0.83	1.11	1.21	1.65	0.74
ov^{i}_{EMU-4}	1.32	0.82	1.17	0.79	0.98	1.51	1.58	0.72
ov_i	1.21	0.86	0.94	1.08	0.85	1.23	1.62	0.66
2-year-ahead inflation prediction								
ov_{EMU-4}	1.62	0.84	1.75	0.91	1.16	1.54	2.22	1.10
ov^{i}_{EMU-4}	2.10	0.85	1.42	0.77	1.14	1.94	1.89	0.97
ov_i	2.00	0.86	0.94	1.23	0.81	1.46	1.98	0.65

Table 7: Encompassing tests

		Germany		France		Spain		Italy	
sample start:		1993Q1	1999Q1	1993Q1	1999Q1	1993Q1	1999Q1	1993Q1	1999Q1
sample end:		1998Q4	2004Q4	1998Q4	2004Q4	1998Q4	2004Q4	1998Q4	2004Q4
1-year-ahead inflation prediction									
ov_{EMU-4} enc. ov^i_{EMU-4}	λ	0.24	0.80	0.76	0.63	0.89	-0.94	0.80	0.52
	t-stat	(1.33)	(1.70)	(2.54)	(2.82)	(1.43)	(-1.80)	(1.65)	(4.51)
	MDM	(1.38)	(1.55)	(1.36)	(1.51)	(1.23)	(-1.30)	(1.25)	(3.49)
ov_{EMU-4} enc. ov_i	λ	0.38	0.57	0.75	-1.48	1.11	0.41	0.60	0.67
	t-stat	(1.99)	(1.44)	(4.70)	(-6.62)	(12.32)	(0.82)	(0.91)	(6.70)
	MDM	(1.51)	(0.97)	(1.24)	(-2.20)	(2.31)	(0.58)	(0.73)	(1.91)
ov^i_{EMU-4} enc. ov_{EMU-4}	λ	0.76	0.20	0.24	0.37	0.11	1.94	0.20	0.48
	t-stat	(4.14)	(0.43)	(0.80)	(1.63)	(0.18)	(3.71)	(0.42)	(4.14)
	MDM	(1.24)	(0.35)	(0.72)	(1.09)	(0.15)	(1.87)	(0.35)	(2.13)
ov_i enc. ov_{EMU-4}	λ	0.62	0.43	0.25	2.48	-0.11	0.59	0.40	0.33
	t-stat	(3.23)	(1.08)	(1.53)	(11.09)	(-1.23)	(1.16)	(0.62)	(3.29)
	MDM	(1.49)	(1.02)	(1.60)	(2.11)	(-0.87)	(1.14)	(0.53)	(1.86)
2-year-ahead inflation prediction									
ov_{EMU-4} enc. ov^i_{EMU-4}	λ	0.04	0.49	1.03	0.64	0.54	-0.84	0.81	0.57
	t-stat	(0.27)	(2.29)	(3.99)	(4.23)	(1.15)	(-2.10)	(2.88)	(3.16)
	MDM	(0.18)	(1.84)	(1.27)	(1.98)	(0.78)	(-1.07)	(1.54)	(5.65)
ov_{EMU-4} enc. ov_i	λ	-0.04	0.49	1.10	-1.59	0.85	0.75	0.76	1.17
	t-stat	(-0.13)	(3.15)	(18.16)	(-6.06)	(4.08)	(3.03)	(2.44)	(5.99)
	MDM	(-0.09)	(1.37)	(1.36)	(-1.83)	(1.46)	(1.58)	(1.57)	(2.76)
ov^i_{EMU-4} enc. ov_{EMU-4}	λ	0.96	0.51	-0.03	0.36	0.46	1.84	0.19	0.43
	t-stat	(6.44)	(2.38)	(-0.12)	(2.36)	(0.98)	(4.61)	(0.68)	(2.38)
	MDM	(1.75)	(1.00)	(-0.08)	(0.80)	(0.63)	(1.57)	(0.34)	(1.06)
ov_i enc. ov_{EMU-4}	λ	1.04	0.51	-0.10	2.59	0.15	0.25	0.24	-0.17
	t-stat	(3.44)	(3.28)	(-1.66)	(9.87)	(0.70)	(1.02)	(0.78)	(-0.86)
	MDM	(2.22)	(2.10)	(-0.84)	(2.11)	(0.53)	(0.59)	(0.45)	(-0.55)

