



EUROPEAN MONETARY INSTITUTE

**Money Demand in EU Countries:  
A Survey**

by

**F. X. Browne, G. Fagan and J. Henry**

**Staff Paper No. 7**

**March 1997**

*Scarb*

**© European Monetary Institute, 1997**

All rights reserved. With the exception of rights granted by statutory law, no part of this publication may be reproduced, translated, stored in retrieval system, or transmitted in any form by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of the European Monetary Institute. Photocopying for educational and non-commercial purposes permitted.

**ISSN 1025-868X**

**Money Demand in EU Countries:  
A Survey**

by

**F. X. Browne, G. Fagan and J. Henry**

**Staff Paper No. 7**

**March 1997**

**European Monetary Institute**

**Postfach 10 20 31**

**D-60020 Frankfurt am Main**

Views expressed are those of the authors and not necessarily those of the EMI. Suggestions by anonymous referees on a previous version of the paper are gratefully acknowledged. The authors would also like to thank colleagues at the EMI and participants at an EMI conference on EU money demand, which was held in Frankfurt on 24 November 1995, for helpful comments and suggestions.

## **Abstract**

Money demand is probably one of the most extensively studied economic relationships in applied economics. While useful surveys of existing literature are available, much of the attention has focused on the United States. However, a considerable number of papers have recently been produced dealing with the situation in the EU, both at a country and at an area-wide level, with much of this research being carried out at EU central banks. Therefore, it appears useful to also examine this recent work, both in order to assess the current situation, and to guide future research.

The first part of the paper covers a range of general issues which arise, such as the theoretical models, the specifications, the variables employed, and estimation techniques that have been used. It is emphasised that the basis of all these papers appears to be a benchmark model, in which money is a function of a scale variable, of interest rates and, when necessary, of variables accounting for financial innovation. The second part of the paper focuses on the estimated equations for the individual countries, paying particular attention to the case of Germany. A reasonable summary of the results obtained in general is that money demand equations perform fairly well in EU countries. Estimated parameters have the signs, if not always the magnitudes, predicted by economic theory. In most cases, the evidence points to the existence of the long-run equilibrium relation between money and a few determinant variables (real income, prices and interest rates) although the size of the adjustment coefficients indicate that deviations from the steady state may be of long duration. The next section provides a review of empirical evidence of aggregate money demand in groupings of EU countries taken together, an area in which interest is increasing as EMU approaches. In this strand of the literature, there seems to be a consensus that EU-wide equations yield satisfactory results, with area-wide equations often performing better than comparable national equations. Some reasons underlying this result are also examined.

**JEL Classification nos.: E41, E52**

**Keywords: Money demand, cross-country comparisons, European Union**

## Money Demand in EU Countries: A Survey

### 1 Introduction

There is general consensus that, for a monetary targeting strategy to be successful, “it is necessary to have a stable, or at least predictable, relationship between the growth of the money supply and inflation” (see EMI, 1996).<sup>1</sup> Moreover, even in the absence of an explicit monetary targeting strategy, the stability of the link between money and prices exerts a crucial influence on the role of monetary aggregates in the conduct of money policy, having, for example, major implications for the indicator properties of alternative aggregates. The stability of this money prices link, in turn, depends ultimately on the behaviour of moneyholders, that is, on the properties of the aggregate demand for money in the economy. Given its importance for policy purposes, it is hardly surprising that “the demand for money has been subjected to extensive empirical scrutiny” (see Goldfeld, 1989) with central banks, in particular, devoting particular attention to this area. In an EU context, interest in the issue of money demand has been sustained by the continued use of a monetary targeting strategy in the anchor country and by considerations of the choice of an appropriate monetary policy strategy for Stage Three of EMU.

Against this background, the objective of this paper is to review recent developments and results in the study of money demand in EU countries and in the EU as a whole, and assess their implications. While useful surveys of existing literature are available [see e.g. Goldfeld and Sichel (1990), Fase (1993), and Filosa (1995)], much of the attention has focused on the US experience rather than the EU and, in the meantime, a considerable number of additional papers have been produced dealing with the situation in the EU, both at a country and at an area-wide level. Much of the recent work, which is the focus of this review, has been carried out at the national central banks (NCBs) of the EU countries. For the present paper, a total of around sixty papers which appear to encapsulate the most up-to-date thinking on both theoretical and econometric aspects of money demand in EU countries are reviewed. The approach followed is to extract the features of money demand which are most common in these studies while, at the same time, paying attention to country-specific or idiosyncratic features.

The structure of this paper is as follows. Section 2 briefly reviews common theoretical and empirical issues which arise in the context of the studies under review. Section 3 presents both a country-by-country review of the papers and a comparative overview. Section 4 address the issue of analysis of money demand behaviour in groupings of EU countries, the so-called ‘area-wide’ money demand analysis, on which attention is increasingly being focused in the run-up to Stage Three of Monetary Union. Section 5 concludes.

---

1 Other conditions that may be required are the controllability and the leading indicator properties of the money stock.

## 2 General issues in specification and estimation of money demand equations

A number of fundamental issues need to be addressed in the preparation of any study of money demand, including the specification of the model derived from theory, the choice of the empirical counterparts of the theoretical variables, specific issues such as the treatment of financial innovation and, finally, the estimation strategy. These issues, which are dealt with in greater detail in the survey papers (see above), are reviewed briefly here in order to provide the necessary background for the following review.

In terms of theory, there have not been major developments in recent years and this is reflected in the papers reviewed here, which take as their starting point an eclectic approach based on the theoretical contributions of Baumol (1952), Tobin (1956), Friedman (1956), and Miller and Orr (1966). This involves a benchmark model in which money is expressed as a function of scale variables (real income, prices and, occasionally, wealth), an interest rate vector and, where necessary, other variables to take into account the effects of financial innovation.

However, in moving from the theoretical model to an implementable empirical counterpart, a number of difficult issues have to be addressed. These tasks are made all the more complex by factors such as financial innovation, which has had, and continues to have, a significant influence on money demand behaviour in a number of countries. These practical problems which arise in specifying a model for money demand may be classified under four headings.

Firstly, the most crucial issue which must be addressed is: what is money? Theoretical considerations do not provide a clear answer and thus researchers must rely, for the most part, on judgement, experience in different countries and empirical evidence on the performance of alternative measures. This pragmatic approach is reflected in the papers examined here, where empirical analysis is confined to traditional aggregates published by the central bank (e.g. M1, M2 and M3), which are believed, on the basis of experience, to be the most appropriate measures of money in the countries concerned, although, in a small minority of cases (e.g. in the case of Spain), empirical demand studies pay considerable attention to the behaviour of different aggregates. In addition, in a number of countries, analysis has been carried out for Divisia indices,<sup>2</sup> while in France and the United Kingdom work has been carried out on disaggregate analysis of the components of the money stock, using either an asset (France) or a sectoral (United Kingdom, Germany) breakdown.

Secondly, problems also arise with respect to the choice of scale variables. Nominal money demand should depend on the price level and theory suggests that this particular variable should enter the money demand equation with a unit elasticity. This restriction is usually imposed – in some cases after testing – and analysis then takes the form of the estimation of a demand for real money balances. As regards other scale variables, for the most part, aggregate income is employed as the relevant transactions variable although, for broader

---

2 See Divisia (1925), Barnett (1980), and Rotemberg et al. (1991) for some conceptual definitions.

aggregates where portfolio considerations may be important, wealth is sometimes employed as a scale variable.<sup>3</sup>

Thirdly, while a number of conceptual problems arise with respect to the choice of interest rate variables, most studies include either a long-term or a short-term market interest rate (or, in some cases, both) as the opportunity cost variables. In the case of broader aggregates which contain interest-bearing components, some measure of the 'own rate' on money is usually included in the specification. In a number of papers, 'foreign' variables, to allow for possible currency substitution, have also been employed.

Finally, some studies include variables to take account of the effect of financial innovation on the pattern of money demand. In some cases these take the form of statistical devices such as dummy variables, or deterministic or segmented trends [see e.g. Henry and Sicsic (1994)].<sup>4</sup> Alternatively, the process of financial innovation is modelled as an endogenous process [see Ireland (1995)], using explicit proxies such as cumulated interest rate terms [see e.g. Breedon and Fisher (1993)]. A further response to the problem of financial innovation is the widening of traditional monetary aggregates to incorporate additional assets, such as the addition of monetary UCITS to M3 in France and the successive widening of the ALP aggregate in Spain.

In terms of econometric methodology, nearly all of the studies examined here employ cointegration techniques to estimate the long-run equilibrium relation between the chosen measure of the money stock and its determinants as well as its dynamic adjustment to the steady state level, using the ECM approach rather than a partial adjustment model.<sup>5</sup> Most single-equation approaches employ the two-step method of Engle and Granger (1987), involving the estimation, first, of the long-run equation and then of a dynamic ECM specification, although a minority of papers use alternative techniques such as one-step non-linear estimations [see Phillips and Loretan (1991)], and Phillips' and Hansen's (1991) fully modified estimation. Joint estimation of systems of equations for money demand using the Johansen (1991) approach is, however, enjoying increasing popularity, providing a useful framework for modelling the long and short-run properties of a group of series jointly, testing for weak exogeneity and various causality schemes. Modelling a system of equations also gives the opportunity to deal with issues of identification which may arise, since the observed money stock corresponds to an equilibrium value resulting from both money demand and money supply curves. In many studies reviewed here, the estimated equations are subjected to a battery of diagnostic tests for stability, exogeneity and other features.

---

3 The specification is generally expressed in real terms, although the implied unit value for the price elasticity of money may not hold for all countries [see Gupta and Moazzami (1990), Filosa (1995), Fase and Winder (1996) for a discussion].

4 Another available option, namely that of time-varying parameters [see e.g. Bomhoff (1991) or Feldstein and Stock (1994)], has rarely been used on EU data. The issue, raised in Melnick (1995), of the measurement of financial services, has not been addressed on EU data.

5 As documented in Boughton (1991), the former is far superior to the latter.

### 3 Econometrics of money demand in the EU countries<sup>6</sup>

In this section we present a review of the empirical papers on money demand in individual EU countries. Given the importance attached to the money stock in the conduct of monetary policy in Germany and this country's role as the anchor for the exchange rate mechanism, money demand in this country has attracted particular attention in the empirical literature. We thus begin our review by examining the evidence for Germany. Then, the empirical evidence for the remaining EU countries is reviewed on a country-by-country basis. The lessons learned from the review are drawn together in the final part of this section.

#### 3.1 Is there a consensus about German money demand?

Fourteen papers dealing with German money demand have been perused. The close attention paid to German money demand is no surprise since it is the only country where actual monetary targeting has been continuously pursued. Moreover, the shock of German unification presented researchers with a context within which the effect of a structural break on the demand for money could be examined. Indeed, the unification episode has prompted some authors [see von Hagen (1993)] to draw an analogy between German monetary union and Stage Three of European Monetary Union. This has further served to heighten interest in the German case.

Most of the papers examined did not consider it necessary to extend the number of interest rates included in the money demand specification beyond one, with only three out of the fourteen using at most two rates [see e.g. Gerlach (1994) and Lütkepohl et al. (1996), who use an own rate which is a weighted average of sight and time deposit rates]. The single interest rate included is the opportunity cost rate, as proxied by the long-term bond rate. The own rate, when included, turns out to be mostly non-significant [see e.g. Biefang-Frisancho et al. (1995)]. In this respect, von Hagen (1993) suggests that the lack of public access to a Treasury bill market on the one hand, or measurement error in the own rate of interest on the other, could explain the non-significance of the short-term rate [the argument is used in Kole and Meade (1994)]. Regarding inflation, Hansen and Kim (1994), Beyer (1994), and Lütkepohl et al. (1996) are the only cases where it is used, though one might question the relevance at all of inflation – given that it is found to be stationary – as a long-run determinant of the German money stock.<sup>7</sup> Although the use of inflation in the long run makes it acceptable to impose a specification expressed in velocity, i.e. unit coefficients on real income and prices, such equations are difficult to interpret: first, inflation is very likely to be caused by money; moreover entering inflation as a separate term may not be superior to using real short-term and nominal long-term rates, which then comes close to the equations presented in Deutsche Bundesbank (1995) or Gerdesmeier (1996).

---

6 The equations for country studies are shown in Table 1. For each of the papers under review, the following features are listed: Authors, Date of publication, Sample used, Aggregate studied, Elasticities and semi-elasticities for {income, short-term and long-term rates}, Type of dynamic model estimated, Size and marginal significance of the ECM term if any, Estimation method, Standard Error of the residuals, Stability results, Availability of exogeneity tests, Additional variables and comments.

7 German nominal money and the price level are usually found to behave as I(1) but real money appears I(1) too, though in many other countries nominal money and the price level would cointegrate and give real money a lesser order of integration, from I(2) to I(1).

Money demand in Germany is generally found to be stable - at least in the long-run - even for samples that cover unification, provided some simple dummies for slopes and/or intercepts are used, which is typically the case in the numerous studies that have been completed. An exception to this is von Hagen (1993), who found a pre-unification demand function unable to predict satisfactorily the post-unification data. Other papers which used longer spans of data found "dummied" functions to be stable.<sup>8</sup> Without dummies, the relation between output and money tends to disappear. This appears to be because of the lag between the increase in money and output and/or problems related to seasonal adjustment [see e.g. Gerlach (1994) or Lütkepohl et al. (1996)].<sup>9</sup> Furthermore, unification also caused changes in the currency ratio [as described by von Hagen (1993)] apparently because in the former German Democratic Republic there were no intermediate assets between currency and savings deposits. This provides a rationale for the change in interest rate semi-elasticities sometimes found. Changes in the seasonal adjustment after unification have also been uncovered [see e.g. Lütkepohl et al. (1995) for M1 and Kole and Meade (1994) or Lütkepohl et al. (1996) for M3].

There are indeed many long-run behavioural relations involving German money which appear to be stable.<sup>10</sup> It is somewhat difficult to have a clear view on this issue since only four papers use the multivariate analysis, namely Beyer (1994), Lütkepohl et al. (1995), Gerdesmeier (1996) and Biefang-Frisancho et al. (1995). As a matter of fact, estimations performed with many interest rates [see Beyer (1994), Gerlach (1994)] or with wealth along with income [see Deutsche Bundesbank (1995), Gerdesmeier (1996)] could yield two long-run relations. Estimations including wealth can also lead to two independent long-run relations [at 10%, in Gerdesmeier (1996), or in Deutsche Bundesbank (1995)]. In such a case, the dynamic equation for money should incorporate two distinct ECM terms, as pointed out by Johansen (1992) and Chow (1993).<sup>11</sup> These findings may be interpreted in either of two ways. Either the additional wealth variable conveys no information as to the long run, which may be illustrated by the only slight change in the other parameters when this variable is used [see Deutsche Bundesbank (1995)], or, if there are two independent long-run relations involving all of the variables, it is always possible to re-arrange them in the form of a system with identifying restrictions (e.g. the exclusion of a different variable in each of the two vectors). Such an analysis would yield, on the one hand, a money demand excluding wealth, and, on the other hand, a relation between money, wealth and income (i.e. excluding interest rates).<sup>12</sup>

---

8 The kind of dummies used (namely impulse, step or slope) nevertheless varies a lot from author to author.

9 In Lütkepohl et al. (1996) the inclusion of inflation removes the structural change in the seasonal pattern which is found to coincide with German unification.

10 A similar case is to be found for Italy, where Bagliano et al. (1991) found no less than four relations within the system made of broad money, output and three interest rates. Once the identification is performed, the system is composed of money demand and supply equations supplemented by a yield curve and an indexation of the loan rate on short-term rates. One should not be strongly against detecting many long-run equilibria, since economic theory usually offers more relations than are actually found.

11 This is done in the two papers using more than one interest rate, in which, although velocity per se is not stationary on the basis of univariate DF tests, a stationary velocity and a relation linking interest rates define the two ECM terms. In Beyer (1994) velocity is trend stationary, whereas Gerlach (1994) finds a relation between the yield curve slope and velocity. In the latter case, indeed, the only valid ECM holds for the velocity model [all other models should have been rejected, since, contrary to the t-tests, Wald joint tests are not relevant, see Banerjee et al. (1993)].

12 Employing a p\*-model [see Hallman et al. (1991)] for Germany shows that the price level is not weakly exogenous, since its long-run value adjusts to the deviations between M3 and potential output [see Tödter and Reimers (1994)]. Moreover, in this

The problem about the number of relations is related somewhat to the widely assumed – but rarely tested – endogeneity of money, which is not always confirmed when the appropriate tests are undertaken. At least one would have expected weak-exogeneity tests to be performed more often so as to assess more precisely, for instance, the impact of interest rates on money demand.

There is another point which may appear controversial, linked to deterministic trends. In line with Beyer's (1994) comment on the presence of deterministic trends of different magnitudes in both output and money, it should be stressed that this feature can lead to biased income elasticities. Without a deterministic trend or a trended variable in the model, the income elasticity will automatically be equal to the ratio between the slopes which will tend to give a value higher than one for real M3. This will then reflect the relation between the underlying deterministic components of money and output – the ratio between their drifts – but not the actual relation between their stochastic components. Using nominal, instead of real, variables for money and output seems to solve the problem [see e.g. Deutsche Bundesbank (1995)], probably because the price level entering both variables could be the dominant trend in them. If this is the case, then it leads to a coefficient on nominal income of close to one. Alternatively, when other variables are added to the specification, the coefficient on nominal income can also be reduced. Financial innovation as a missing variable would seem a more inadequate explanation for Germany than for France or the United Kingdom, for instance. As a consequence, most studies reject the inclusion of additional interest rates, which anyhow could not pick up such a lasting divergence in the long-run underlying deterministic trends. Another approach is to introduce wealth in the specification [see e.g. Deutsche Bundesbank (1995) or Gerdesmeier (1996)], but then multicollinearity between wealth and income, on the one hand, or between wealth and money, on the other hand, requires further investigation, as mentioned in Gerdesmeier (1996). An additional interesting feature of the latter paper is the fact that wealth and income elasticity add up to one, suggesting that, for a particular level of interest rates, the money-to-wealth ratio would be proportional to the liquidity ratio. However, since the income-to-wealth ratio seems stationary around a deterministic trend, the omission of this variable could change the results [see Beyer (1994), Hassler (1996), and Rinaldi and Tedeschi (1996) on the inclusion of a deterministic trend in money demand analysis].

### **3.2 Money demand studies in other EU countries**

The level of attention to money demand behaviour in other individual EU countries – measured by the number and the diversity of authorship of papers – is not comparable with that paid to German money demand. This situation probably reflects the fact that in many of these countries a monetary targeting strategy has never been pursued or that such strategies have been abandoned. Nonetheless, it remains true that, for most EU countries, money demand studies have been carried out, mainly, though not exclusively, by researchers at national central

---

paper, money and output cointegrate without the need to include interest rates in the model [as in Hoffman et al. (1995)], which may explain why two long-run relations are found elsewhere. Finally, according to the authors' tests, the rejection of a link from  $p^*$  to M1 is questionable, which suggests that a long-run relation would exist involving narrow money and output [see Lütkepohl et al. (1994)].