Note: The null hypothesis is $\lambda = 0$, i.e., the variable listed first encompasses the variable listed second. The alternative hypothesis is $\lambda > 0$, i.e., the variable listed second does contain useful information not contained in the first variable. Since the tests are one-sided, the critical values of the t distribution as recommended by Harvey et al. (1998) are $t_{0.9}(23) = 1.319$, $t_{0.95}(23) = 1.714$ and $t_{0.99}(23) = 2.50$ at the 10%, 5% and 1% level, respectively. The MDM statistic is calculated as described by Harvey et al. (1998). Both the t statistics and the MDM statistics are based on a nonparametric covariance estimator that is robust to autocorrelation of the order $h-1$, where h is the forecast horizon.

Figure 1: Euro Area M3 Growth and the Reference Value

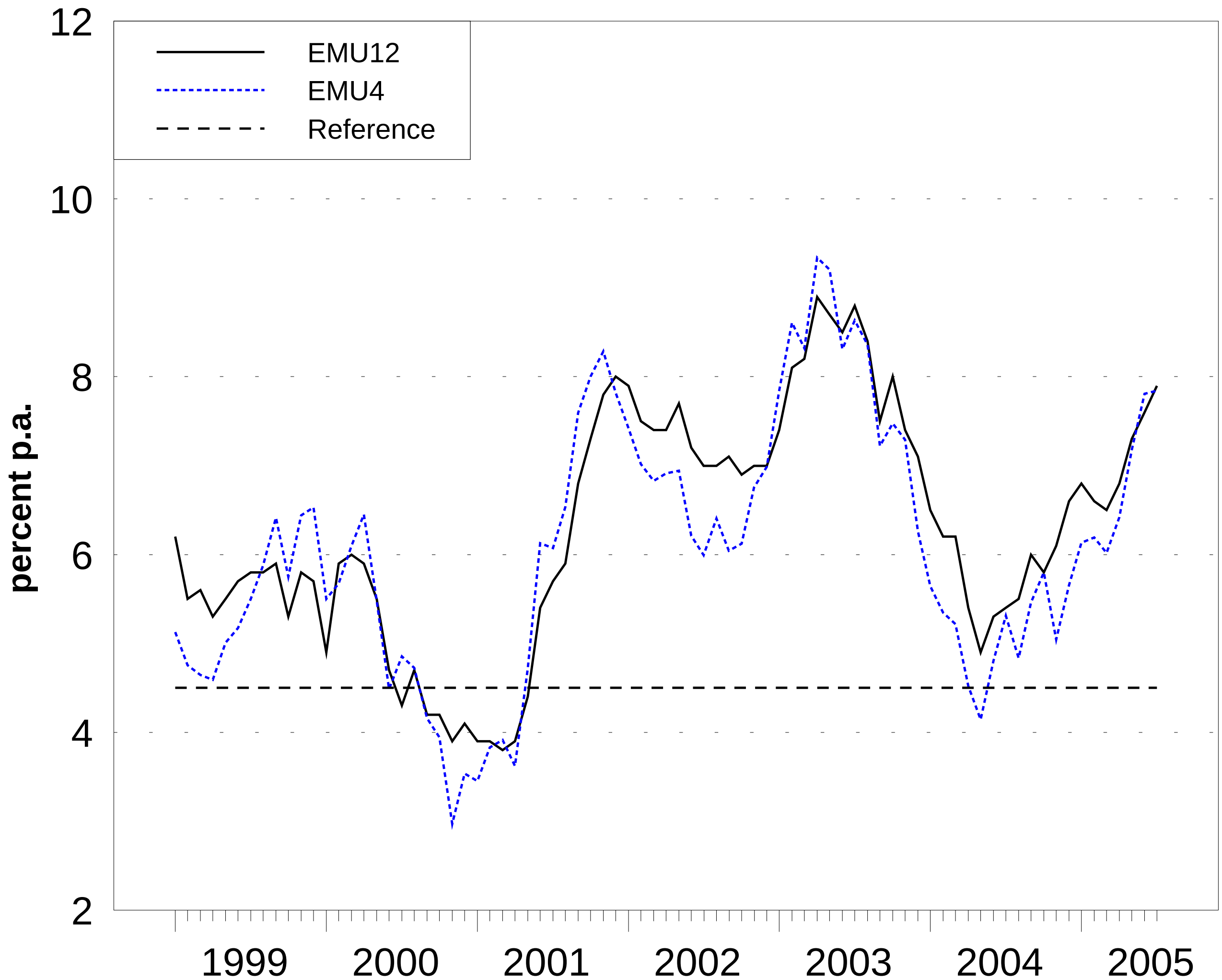


Figure 2: Individual Country M3 Growth and the Reference Value

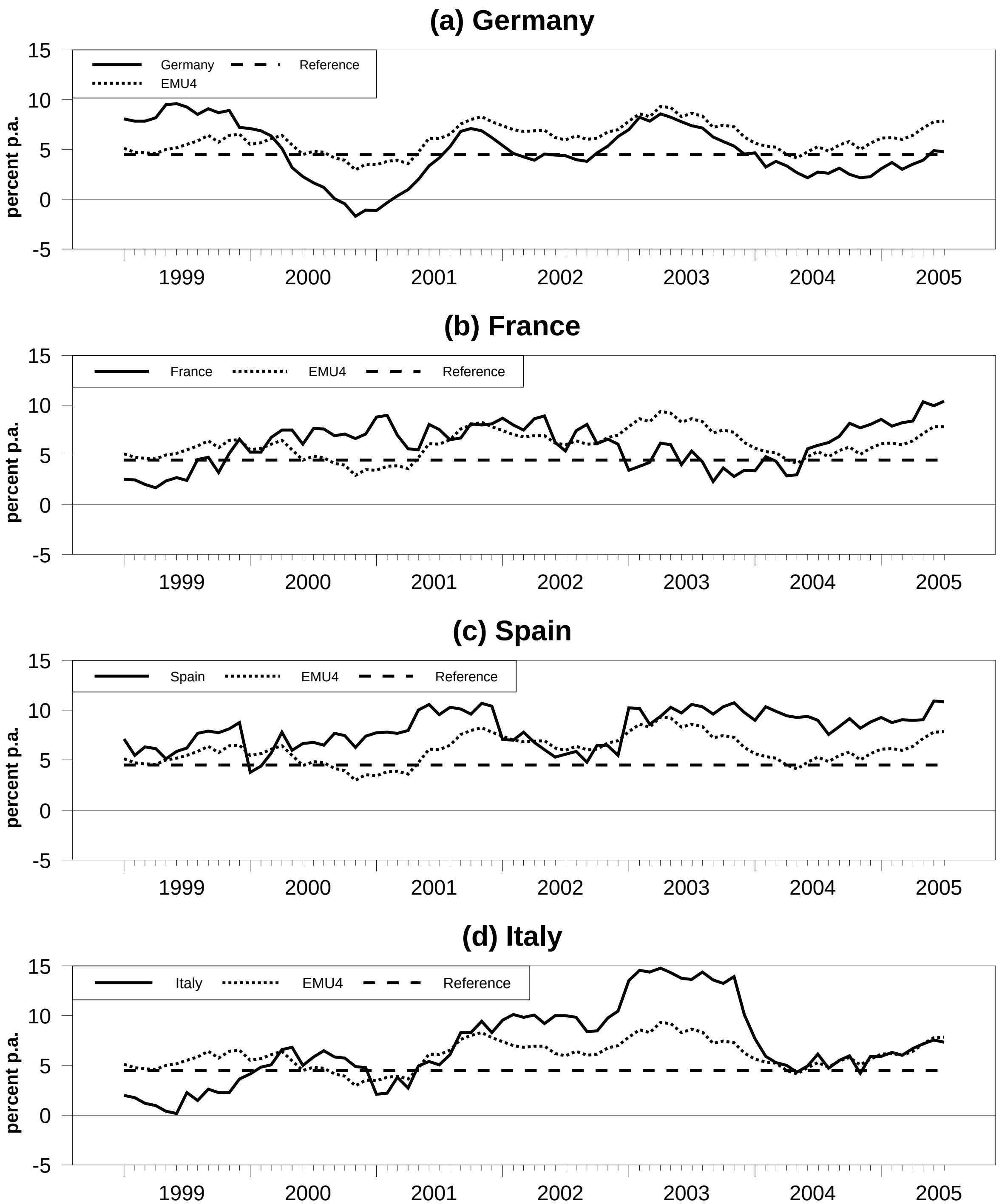
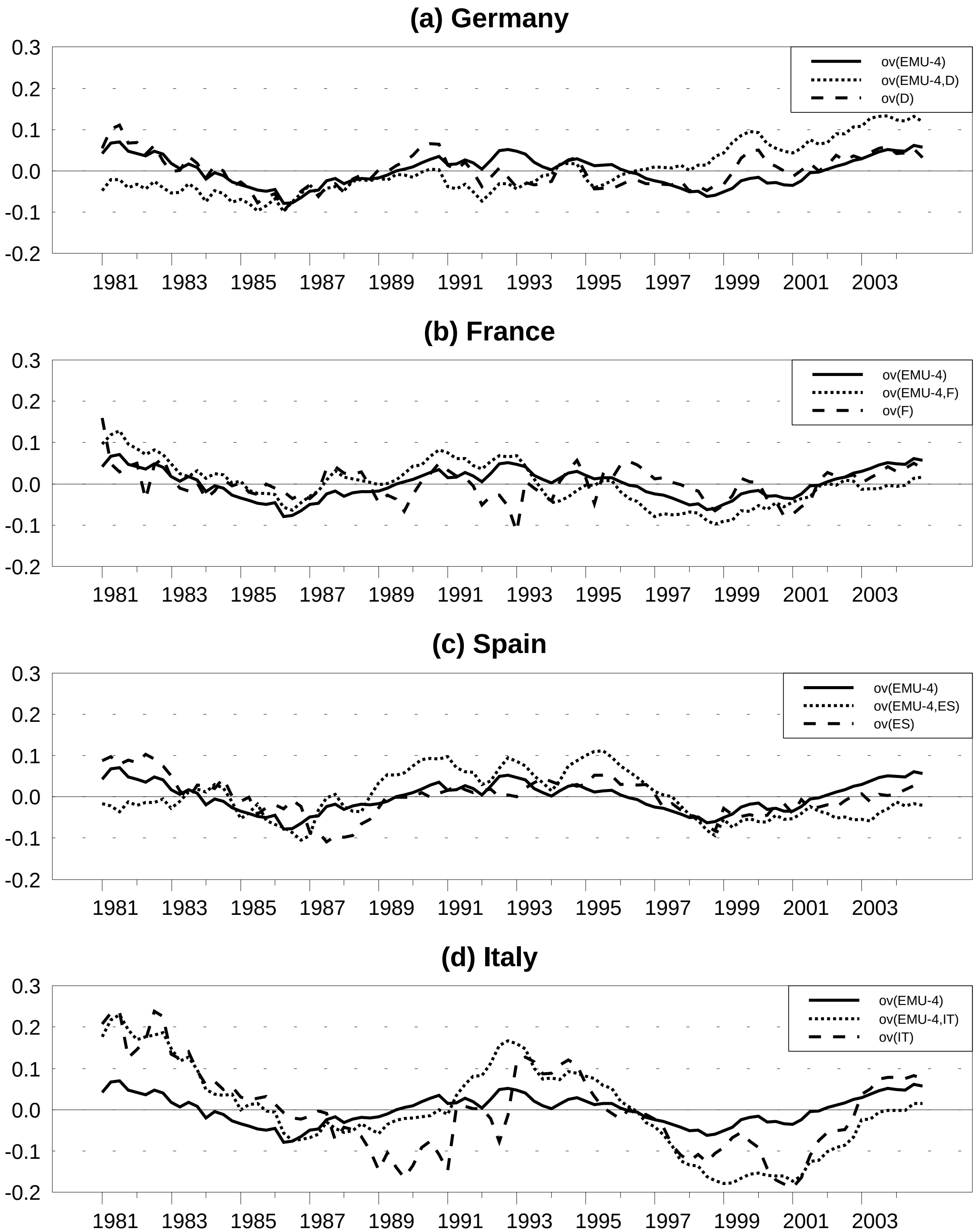


Figure 3: Measures of Money Overhang



Note: Aggregate money overhang is denoted by a solid line, semi country-specific money overhang by a dotted line, and country-specific money overhang by a dashed line.