Table 1: Summary of Empirical Studies of Money Demand in EU Countries

Country	Author	Date	Aggr.	Sample	Elasticities			Models	t-ECM	Method	SE	Stab	Exog	Additional Variables and Comments
					Income	ST Rate	LT Rate							
BE	Jeanfils	1994	M4	1973-91	1.8	1.3	-2.5	(V)EC=0.22	6	J,OL2	0.8	Y	Y	Finds 2 LR (M4 Yield Curve)
		1973-91	M4 dom	1973-91	1.8	0.3	-3.8	(V)EC=0.28	8.6	J,OL2	0.7	Y	Y	For M4 in BEF (M4 dom), ST=real rate differential
		1973-91	M1	1973-91	0.8	-2.2		(V)EC=0.19	5	J,OL2	1.5	Y	Y	Finds 2 LR (M4, dntP) but they are not identified
AT	Glueck	1987	M1	1968-86	0.8	-1.4		EC=0.23	1.5	OL2	2.6	N	-	Inflation and Exchange rate enter the LR for M1
		1987	M2	1957-84	1	-0.2		EC=0.16	3.3	OLS	1.3	N	-	LR estimated in a PA model, LT not significant
DE	Luetkepohl et al.	1995	M1	1961-94	1.1		-4.3	EC=0.11	3	OL1,J	1.3	Y	-	Inflation enters the LR
		1995	M3	1975-94	1	4.1	-4.1	EC=0.11	7.1	OL1	0.7	Y	-	Use M and Y per capita GMU implies changes in SA, shifts in LR elasticities for Y and in SR semi-elastic for ST
	Deutsche Bundesbank	1995	M3n	1975-95	1.2		-6	EC=0.32	4.3	OL2	1	Y	-	Inflation in LR equation, explains velocity
		1995	M3n	1975-95	1		-3	EC=0.24	4.3	OL2	0.6	Y	-	Without inflation, coefficients are unstable
	Bielang-Frisancho et al.	1995	M3	1963-90	1.2		-2.3	LR eqn	-	J	?	-	-	2nd model, with income/wealth ratio
		1994	M3	1976-89	1	3.7 real	-6.4	EC=0.09	3	OL1	0.6	Y	-	Dummied models give the same ECM
	Hansen & Kim	1994	M1	1960-92	0.6	-0.7		EC=0.02	3.7	NL1?	?	Y	Y	Inflation, own rate, swap, SE index ns
		1994	M3	1974-92	1.4		-0.2	EC=0.13	1.9	NL1?	?	Y?	Y	Velocity is Trend-Stationary
	Toedter & Reimers	1994	M1	1971-92	1.6			EC=0.08	3.1	OL2	?	-	-	Inflation is (1), enters the LR through real ST
		1994	M2	id	1.7			EC=0.01	0.7	OL2	?	-	-	use P* model where Y=Ypct and the ECMs are estimated for dln P
	Geflach	1994	M3	1971-90	1	5	fixed, -ST	EC=0.04	3	OL1	?	-	-	
		1994	M3	1975-92	1.6		-1.6	EC=0.19	2.5	OL2	?	Y	-	ECM for growth in M3n, ST=own rate
	Kola & Meade	1994	M3	1970-94	1.2		-3.6	EC=0.07	5.7	OL1	0.7	Y	-	Finds that Div works better for the LR
		1996	M3n	1975-93	0.8	0.5	-0.5	EC=0.2	3.4	J,OL2	0.6	Y	Y	Use changing SA, own rate ns
	von Hagen	1993	M1	1965-89	1		-0.1	EC=0.02	5.8	OL1	1	N	-	Both models include wealth
		1993	M3	id	1.3		-4	EC=0.06	2.3	OL1	0.9	N	-	Models with real variables give similar results
	Herz & Roeger	1990	M1	1962-84	[0.1, 0.3]			PA+AR d2ln	-	OLS	1	Y	-	Absorption or GNP for Y
		1988	M1	1962-94	0.5	0.7	1.4	AR d2ln	-	OLS	1	Y	-	Stability holds thanks to changing SA
	von Hagen & Neumann	1992	M2	1974-87	1	5.9	-5.9	(V)EC=0.18	-	J	-	Y	Y	Div=cash+17sc+12td+08sav
		1993	M2	1976-89	1	4.7	-4.7	EC=0.09	2	J,OL2	1.4	Y?	Y	Use a Beaton-Woods dummy
DK	Lacour	1996	M2	1975-96	1	4.4	-4.4	EC=0.21	9.4	J,OL2,OL1	1.2	Y	Y	Exchange rate enters the LR
		1991	ALP	1974-91	1	1.9	-0.8	EC=0.22	8.9	J,OL1	0.35	Y	Y	German interest rates ns
ES	Ayuso and Vega	1993	ALP	1978-89	1.7	2.35	-0.17	LR Eqn	-	OL(CO)	?	Y	-	In all cases:
		1993	M2	1978-89	1.06	6.33	-0.73	LR eqn	-	OL(CO)	?	Y	-	ST = own rate on aggregate
	Cabrero et al.	1993	ALPV	1978-89	1.46	0.11		EC=0.27	5.1	OL1,NL	0.5	Y	-	LT = yield on Gov. debt over 2 years
		1993	ALP	1978-89	1.77	0.13		EC=0.26	4.9	OL1,NL	0.44	Y	-	Some instabilities are detected around 1989

Table 1: Summary of Empirical Studies of Money Demand in EU Countries

Country	Author	Date	Aggr.	Sample	Income	Elasticities ST Rate, LT Rate	Models	FECM	Method	SE	Stab	Exog	Additional Variables and Comments																																																																																																									
ES	Cabrero et al. contd.		ALP2 ALPA M3 M3A M3B M3C M2 M1	1979-93	1.75 1.84 1.27 1.74 1.1 1.3 0.62 0.54 1.57	0.11 0.15	EC=0.28 EC=0.14 EC=0.15 EC=0.15 EC=0.18 EC=0.16 EC=0.07 EC=0.11 LR Eqn	5	OL1,NL OL1,NL OL1,NL OL1,NL OL1,NL OL1,NL OL1,NL OL1,NL FME, oth	0.4 0.58 0.5 0.5 0.6 0.6 0.8 1.2	Y ? N Y ? N Y N		LT rate - weighted average of long rate plus return on assets in ALP but not in M1 and M2 Short rate = own rate, Long rate = govt debt rate Stability restores if foreign interest rate added after 1989 Extensive Johansen-type analysis ECM found not to enter M2 equation LRATE = The Bank of Finland's base rate Inflation rate enters the short-run function LRATE = Inflation rate Use breaking trends (proxy for logistic curves) to model financial innovation ST or LT in the LR, with or without Wealth or Inflation Inflation enters the LR for both 'long' sample estimates																																																																																																									
														FI	Ripatti	1980-90	0.85 1	-1.5 0.76	EC=0.36	4.7	J,OL2	1.3	Y		Y	St = deposit rate, Inflation in LR eqn, Tbill rate Inflation in LR equation ST = Money mkt rate, Exchange rate in LR eqn Y=retail sales, ST = Tbill rate																																																																																												
																											FR	Pösbö	1972-89	1.18		EC= 0.455	4.69	J, OL2	2.07	Y		Y	Use learning effects to get stability Inflation in LR equation																																																																															
																																								GR	Henry & Sicsic	1972-89	1.45	-0.7 -0.9	EC=-0.190 EC=-0.27 EC=0.17 EC=[0.38,0.47][4.1,4.9]	6.13 4.4 3.9	J, OL2 OL1,J OL1,J	1.06 ? ?	Y Y Y		Y Y Y	Find 3 LR relations (M3,YC,supply) Use a STAR model whereby Y progressively substitutes for wealth in the LR ST=own rate, LT=Tbill rate, dlnP enters the LR																																																																		
																																																					IE	Bordes & Strauss-Kahn	1976-88	0.3 0.3	[-0.4,-0.7]	EC=0.27 EC=0.48 EC=0.08 EC=0.04 EC=0.55 LR eqn	3.6 4.7 5.5	OL1 OL1	1.2 ?	- -		-	ST = deposit rate, Inflation in LR eqn, Tbill rate Inflation in LR equation ST = Money mkt rate, Exchange rate in LR eqn Y=retail sales, ST = Tbill rate																																																					
																																																																		IT	Sharma	1975-93	1	4.4	EC=0.08	5.5	OL1	?	Y		Y	Use learning effects to get stability Inflation in LR equation																																								
																																																																															NL	Pasaradakis	1960-89	0.8175	-0.02	EC=0.04	5.3	J,PVAR	2.1	Y		Y	Use learning effects to get stability Inflation in LR equation																											
																																																																																												PT	Karfakis	1975-88	1.15	-0.24	EC=0.55	4.2	OL2,J	2	?		-	ST = deposit rate, Inflation in LR eqn, Tbill rate Inflation in LR equation ST = Money mkt rate, Exchange rate in LR eqn Y=retail sales, ST = Tbill rate														
																																																																																																									SE	Hurley & Guionard	1979-88	0.73	-0.01	LR eqn		OLS					-	Use learning effects to get stability Inflation in LR equation
UK	Angelini et al.	1975-90	0.73	1.83	2-regime EC		NLS	0.6	Y		-	Use learning effects to get stability Inflation in LR equation																																																																																																										
													UK	Muscatelli & Papi	1983-90	0.74	3	EC=0.23		OL1	0.4	-		-	Use learning effects to get stability Inflation in LR equation																																																																																													
																										UK	Baqilano et al.	1972-89	1.21	1.99	(V)EC=0.07	2.1	J,FIML	1.6	-		-	Use learning effects to get stability Inflation in LR equation																																																																																
																																							UK	Muscatelli & Papi	1963-87	1.37	2.08	EC=0.02	2.2	OL2,J,IV	0.3	Y		-	Use learning effects to get stability Inflation in LR equation																																																																			
																																																				UK	Fase & Winder	1959-88	1	-2.4	EC=0.21	2.2	OL1	1.9	Y		-	Use learning effects to get stability Inflation in LR equation																																																						
																																																																	UK	Fase & Winder	1971-89	1	1.5	EC=0.07	5	OL1	2.1	Y		-	Use learning effects to get stability Inflation in LR equation																																									
																																																																														UK	Fase & Winder	1971-89	1	1.1	EC=0.05	1.7	OL1	1.9	Y		-	Use learning effects to get stability Inflation in LR equation																												
																																																																																											UK	Marques & Lopes	1976-89	1.2	-1.8	EC=0.52	9.2	OL1,OL2	1.5	?		-	Use learning effects to get stability Inflation in LR equation															
																																																																																																								UK	Marques & Lopes	1976-89	1	3.4	EC=0.13	4.1	OL1,OL3	1.1	?		-	Use learning effects to get stability Inflation in LR equation		
																																																																																																																					UK	Marques & Lopes
UK	Mafor	1985-92	0.57	-0.002	PA		OLS					Use learning effects to get stability Inflation in LR equation																																																																																																										
													UK	Berg	1972-92	0.69	-0.008			?					Use learning effects to get stability Inflation in LR equation																																																																																													
																										UK	Breeden & Fisher	1972-92	0.91	-0.32	EC=0.09	3.98	J,OLS	0.8	Y			Use learning effects to get stability Inflation in LR equation																																																																																
																																							UK	Breeden & Fisher	1972-92	0.91	-0.32	EC=0.09	3.98	J,OLS	0.8	Y			Use learning effects to get stability Inflation in LR equation																																																																			
																																																				UK	Fisher and Vega	1977-92	0.5	-1.92	EC=0.16	3.2	J,FIML	1	Y			Use learning effects to get stability Inflation in LR equation																																																						
																																																																	UK	Fisher and Vega	1977-93	0	8.82	EC=0.1	6.1	J,FIML	0.8	Y			Use learning effects to get stability Inflation in LR equation																																									
																																																																														UK	Fisher et al.	1979-92	0.93	0.22	EC=0.11	3.7	J,OLS	0.8	Y			Use learning effects to get stability Inflation in LR equation																												
																																																																																											UK	Fisher et al.	1979-92	2.52		EC=0.09	2.5	J,OLS	2.8	Y			Use learning effects to get stability Inflation in LR equation															

## Explanatory Notes to Table 1

<b>Aggr:</b>	monetary aggregate examined		<b>SE:</b>	Standard error of dynamic ECM equation (%)
	n	nominal	<b>Stability:</b>	If stability tests are passed (Y) or rejected (N) a blank indicates no tests for stability
	dom	domestic currency	<b>Exog:</b>	If tests for exogeneity of money are carried out and passed (Y) otherwise (N) or blank
	pers	personal sector		
	cor	corporate sector		
	mth	monthly		
<b>Models:</b>	(V)EC = x	(Vector) error correction coefficient = x		
	LR eqn	long run equation estimated		
	PA/AR	partial adjustment autoregressive model		
	ARd2In	Autoregressive model of second difference of the log of the variable		
	2 regime EC	Error correction model with two regimes		
<b>t-ECM:</b>	size of the t-ratio on the ECM term			
<b>Method:</b>	J	Johansen procedure		
	OL1	one-step OLS estimation		
	OL2	two-step (Engle-Granger) OLS procedure		
	NL	non-linear estimation of dynamic ECM model		
	IV	instrumental variable model		
	OL (CO)	estimation of long-term equation with correction to autocorrelation		
	FME	Phillips-Hansen fully modified estimation		
	PVAR	Parsimonious VAR		
	FIML	full information maximum likelihood		

banks. This section provides a country-by-country review of the more recent studies, focusing on technical issues, followed by an overview of the main features of these papers.

### 3.2.1 A detailed assessment for each EU country

**Austria (AT):** Glück (1987) estimated both a partial adjustment and an ECM model for Austrian M1 using quarterly data from 1968 to 1986. He found that, in addition to income, foreign interest rates and inflation are significant, although it was difficult to identify an effect coming from domestic rates. Evidence of a structural break in 1979 was detected. Schebeck and Thury (1987) examined the behaviour of M2 using quarterly data over the period 1954 to 1985. They arrived at a dynamic ECM model which has satisfactory properties and an implied long-run equation in which velocity is expressed as a function of interest rates and the inflation rate.

**Belgium (BE):** Jeanfils (1994) provides a group of companion papers which offer a very comprehensive illustration of what the multivariate approach can yield, though the exercise would have needed more investigation as to identification of the long-run equations found. The author compares the system analysis results for three aggregates: broad, broad in domestic currency and narrow. A comparison of the latter two illustrates the specificity of foreign currency holdings since the real rate differential (related to deviations from both interest rate and purchasing power parities) enters the long-run equation when only domestic currency is considered. The overall sensitivity of the narrow aggregate to interest rates shocks cannot be assessed, for the relations found are underidentified. On the contrary, for the broad aggregates, one of the relations is the yield curve, which means that a positive shock to the level of interest rates would have a negative (around one-to-one) effect on M4. An alternative approach can be found in Fase and Winder (1996), who have estimated equations for M1, M2, and M3 including a wealth variable. Their results show that, although income and wealth elasticity sum up to one, the income-to-wealth ratio and velocity have very different evolutions for M1 and M3, which means that interest rates - nominal and real - have a major influence on money demand in Belgium.

**Denmark (DK):** Danish money demand became quite a famous topic in academia since it was the background of the first empirical illustration [see Johansen and Juselius (1990)] of the Johansen procedure. La Cour (1993) is based on this methodology too, but makes use in addition of a variety of definitions of money indices, including the Divisia one. Concerning the simple-sum aggregates, both papers conclude that two long-run relations can be found in the system, made of interest rates, money and income (the latter two in real terms). At least one of the two relations can be formulated in terms of velocity, which is not stationary and depends on the differential between the returns on bonds and deposits, the semi-elasticity being around 4. La Cour (1993) also shows that using a Divisia index will not affect these results and can even lead to more stable long-run models. It is also proved that the derived ECMs for money (both for the Divisia and the simple-sum aggregates) are stable. Another interesting development shows that a decomposition of the money stock into five components can yield “optimal” weighting schemes for the various monetary assets. These weights are

fixed, contrary to the Divisia approach, and they are selected as the ones which allow a cointegrating relation to hold between the weighted sum and real income.

However, these two academic papers are based on rather old data sets, i.e. with observations ending in 1987 and 1989 respectively. This suggests that updating the data could have drastically affected the results, but this does not seem to be the case according to a study by Hansen (1996), which offers the advantage of dealing with a sample extended to 1996. It also uses the FIML method on a system consisting of money, income, the own and alternative rates, and the exchange rate with the Deutsche Mark so as to account for currency substitution. The single long-run vector can be restricted to a long-run money demand, according to which velocity responds to the exchange rate and to the opportunity cost of money. A remark is that there is probably a second relation in the system - as found in La Cour (1993) - provided that the critical value would be taken at slightly more than 5%. This would probably affect the ECM results, and may even make them even closer to the previous ones.

*Spain (ES):* A number of recent papers examining the behaviour of broad money in Spain have been produced by researchers at the Banco de España. These papers have a number of common features, such as a focus on comparison of the behaviour of different definitions of money, the use of advanced econometric techniques and the use of a weighted average own rate of return as an interest rate variable and the inclusion of inflation in the long-run equations. It is also worth noting the strong preference for the use of a very broad definition of liquidity in comparison to other countries, with the ALP2 aggregate including, for example, Treasury bills and commercial paper. Dolado and Escrivá (1991) estimated the demand for ALP - or "liquidity in the hands of the public", which is a relatively wide aggregate in comparison with other countries - and various sub-aggregates derived by excluding certain components such as Treasury bills, repos, etc., using Johansen techniques, single-step estimation of ECM models and also transfer function modelling. Using various criteria (such as speed of adjustment, stability and prediction errors), they conclude that while cointegration is found for most of the sub-aggregates examined, the ALP aggregate is the one with the best behaviour. Some instability is found for all aggregates around 1989, which is attributed to disintermediation effects arising from credit restrictions.

Cabrero et al. (1993) returned to the issue of the performance of various definitions of the broad monetary aggregate to take into account the redefinition of aggregates which occurred in 1992. In addition, they also examined the behaviour of some narrower aggregates, in particular M1 and M2. Using one-step OLS and non-linear estimation, cointegration relationships are found between each aggregate and real income, the inflation rate and interest rates. The response of the various aggregates to income and interest rates varies significantly; for broad aggregates, for example, income elasticities are usually well above unity, consistent with significant wealth effects; in contrast, income elasticities for narrower aggregates are around 0.5, in line with theory. In terms of stability, ALP2 does not show signs of persistent instability, while some of the narrower aggregates exhibit such instability. Ayuso and Vega (1993) develop various Divisia and currency aggregates and compare their long-run properties with ALP and M2, but are unable to find satisfactory cointegration relations for these new aggregates.

Vega (1994) returned to the issue of the stability of ALP using a data set extending to the end of 1993. It was found that previously estimated long-run equations for ALP2 exhibited a major structural break around 1989 which substantially altered its long-run properties. This is attributed to the growing openness of the Spanish financial system and the progressive reductions of restrictions on capital flows. When this factor is allowed for - by means of the addition of a foreign interest rate term beginning from 1989 - stability appears to be restored to the long-run relation. The notable methodological feature of this paper is the explicit focus on the estimation of and behaviour of the long-run equation using various techniques such as the fully modified estimator of Phillips and Hansen (1991).

**Finland (FI):** Ripatti (1994) follows the Hendry and Mizon (1992) approach to model M1 and M2 in Finland, applying the Johansen method to monthly data. In the case of M1, the VAR is reduced to a dynamic ECM model where real money depends on real GDP and money market rates (price homogeneity could not be rejected after likelihood ratio Johansen tests). Broad money is modelled jointly with output, credit stock, money market interest rates and inflation. However, in the structural dynamic model for real M2, the right-hand-side variables are: difference of inflation, interest rates, credit; various dummy variables and an ECM term which reflects the banking system balance sheet constraint. Another route is taken by Ripatti (1996), using a specification derived from a portfolio approach. The long-run components are estimated by the Johansen method, the dynamic forward-looking specification by the GMM (no standard ECM being therefore estimated). The equation for narrow money appears more stable than the one for broad money. The results might nevertheless depend on the hypothesis of a zero covariance between inflation and growth, whereas no long-run restriction on the link between money and output has been imposed.

**France (FR):** This country is a clear illustration of the implications of financial innovation, the bulk of which took place in the mid-1980s, for the definition of the broad aggregates. The M3 concept was broadened in the late 1980s so as to incorporate money market funds (OPCVM monétaires), which became very popular since they provided non-financial agents with an intermediated access to money markets assets [Henry and Sicsic (1994)]. Up to the early 1990s the narrow aggregate M1 was also quite stable in terms of its relation to output [see also Bordes and Strauss-Kahn (1989)], the main question being the size of the elasticity to output ("square-root law" vs. velocity model, depending on the type of trends employed). As to interest rates, the overall effect of the level of interest rates remains negative, with an elasticity of around unity, even though part of M3 is interest-bearing. The long-term/short-term spread has been found stationary, without any impact on M3. Moreover, the size of the negative interest rate effect found on M3 is even higher than the one found on M1. Indeed, this is counter-intuitive, since M3-M1 consists of interest-bearing assets. Estimations including wealth, learning-effects and trends in the long-run equations might have yielded more consistent results but have not been implemented.

**Greece (GR):** A number of recent studies have examined the demand for the narrow aggregate M1 [see Karfakis (1991) and Psaradakis (1993)] as well as M3 [Sharma (1994)]. A notable feature of some of the

results is the role of inflation in the long-run equations in all studies. This is attributed to the (up until recently) underdeveloped and regulated structure of financial markets, which implied that holdings of real assets - particularly real estate - constituted an important alternative to money in agents' portfolios. In the Karfakis paper, cointegration between real M1, income, short-term money market rates and the drachma exchange rate is found using the Johansen procedure and, after accepting the hypothesis of homogeneity for income, an ECM equation is estimated for velocity and this appears to pass the usual diagnostic tests, including stability. Psaradakis applies the Hendry and Mizon (1992) modelling strategy, testing down from a parsimonious VAR model to a structural equation model of money demand using the Johansen approach. The results point to a long-run relation between money and prices and income, with homogeneity being accepted for both variables, and with interest rates and changes in inflation entering the dynamic equation. Sharma uses the one-step OLS procedure to estimate a dynamic ECM model for M3. Homogeneity with respect to income and prices is accepted with the long-run velocity found to depend on deposit rates and inflation. The equation appears to be stable over the sample period.

**Ireland (IE):** The most recent study – by Hurley and Guiomard (1989) – applied the technique of OLS estimation of a long-run equation to monthly data. The authors report that both M1 and M3 are cointegrated with a scale variable (retail sales and industrial production, respectively) and a short-term money market interest rate.

**Italy (IT):** Two very different devices are employed to track the impact of financial innovation on the aggregate M2 [not to mention the impact of CBH when considering the extended M2, see Angeloni et al. (1992)]. On the one hand, there is Muscatelli and Papi (1989), with an extensive use of the multivariate approach, or, on the other, Bagliano et al. (1991), with two learning curves - as suggested in Hendry and Ericsson (1991) - on returns for both Treasury bills and CCTs, instruments which were only introduced in the late 1970s. Second, in Angelini et al. (1994) financial innovation is modelled, with a shift in the scaling variable from wealth to income. This solution was selected because the logistic trends would not yield stable or sensible (no price homogeneity) equations. The proposed interpretation of the latter model is that due to the introduction of new financial products, money became progressively more transaction-oriented. In both cases, assuming the long rates are indexed on the short rates would lead to an overall effect of a one-point shock to the level of interest rates in the direction of increased money, which is an original result. Angelini et al. discuss this point: assuming an equilibrium where the Treasury bill rate increases twice as much as the own rate, hence a non-stationary spread, the expected negative impact comes back. Of course, multivariate analyses would help in this respect, and they would also give insight into the weak exogeneity of the interest rates with respect to the long-run parameters of money demand.

A multivariate approach is taken by Rinaldi and Tedeschi (1996), who estimate a VAR consisting of money, income, inflation, deposit and Treasury bill rates. They find three cointegration relations which they identify as, first, a money demand whereby velocity depends on the two interest rates with the expected opposite signs; second, a term structure equation in which the slope of the yield curve depends on inflation; and, finally, the

deviation of output from its trend value which depends on the real interest rate. The Treasury bill rate appears exogenous, whereas money reacts essentially to the ECM term pertaining to its own long-run equation, and the own rate mostly to the other two long-run components.

**Netherlands (NL):** Many papers have been produced over the years, addressing a number of standard issues in money demand econometrics. For instance, Fase and Winder (1990) estimate aggregate demand functions for M1 and M2 as well as household and business sector demand for both aggregates using quarterly data from 1959 to 1988. The one-step OLS estimator, in which the long-run steady state relationship was estimated jointly with the short-run dynamics, was employed. In the long-run equations, real money balances were expressed as functions of real income, inflation, short and long-term interest rates and tests on a unitary income elasticity were carried out and accepted. While the overall results were satisfactory on the basis of a priori and statistical criteria, preliminary tests indicated that the inclusion of financial wealth leads to a significant improvement in equations for broader aggregates. In a further paper [see Fase and Winder (1994)], the behaviour of Divisia measures for M2 and M3 is also examined. While the equation for Divisia M2 appeared to have better properties than the corresponding simple-sum aggregate, the results for M3 were less clear-cut.

Fase and Winder (1996) also analysed the importance of wealth in the long-run money demand for three aggregates (M1, M2, and M3). They find that nominal and real interest rates enter these money functions, although the correlation between the liquidity and wealth-to-income ratio is very stable, suggesting that the role of interest rates may be marginal in the monetary evolutions. System approach and exogeneity tests would nevertheless be required to clarify this statement.

**Portugal (PT):** Marques and Lopes (1992) estimated money demand equations for the three aggregates M1, M2 and L-. For M1, strong evidence of cointegration with real *income* and the interest rate on alternative assets is found, although homogeneity with respect to both prices and income is rejected. Moreover, the dynamic equation appears quite stable. For the other aggregates, the evidence for cointegration between money and real income and the spread between the deposit rate and long-term market rates, though somewhat weaker, cannot be rejected and there is no evidence of a structural change over the period. A notable feature of this paper is that it allows for non-linear and asymmetric responses of money to deviations from equilibrium and some of these effects are found to be significant.

**Sweden (SE):** Marlor (1993) estimates a traditional partial adjustment model for real M3 as a function of real income, the spread between deposit and bond rates and the level of Treasury bill rates. A notable feature of these results is the low long-run income and interest elasticities and the negative coefficient on the lagged dependent variable. Berg (1993) reports some results from the estimation of ECM models which broadly confirm the previous results.

**United Kingdom (UK):** Recent work by researchers at the Bank of England have examined demand for M0, M4 and Divisia measures of money. Breedon and Fisher (1993) examine the behaviour of M0 in three samples: annual data from 1925 to 1992; quarterly data from 1972 and monthly data from 1978. A notable feature of the model used is the method employed to deal with the effects of financial innovation. The rate of financial innovation affecting M0 demand is assumed to be endogenous and depend on the level of short-term interest rates (i.e. the opportunity cost of holding M0). At any point in time, the stock of financial innovation, by definition equal to the sum of all past innovations, is measured by a cumulative interest rate term, which acts as a variable trend. Thus an increase in short-term interest rates is seen as inducing increased financial innovation which, once created, will have a permanent effect on demand for M0. In the quarterly model, for example, real M0 is found to be cointegrated with this cumulative interest rate term and the volume of retail sales using the Johansen procedure and a dynamic ECM model is estimated.

Fisher and Vega (1993) examine the demand for M4 using the Hendry-Mizon approach of reducing an unrestricted VAR to a structural representation using Johansen procedures. A notable feature of this paper is the disaggregated approach, with personal and corporate sector demand being modelled separately, as well as the important role played by wealth variables [building on Hall et al. (1989)]. As regards the personal sector, M4 and consumer expenditure are modelled jointly, with long-run real M4 demand being cointegrated with income, real tangible and financial wealth, the inflation rate and the spread between the own rate on M4 and Treasury bill rates. For the corporate sector, using the same methodology, long-run real M4 is found to depend on real corporate sector financial assets and the spread between short-term market rates (assumed to be the own rate on corporate M4) and long-term market rates. Since output does not enter the equation, this can be interpreted as the modelling of a simple portfolio allocation decision.

Fisher et al. (1993) develop Divisia measures of the money stock for the personal and corporate sectors. They find that real personal sector Divisia cointegrates with real domestic demand and the user cost of the aggregate (i.e. the spread between the weighted return on the aggregate and the alternative interest rate). Corporate sector demand for Divisia proves difficult to model but there is some evidence that it is cointegrated with GDP.

### **3.2.2 A comparative overview**

In the majority of papers examined, it can be said that broad money aggregates are the primary focus of attention, although a minority of studies focus on narrower aggregates. Some papers also attempt to compare the empirical performance of alternative aggregates, particularly in the case in Spain, but this only applies to a small number of papers.

The specification and methodology across countries appear to be quite similar, with money being expressed as a function of income and, occasionally, wealth. In many cases some measure of the own return is included, while the preferred opportunity cost variable is typically a longer-term market rate. In most countries a relatively simple specification is found to be adequate, although in some cases (e.g. France, Italy and the

United Kingdom) various additional variables to account for the effects of financial innovation are found to be useful. The econometric methods used incorporate developments in cointegration theory and focus on the joint estimation of long-run behaviour together with short-term dynamic responses. A wide range of estimation techniques are employed, including single-step OLS estimation, two-step OLS and non-linear estimation to systems of equations methods.

Although the results obtained vary considerably across countries, it is nonetheless possible to identify some empirical regularities. For example, in the case of broader aggregates, estimated income elasticities are typically above unity (in some cases, substantially so), contrary to a priori expectations. This, of course, implies that velocity will have a trend related to the trend in income. One possible explanation for the high income elasticity is that this variable may be picking up the effects of omitted variables, particularly wealth [see for example the results for UK M4 in Hall et al. (1989)]. On the other hand, for narrower aggregates, income elasticities are, as theory predicts, generally below unity.

As far as long-run interest rate semi-elasticities are concerned, it is more difficult to discern a clear pattern to the results and the range of estimates is extremely wide: ranging from zero to levels as high as 8. Nonetheless, it is fair to say that the broad thrust of the results suggests that interest rate variables are an important determinant of money demand in these EU countries.

Overall, the estimates reported by the various authors appear to have quite satisfactory statistical properties. Standard errors of dynamic equations, though varying from aggregate to aggregate and across countries, are typically around 1 percentage point or less. The results in most cases (e.g. the size and t-ratio of the ECM adjustment term) point to the existence of a long-run equilibrium relationship between real money and its determinants, although the small size of the ECM parameter itself suggests that deviations from the long-run steady state may be quite protracted.

A comparison with the results for Germany shows that there are some common features, like the stability of the estimated equations, which is somewhat surprising. However, this may relate to an "academic bias", whereby studies finding instability or unsatisfactory results tend not to be published. Another possibility is that empirical work concentrates on the aggregates to which most importance is attached for policy purposes, but these aggregates are likely to have been chosen by the central bank on the basis of the stability of their relationship with the final variables. It may be said, in addition, that a stable money demand is often viewed as a necessary, but not sufficient, condition for monetary targeting.

However, there are also some results which are quite specific to the other European countries, such as the much more frequent use of the own rate of return on money in many countries, while this variable is almost never found significant in money demand equations for Germany. To some extent the income elasticity also appears higher in Germany. These differences suggest aggregation problems may occur when money demand is to be studied at the EU-wide level.

#### **4 The (short) history of EU-wide money demand: towards more stability?**

Empirical work on this topic began with the pioneering work by Bekx and Tulio (1989) and since then considerable research effort has been expended on this issue (for a survey, see van Riet, 1993). There are now at least fourteen papers available on this topic (see Table 2). In carrying out an EU-wide money study, a number of specific issues have to be addressed apart from those mentioned above. These relate mainly to the countries to be included in the analysis and the method of aggregation.

As regards country composition, most of the work has focused on those countries which belonged to the narrow band of the EMS rather than on the wider EU, reflecting the fact that, since the countries in this group have aimed at stable exchange rates among themselves, area-wide monetary analysis would be more appropriate than for countries which have allowed their exchange rates to float against each other. However, papers by Monticelli and Strauss-Kahn (1992), Monticelli (1993) and Fase and Winder (1993) have examined equations for wider groups of countries and, overall, the results are similar to those obtained for the narrower grouping. The shift of focus towards wider groupings of countries in the more recent studies reflects a number of factors including improved data availability, the enlarged membership of the ERM up to 1992 and progress towards Stage Three of Monetary Union, which has led to increasing emphasis on monetary policy co-ordination among EU countries.

A crucial issue which does not, by definition, arise in single-country studies is the method of aggregation of the data to obtain cross-country aggregates that enter the area-wide money demand specification. Quantity data must be converted to a single unit of account. In existing studies, three methods have been employed for doing this:

- 1) conversion at current exchange rates;
- 2) conversion at fixed base-period exchange rates (including ERM central rates); and
- 3) conversion at PPP exchange rates.

Theoretical considerations would tend to favour methods 1 or 3, since the arbitrary choice of some base-period exchange rates may give rise to a valuation of different money stocks over time which is far removed from either market values or from a valuation in terms of their purchasing power. In this respect, there are some differences of view among authors. Kremers and Lane (1990), for example, argue strongly in favour of the PPP method, on the grounds that a) the weight of each currency in the area-wide money stock reflects more realistically the size of the economy of the country and b) that the use of PPP exchange rates ensures that money is measured in terms of the purchasing power in the country where it is held. In contrast, Monticelli (1993) argues in favour of the current exchange rate method on the grounds that it provides a consistent market evaluation of the stocks of financial assets across countries and that the effective purchasing power of currencies across countries is properly measured by current rather than PPP exchange rates. In any event,

Table 2: Summary of Empirical Studies of area-wide Money Demand in the EU

Author	Date	Aggr.	Group	Method	Sample	Elasticities:		Curr Subs	Models	ECM	Method	SE	Stat	Exog	Additional Variables and Comments
						Income	LT Rate								
Belx and Tullio	1989	M1	EMS7	er-79	78:3-86:4	0.91	-	-1	LR eqn		OL1				P in LR equation, Curr subs = \$/EMS int diff.
Kreiners & Lane	1990	M1	EMS7	DM-85P	78:4-87:4	1	-0.67	0.08	EC=0.95	5.3	OL2	0.08	Y		Curr subs = ECu\$; infl. in LR equation; cur-er & base period er examined
Gurney & int'Veid	1991	M1	EMS4	er-cu	75:2-89:4	1	-3.04		EC=0.13		OL2	1.17			
Artis	1992	M1	EMS7	US\$ 80	78:4-87:4	1		-1.18	LR eqn		OL1		Y		Curr subs = ECu\$
Artis et al.	1992	M1	EMS7	US\$ 80	79:2-90:2	0.99		-1.21	ECM=0.73	4.8	OL2	1.2	Y		Curr subs = ECu\$
		M2	EMS8	US\$ 80	79:2-90:2	1.2		-0.7	ECM=0.38	3.5	OL2	0.5	Y		
Monticelli & Strauss-Khan	1992	M3	EMS9	ECU-cu	79:1-89:4	1.28	-0.65		ECM=0.46	4.8	OL1,2,J	0.5	Y	Y	Segmented trend (reduces income elasticity)
		M3	EMS9	ECU-cu	79:1-89:4	1.29	-0.72	0.018	ECM=0.44	4.4	OL1,2,J	0.5	Y	Y	Fixed 87 yr also examined
Fase & Winder	1993	M1	EC11	er-cu	71:1-89:4	1	-1.51	-1.23	ECM=0.15		OL2	0.63			
		M2	EC11	er-cu	71:1-89:5	1	1.67	-2.6	ECM=0.09		OL2	0.58			
		M3	EC11	er-cu	71:1-89:6	1	1.48	-2.38	ECM=0.08		OL2	0.49			
Barr	1992	M1	EC7	DM-85P	79:1-90:4	1 (fixed)	n.s.		LR eqn		OL1		N		inflation in LR equation relaxing the velocity restriction improves stability
Monticelli	1993	M3	EC9	ECU-cu	79:1-92:1	1.25	-0.49		ECM=0.55	5.3	OL1,2	0.5	Y		Linear trend and segmented trend (86:1-89:4) included; not strictly necessary for coin but gives more sensible income coeff.
		M3R		ECU-cu	79:1-92:1	1.51	-0.29		ECM=0.31	4.1	OL1,2	0.6			
		M3L		ECU-cu	79:1-92:1	0.85	-0.04		ECM=0.37	3.9	OL1,2	0.7			
		M3RL		ECU-cu	79:1-92:1	1.33	-0.32		ECM=0.42	5.1	OL1,2	0.5			
		M3RC		ECU-cu	79:1-92:1	1.44	-0.32		ECM=0.38	4.8	OL1,2	0.4			
		M3RLC		ECU-cu	79:1-92:1	1.41	-0.36		ECM=0.38	4.4	OL1,2	0.6			
Cassard et al.	1994	M3	ERM6	DM-P	82:4-90:2	1.62	-0.8		EC=0.33	3	OL2,J	0.4			SR = money mkt-own rate
Wesche	1994	M1	EC4	DM85P	70:1-92:4	0.88	-1.1		EC=0.37	6.34	OL2		Y		
Fase & Winder	1994	DivM2	EC10	ECU85	71:1-91:1	1	-1.4		EC=0.1	2.4	OL1	0.7			Various aggregation schemes. Price homog. not imposed. ST rate = opportunity cost
		DivM3				1	-1		EC=0.1	2.4	OL1	0.7			
Falk & Fünke	1995	M1	EC3	DMP	72:4-92:4	1.47	-1.5	n.s.	EC=0.8	8.9	OL1		Y	Y?	Use dummy for German Unification and a DM-\$ exchange rate; er-cu gives unit income elasticity
		M1	EC7	DMP	72:4-92:4	1.12	-1.4	n.s.	EC=0.4	6.1	OL1		Y	Y?	
Wesche	1996	M3	EC4	DM90P	73:1-93:1	1.55	-2.2		EC=0.08	3.9	J				Base year and PPP yr give similar results
				DM-cu	73:1-93:1	5	-1.9		non signif.		J				

## Explanatory Notes to Table 2

### As in Table 1 plus:

Method:	method of constructing aggregate variable
er-x	exchange rates prevailing on date x
P	purchasing power parity exchange rates
cu	current (market) exchange rates
<b>Aggr:</b>	
M3R	M3 extended to include EC-residents' CBHs irrespective of their location and currency denomination
M3L	M3 extended to include CBHs held within the EC irrespective of the residence of the holder and the currency denomination
M3RL	M3 extended to include EC-residents' CBHs held within the EC irrespective of their currency denomination
M3RC	M3 extended to include EC-residents' CBHs denominated in the EC currencies irrespective of their location
M3LC	M3 extended to include CBHs held with banks located within the EC and denominated in EC currencies irrespective of the residence of the holders
M3RLC	M3 extended to include EC-residents' CBHs denominated in EC currencies and held with intermediaries located in the EC

Monticelli's results suggest that both approaches yield broadly similar conclusions. Nonetheless, on the basis of the existing literature it is clear that no consensus on the appropriate method of aggregation is available and thus, from a practical point of view, it is desirable to examine the impact of different methods of aggregation on the empirical results. A final point worth stressing is the need - regardless of the method employed - to ensure consistency of the aggregation across variables. For example, it scarcely needs to be stressed that the method used to calculate the area-wide money stock should also be used when aggregating quantity variables on the right-hand-side of the equation. Similarly, nominal money and nominal income should be transformed into real variables using an aggregate deflator computed along the same lines.<sup>13</sup>

Early studies of money demand have tended to focus on the behaviour of the narrow money aggregate, M1. However, more recently, Monticelli and Strauss-Kahn (1992), Monticelli (1993), and Wesche (1996) have examined the empirical properties of the broad money aggregate M3. In addition, Monticelli has examined the properties of various definitions of extended broad money aggregates which reflect different measures of cross-border holdings. Area-wide Divisia aggregates have also been analysed by Monticelli and Papi (1996) and Fase (1996). In general, the specifications of the equations are relatively simple and include the standard variables examined above. However, the specifications are compromised somewhat by the difficulty encountered in compiling some of the more complicated variables. Money demand is expressed as a function of prices (with homogeneity imposed in most, though not in all cases), real income, and one or more interest rate variables. As regards the latter, most studies employ either a short or long-term interest rate as the opportunity cost variable, although, for broader aggregates, some studies also employ an own-rate term based on a weighted average of the rates on the constituent components of money with the rate attaching to currency being zero. In addition, some authors use variables such as the USD/ECU or USD/DEM exchange rate to assess possible currency substitution between EU and third currencies. In the case of Monticelli and Strauss-Kahn (1992) and Monticelli (1993), segmented trend variables - which are not strictly necessary to achieve cointegration but nonetheless serve to reduce the coefficient on real income - are employed to capture possible effects from financial innovation.

In terms of econometric methods, since interest in EU-wide money demand coincided with the cointegration revolution in econometrics, all studies reflect the 'standard' cointegration approach. Most studies employ either one-step or two-step estimation of the long-run equation and in the majority of cases a single-equation dynamic ECM model is estimated. However, the multivariate analysis using Johansen techniques has also been carried out, *inter alia* by Monticelli and Strauss-Kahn (1992) and Cassard et al. (1994), but these papers mostly point to the existence of one single long-run relation anyway. Analysis is normally carried out on quarterly data with samples usually beginning at, or soon after, the late 1970s.

---

<sup>13</sup> This may explain why e.g. Wesche (1996) found a big difference between the results obtained from method (1) and those obtained from the other two methods. See Falk and Funke (1995) for a comparison between methods (1) and (3) for which results are similar, although (1) leads to a significantly lower income elasticity.

Despite the simplicity of the underlying specification, there seems to be a consensus that EU-wide money demand equations have very satisfactory statistical properties. Evidence in favour of a stable long-run relation is strong in comparison with corresponding national estimations. This is reflected in the high coefficient on the error correction term [in some cases extremely high, see e.g. Kremers and Lane (1990), with 0.95] and in its generally high t-statistic as well as relatively low equation standard errors. In addition, where stability tests are carried out, the general conclusion is that the equations are stable.<sup>14</sup> However, it should be noted that this comparison of national and area-wide equations does not guarantee that area-wide equations are better at predicting area-wide money growth than an aggregation of the predictions of the national equations. This latter test for aggregation effects, which was originally suggested by Grunfeld and Griliches (1960), was applied by Wesche (1996) to EU money demand with results unfavourable to an area-wide approach.

In terms of estimated parameters, income elasticities for narrow aggregates are found to be close to unity, while, for the broad aggregates, elasticities generally exceed unity, in some cases considerably. Interest elasticities have the expected signs and are usually significant although varying considerably in magnitude. Where currency substitution effects (between European currencies and the dollar) are considered, they are usually found to be significant albeit with a relatively small elasticity.

An important question which arises from these results is: what accounts for the relatively better performance of area-wide as against national equations? A number of explanations have been put forward in this context:

- 1) Purely statistical explanations (i.e. averaging-out of shocks across countries). For example, changes in national money stocks due to factors such as trade, tourism or capital flows may contribute to instability in national money demands. Such changes might, however, tend to cancel out at an EU-wide level. Similarly, shocks, due to policy or changes in local payment habits, for example, although significant in national terms, could be desynchronised across the countries comprising the aggregate with the result that an EU-wide aggregate may be little affected.
- 2) Neutralisation of currency substitution within Europe. The idea here is that shifts in EU residents' liquidity preferences between different EU countries would contribute to the instability of the national money demand function.<sup>15</sup> However, if this currency substitution is confined to the countries making up the EU-wide aggregates it will clearly wash out of these aggregates, leaving them insulated from such currency substitutions. In addition, it should be pointed out that most studies are based on the addition of existing national aggregates, which do not include cross-border holdings (though they include foreign currency deposits held by residents). Thus currency substitution will not be entirely captured in the aggregates used and therefore this factor cannot explain the stability of the area-wide aggregates employed in most studies. An exception here is Monticelli (1993), who examines various aggregates which include CBHs and

---

<sup>14</sup> Barr (1992), questioning Kremers and Lane (1990), found that a specification without restriction on the income coefficient could be stable. Similarly, Falk and Funke (1995) found that German unification had only temporary effects on the stability of the European money demand.

<sup>15</sup> Filosa's (1995) results suggest that exchange rates play a crucial role regarding the stability of the demand for money in six EU countries.

therefore should be robust with respect to intra-EU currency substitution. However, his results are that traditional aggregates typically perform as well as, if not better than, extended aggregates. This suggests that currency substitution per se may not be the main factor behind the stability of EU-wide or area-wide money demand functions. However, a caveat to this argument should be noted. If estimated national money demand equations are misspecified due to the exclusion of foreign variables on the RHS, then an area-wide demand function would correct this omission and could therefore, in principle, have better properties than the individual national equations.

- 3) Specific features of the ERM system [see Sardelis (1993)]. Given that the ERM has apparently operated largely as an asymmetric system [see Henry and Weidmann (1995)], with the stance of policy being set by the Deutsche Bundesbank, this implies, in line with standard theory, that the stock of money in individual non-anchor countries was predominantly demand-determined (at horizons anywhere beyond the very short run) and thus not substantially influenced by money supply shocks, since monetary policy was constrained to peg interest rates at a level compatible with the exchange rate objective. Since such countries account for the bulk of the non-anchor EU, it is argued that it is not surprising that the area-wide aggregate is more closely related to the demand variables than it is in the countries where the exchange rate is floating.
- 4) Although the effective reserve currency central bank in the EMS (the Deutsche Bundesbank) would have had a considerable influence on the evolution of the national money stocks of those countries targeting their exchange rates to the Deutsche Mark, it was, nevertheless, not attempting to target any EU-wide (or sub-EU-wide) money stock. Therefore, Goodhart's law would not have applied to an area-wide aggregate. It would therefore not have been affected by this potential source of instability, which may be relevant at the national level where monetary targeting was seriously pursued. Therefore an area-wide aggregate may turn out to have stable properties in empirical tests only because it has not been targeted in any monetary policy strategy.
- 5) The extent and timing of major financial innovation in EU countries. Given that financial innovation is often viewed as the prime reason for instability in national money demand functions, the relatively limited extent of major financial innovations in some EU countries and the fact that the timing of the innovation process may have varied across EU countries could also be a factor accounting for the greater stability of area-wide, as against national money demand functions.

As Arnold (1994) points out, the sources of area-wide EU money demand stability is a crucial issue for Stage Three. If it is due to (2) then one could expect this to continue into the third stage, implying the continuing stability of area-wide money demand. On the other hand, if (3), (4) or (5) are important reasons for stability at the EU level, then there is a major risk that the stability found in Stage Two in area-wide money demand functions may not be carried forward into Stage Three. More generally, if stability is due to statistical factors (1), it will persist only to the extent that the shocks under this heading do not become more synchronised in Stage Three. In this respect, in a more recent paper, Arnold (1996) compares regional money demands in the United States with national money demands in the EU, finding a much higher degree of residual cross-correlation in the United States. Judging by the US experience, it is argued that in Stage Three

of Monetary Union national money demands are likely to become increasingly correlated in view of the single monetary policy and integration of markets. This implies that - even in the absence of major financial innovations - the performance of area-wide equations in Stage Three is likely to be poorer than is suggested by results obtained from estimations carried out in Stage Two.

Finally it should be noted that, in any case, the move to Stage Three will, of course, represent a regime shift which may give rise to new sources of instability in the behaviour of monetary aggregates at the start of, or in the early stages of, Stage Three over and above those observed in Stage Two. All of these considerations suggest the need for caution in attempting to derive conclusions for Stage Three from the results currently available.

## **5 Conclusions**

Money demand estimations have been carried out for nearly all EU countries. However, particular attention has been paid to the features of money demand in Germany, presumably because this country continues to pursue a strategy of medium-term monetary targeting and because of the importance of developments in the anchor country for monetary conditions elsewhere in the Union. A reasonable summary of the results obtained in general is that money demand equations perform fairly well in EU countries. Estimated parameters have the signs, if not always the magnitudes, predicted by economic theory. In most cases, the evidence points to the existence of the long-run equilibrium relation between money and a few determinant variables, although the size of the adjustment coefficients indicate that deviations from the steady state may be of long duration. Moreover, the dynamic equations have a good fit, with residual standard errors typically around or below 1%. Where stability tests are conducted, they generally confirm that the estimated relationships are stable over the sample experience.

In recent years, there has been considerable interest in the properties of money demand in the EU as a whole and in various subgroups of EU countries. In all, some fourteen papers covering this topic have been examined in this survey. These studies have examined the behaviour of a range of monetary aggregates, including M1, M3 and various extended M3 aggregates. The specification of the explanatory variables has been quite simple given data difficulties, with money modelled as a function of prices (with homogeneity usually imposed), real income, market interest rates and, occasionally, currency substitution variables. Sample periods typically start from the mid to late 1970s. Notwithstanding the relative simplicity of the underlying specification, there appears to be consensus that area-wide money demand functions have very satisfactory statistical properties in term of both a priori and statistical criteria. Indeed, it is often argued that area-wide equations compare very favourably with the best national equations. However, the reasons for this apparently better performance remain unclear, although a number of possible explanations have been put forward, implying a need for caution in attempting to derive conclusions for Stage Three from results currently available.

## References

- Angelini, P., Hendry, D.F. and Rinaldi, R.** (1994), "An Econometric Analysis of Money Demand in Italy", *Banca d'Italia: Temi di discussione*; No. 219.
- Angeloni, I., Cottarelli, C. and Levy, A.** (1992); "Cross-Border Deposits and Monetary Aggregates in the Transition to EMU"; *Banca d'Italia; Temi di discussione*; No. 163.
- Arnold, Ivo J.M.** (1994); "The Myth of a Stable European Money Demand"; *Open Economics Review*; 5; pp. 245 - 259.
- Arnold, Ivo J.M.** (1996); "Money Demand Stability in the EMU: Lessons from the US"; *working paper Nijenrode University*; Breukelen.
- Artis, M. J.** (1992); "Monetary Policy in Stage Two of EMU. What can we learn from the 1980s?"; *CEPR Discussion Paper*, No. 629.
- Artis, M. J., Bladen-Hovell, R. C. and Zhang, W.**(1992); "A European Money Demand Function", *Policy Issues in the Operation of Currency Unions*, P. Masson and M. Taylor eds, Cambridge University Press.
- Ayuso, J. and Vega, J. L.** (1993); "Weighted Monetary Aggregates: The Spanish Case", Banco de España; *Documento de Trabajo*; No. 9303.
- Bagliano, F.C., Favero, C.A. and Muscatelli, C.A.** (1991); "Cointegration and Simultaneous Models: an Application to the Italian Money Demand"; University of Glasgow; *Discussion Papers in Economics*; No. 9108.
- Banerjee, A., Dolado, J., Galbraith, J. and Hendry, D.** (1993); "Cointegration, Error-Correction, and the econometric Analysis of non-stationary Data"; *Advanced Texts in Econometrics*; Oxford University Press.
- Barnett, W.A.** (1980); "Economic Monetary Aggregates - An Application of Index Number and Aggregation Theory"; *Journal of Econometrics*; 14; pp. 11 - 48.
- Barr, D.** (1992); "The Demand for Money in Europe: Comment on Kremers and Lane"; *IMF Staff Papers*; 39(3); pp. 718 - 737.
- Baumol, W.J.** (1952); "The Transactions Demand for Cash: an inventory theoretic Approach"; *Quarterly Journal of Economics*, 66; pp. 545 - 556.

- Bekx, P. and Tullio, G.** (1989); "A Note on the European Monetary System, and the Determination of the DM-Dollar Exchange Rate"; *Cahiers Economiques de Bruxelles*; No. 123; pp. 329 - 343.
- Berg, C.** (1993); "Demand for Money (M3) - an Analysis with new statistical Methods"; Sveriges Riksbank: *Monetary Policy Indicators*; pp. 77 - 84.
- Beyer, A.** (1994); "Die Geldmenge M3 in Deutschland: Geldnachfrage und Geldmengensteuerung - eine ökonometrische Studie"; Johann-Wolfgang-Goethe-Universität, Frankfurt/M.; *Geld-Währung-Kapitalmarkt WP*; No. 33 (see also "Modelling money demand in Germany", working paper, University of Southampton).
- Biefang-Frisancho Mariscal, I., Trautwein, H.M., Howells, P., Arestis, P. and Hagemann, H.** (1995); "Financial Innovation and the long-run Demand for Money in the United Kingdom and in West Germany"; *Weltwirtschaftliches Archiv*; 131(2); pp. 302 - 325.
- Bomhoff, E.J.** (1991); "Stability of Velocity in the major Industrial Countries - A Kalman Filter Approach"; *IMF Staff Papers*; 38(3); pp. 626 - 642.
- Bordes, Ch. and Strauss-Kahn, M.-O.** (1989); "Coïntegration et Demande de Monnaie en France"; *Cahiers Économiques et Monétaires*; No. 34; pp. 161 - 197.
- Boughton, J.M.** (1991); "Long-Run Money Demand in large Industrial Countries"; *IMF Staff Papers*; 38(1); pp. 1 - 32.
- Breedon, F.J. and Fisher, P.G.** (1993); "M0: Causes and Consequences"; *Bank of England: Working Paper Series*; No. 20.
- Cabrero, A., Escrivá, J.-L. and Sastre, T.** (1993); "Demand Equations of the new Monetary Aggregates", *Banco de España; Estudios Económicos*; No. 52.
- Cassard, M., Lane, T. and Masson, P.** (1994) "ERM Money Supplies and the Transition to EMU"; *IMF Working Paper*; No. 94/1.
- Chow, G.C.** (1993); "A two-step Procedure for estimating linear simultaneous Equations with Unit Roots"; *Review of Economics and Statistics*; 75(1); pp. 107 - 111.
- Deutsche Bundesbank** (1995); "Überprüfung des Geldmengenziels und Neuordnung der Mindestreserve"; *Monatsberichte der Deutschen Bundesbank*; July; pp. 19 - 37.

**Divisia** (1925); "L'indice monétaire et la théorie de la monnaie"; *Revue d'Economie Politique*; 39; pp. 842-861.

**Dolado, J.J. and Escrivá, J.-L.** (1991); "The Demand for Money in Spain: broad Definitions of Liquidity"; *Banco de España; Documento de Trabajo*; No. 9107.

**EMI** (1996); *Annual Report*.

**Engle, R.F. and Granger, C.W.J.** (1987); "Co-integration and Error Correction: Representation, Estimation and Testing"; *Econometrica*; 55; pp. 251 - 276.

**Falk, M. and Funke, N.** (1995); "The stability of money demand in Germany and in the EMS: Impact of German unification"; *Weltwirtschaftliches Archiv*; 131(3); pp. 470 - 488.

**Fase, M.M.G.** (1993); "The Stability of the Demand for Money in the G7 and the EC Countries: a Survey"; *De Nederlandsche Bank; Econometric Research and Special Studies Department Research Memorandum*; 9321.

**Fase, M.M.G.** (1996); "Divisia aggregates and the demand for money in core EMU"; *De Nederlandsche Bank; Staff Report*; No. 5.

**Fase, M.M.G. and Winder, C.C.A.** (1990); "The Demand for Money in the Netherlands Revisited"; *De Economist*; 138(3); pp. 277-301.

**Fase, M.M.G. and Winder, C.C.A.** (1993); "The Demand for Money in the Netherlands and the other EU Countries"; *De Economist*; 141(4); pp. 471 - 496.

**Fase, M.M.G. and Winder, C.C.A.** (1994); "Money Demand within EMU. An Analysis with the Divisia Measure"; *De Nederlandsche Bank; Quarterly Bulletin*; September; pp. 25-55.

**Fase, M.M.G. and Winder, C.C.A.** (1996); "Wealth and the demand for money: empirical evidence for the Netherlands and Belgium"; *De Nederlandsche Bank; Staff Report*; No. 3.

**Feldstein, M. and Stock, J.H.** (1994); "Measuring Money Growth when Financial Markets are changing"; *NBER Working Paper Series*; No. 4888.

**Filosa, R.** (1995); "Money Demand Stability and Currency Substitution in six European Countries (1980-1992)"; *BIS Working Paper*; No. 30.

- Fisher, P., Hudson, S. and Pradham, M.** (1993); "Divisia Indices for Money: An Appraisal of Theory and Practice"; *Bank of England; Working Paper Series*; No. 9.
- Fisher, P.G. and Vega, J.L.** (1993); "An Empirical Analysis of M4 in the United Kingdom" *Bank of England; Working Paper Series*; No. 21.
- Friedman, M.** (1956); "The Quantity Theory of Money, A Restatement"; *Studied in the Quantity Theory of Money*; Chicago University Press; pp. 3-21.
- Gerdesmeier, D.** (1996); "The role of wealth in money demand"; *Deutsche Bundesbank; Discussion Paper*; No. 96/5.
- Gerlach, S.** (1994); "German Unification and the Demand for German M3"; *Bank for International Settlements*; Basle; WP No. 21.
- Glück, H.** (1987); "Neuere Entwicklungen bei der Schätzung von Geldnachfragefunktionen ("Latest Developments concerning the Evaluation of Money Demand Functions"); *Quartalshefte der GZ I-II/87*; 22. Jg.
- Goldfeld, S.M. and Sichel, D.E.** (1990); "The Demand for Money"; *Handbook of Monetary Economics* (Friedman, Benjamin M. and Hahn, Frank H. eds.); North Holland; Volume I, Chapter 8.
- Goldfeld, S.M.** (1989); "Demand for Money: Empirical Studies"; in *The New Palgrave*; MacMillan.
- Grunfeld and Griliches** (1960); "Is Aggregation Necessarily Bad"; *Review of Economics and Statistics*; 42; pp. 1-13.
- Gupta, K.L. and Moazzami, B.** (1990); "Nominal vs. Real Adjustment in Demand for Money Functions"; *Applied Economics*; Vol. 22, No. 1, pp. 12-20.
- Gürney and In't Veld** (1991); "Monetary Control in a European Monetary Union"; *working paper, NIESR*, London.
- Hagen, J. von and Neumann, M.J.M.** (1988); "Instability versus Dynamics: A Study in West German Demand for Money"; *Journal of Macroeconomics*; 10 (3); pp. 327 - 349.
- Hagen, J. von** (1993); "Monetary Union, Money Demand and Money Supply"; *European Economic Review*; 37; pp. 803 - 836.

**Hall, S.G., Henry, S.G.B. and Wilcox, J.B.** (1989); "The long-run Determination of the UK Monetary Aggregates"; *Bank of England, Discussion Papers*; No. 41.

**Hallmann, J.J., Porter, R.D. and Small, D.H.** (1991); "Is the Price Level tied to the M2 Aggregate in the long run?"; *American Economic Review*; 81; pp. 841 - 858.

**Hansen, G. and Jeong-Ryeol, K.** (1994); "The Stability of German Money Demand"; *University of Kiel, Institute for Statistics and Econometrics* (also *Weltwirtschaftliches Archiv*; 131(2); pp. 286 - 301).

**Hansen, N.L.H.** (1996); "Money Demand in Denmark"; *Danmarks Nationalbank Monetary Review*; August; pp. 54-69.

**Hassler, U.** (1996); "(When) should cointegrating regressions be detrended? The case of a German money demand function"; *Freie Universität Berlin, Diskussionsbeitrag des Fachbereichs Wirtschaftswissenschaft*; No. 1996/25.

**Hendry, D.F. and Ericsson, N.R.** (1991); "Modelling the Demand for narrow Money in the United Kingdom and the United States"; *European Economic Review*; 35; pp. 833 - 886.

**Hendry, D.F. and Mizon, G.** (1992); "Evaluating Dynamic Models by encompassing the VAR"; *Models, Methods, and Applications of Econometrics* (Phillips, P.C.B., ed.); Basil Blackwell; Oxford.

**Henry, J. and Sicsic, P.** (1994); "Breaking Trends, Financial Innovation and the Velocity of French Money Aggregates"; *Banque de France*.

**Henry, J. and Weidmann, J.** (1995); "German Unification and Asymmetry in the ERM"; *IMF Staff Papers*; 42 (4); pp. 894 - 902.

**Herz, B. and Röger, W.** (1990); "Evaluating conflicting Stability Results in German Money Demand"; *Weltwirtschaftliches Archiv*, 126; pp. 691-708.

**Hoffman, D.L., Rasche, R.H., and Tieslau, M. A.** (1995); "The Stability of Long-Run Money Demand in Five Industrial Countries"; *Journal of Monetary Economics*; 35; pp. 317 - 339.

**Hurley, M. and Guiomard, C.** (1989); "Determinants of Money Demand in Ireland 1970 to 1988: rounding-up the usual Suspects"; *Central Bank of Ireland, Research and Publications Department*.

**Ireland, P.N.** (1995); "Endogenous Financial Innovation and the Demand for Money"; *Journal of Money, Credit, and Banking*; 27(1); pp. 107 - 123.

- Jeanfils, P.** (1994); "Agrégats Monétaires, Cointégration et Stabilité: le Cas belge ("Monetary Aggregates, Cointegration and Stability: the Belgian Case")"; *Banque Nationale de Belgique, "Extraits des Cahiers Economiques de Bruxelles"*; No. 142 (2ème trimestre); pp. 153 - 200.
- Johansen, S. and Juselius, K.** (1990); "The Full Information Maximum Likelihood Procedure for Inference on Cointegration - With Application"; *Oxford Bulletin of Economics and Statistics*; 52 (2); pp. 169 - 210.
- Johansen, S.** (1991); "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models"; *Econometrica*; 59; pp. 1551 - 1580.
- Johansen, S.** (1992); "Cointegration in Partial Systems and the Efficiency of Single Equation Analysis"; *Journal of Econometrics*; 52 (3); pp. 389 - 402.
- Karfakis, Costas I.** (1991); "Monetary Policy and the Velocity of Money in Greece: a Cointegration Approach"; *Applied Financial Economics*; 1; pp. 123 - 127.
- Kole, L.S. and Meade, E.E.** (1994); "Searching for the Holy Grail: an Examination of German Money Demand after Unification"; *Federal Reserve Bank; U.S.A.* (see also *Federal Reserve Bulletin*, 81 (10), pp. 917 - 931).
- Kremers, J.J.M. and Lane, T.D.** (1990); "Economic and Monetary Integration and the Aggregate Demand for Money in the EMS"; *IMF Staff Papers*; 37 (4); pp. 777 - 805.
- La Cour, L. F.** (1993); "Divisia Monetary Aggregates for Denmark: Theory, Construction and empirical Performance"; *Økonomisk Institut; Københavns Universitet; Rød Serie*; No. 29.
- Lütkepohl, H., Teräsvirta, T. and Wolters, J.** (1995); "Investigating Stability and Linearity of a German M1 Money Demand Function"; *Humboldt-Universität zu Berlin, Discussion Paper*; No. 57.
- Lütkepohl, H., Teräsvirta, T. and Wolters, J.** (1996); "Modelling the Demand for M3 in the Unified Germany"; *Humboldt-Universität zu Berlin, Discussion Paper*; No. 24.
- Marlor, F.** (1993); "Money and Credit Aggregates as Indicators for Monetary Policy", *Sveriges Riksbank; Financial Markets Department*.
- Marques, C.R. and Lopes, M.C.** (1992); "Choosing an Aggregate for Monetary Policy: a Cointegration Approach"; *Banco de Portugal*.

**Melnick, R.** (1995); "Financial Services, Cointegration, and the Demand for Money in Israel"; *Journal of Money, Credit, and Banking*; 27(1); pp. 141 - 153.

**Miller, M.H. and Orr, Daniel** (1966); "A Model of the Demand for Money by Firms"; *Quarterly Journal of Economics*; LXXX: pp. 413 - 435.

**Monticelli, C. and Strauss-Kahn, M.-O.** (1992); "European Integration and the Demand for Broad Money"; Bank for International Settlements; Basle; *BIS Working Papers*; No. 18.

**Monticelli, C.** (1993); "All the Money in Europe? - An Investigation of the Economic Properties of EC-wide extended Monetary Aggregates"; *BIS Working Paper*; No. 19.

**Monticelli, C. and Papi, L.** (1996); "European integration, monetary co-ordination and the demand for money"; *Clarendon Press*, Oxford.

**Muscatelli, V. and Papi, L.** (1989); "Cointegration, Financial Innovation, and Modelling - The Demand for Money in Italy"; *University of Glasgow; Discussion Papers in Economics*; No. 8910.

**Phillips, P.C.B. and Hansen, B.E.** (1990); "Statistical Inference in Instrumental Variables Regression with I (1) Processes"; *Review of Economic Studies*; 57; pp. 99 - 125.

**Phillips, P. and Loretan, M.** (1991); "Estimating long-run Equilibria"; *Review of Economic Studies*; Vol. 58; No. 3; pp. 407 - 436.

**Pösö, M.** (1995); "The Demand for Money in Finland: The Long Run and the Short Run"; *unpublished Msc dissertation, University of Tampere*.

**Psaradakis, Z.** (1993); "The Demand for Money in Greece: an Exercise in econometric Modelling with cointegrated Variables"; *Oxford Bulletin of Economics and Statistics*; Vol. 35; No. 2; pp. 215 - 236.

**Rotemberg, J.J., Driscoll, J.C. and Poterba, J.M.** (1991); "Money, Output and Prices: Evidence from a new Monetary Aggregate"; *National Bureau of Economic Research Working Paper*; No. 3824.

**Rinaldi, R., and Tedeschi, R.** (1996); "Money Demand in Italy: A System Approach"; *Banca d'Italia; Temi di Discussione*; No. 267.

**Ripatti, A.** (1994); "Econometric Modelling of the Demand for Money in Finland"; *Bank of Finland*; D. 79.

**Ripatti, A.** (1996); "Stability of the Demand for M1 and Harmonised M3 in Finland"; *Bank of Finland*.

**Sardelis, C.** (1993); "Targeting a European Monetary Aggregate - Review and Current Issues"; *Economic Papers, Commission of the European Communities, Directorate-General for Economic and Financial Affairs*; No. 102.

**Schebeck, F. and Thury, G.** (1987); "Dynamic Specification of the Demand for Money in Austria"; *Empirica*; 1/1987.

**Sharma, S.** (1994); "Money Demand in Greece"; *IMF*; SM/94/173.

**Tobin, J.** (1956); "The Interest Elasticity of Transactions Demand for Cash"; *Review of Economics and Statistics*; 38: pp. 241 -247.

**Tödter, K.-H.** (1994); "Eine transaktionsorientierte Geldmenge ("A transactions-oriented money aggregate")"; *Kredit und Kapital*; Vol. 27; 3rd issue; pp. 319 - 347.

**Tödter, K.-H. and Reimers, H.-E.** (1994); "P-star as a Link between Money and Prices in Germany"; *Weltwirtschaftliches Archiv*, 130(2); pp. 273 - 289.

**Van Riet, A.G.** (1992); "Studies of EC Money Demand, Survey and Assessment"; *De Nederlandsche Bank Quarterly Bulletin*; March; pp. 63-77.

**Vega, J.L.** (1994); "Is the ALP long-run Demand Function stable?"; *Banco de España, Servicio de Estudios, Documento de Trabajo*; No. 9422.

**Wesche, K.** (1994); "Aggregierte Geldnachfrage in Europa - Eine empirische Untersuchung der Geldmenge M1"; IIW; *Universität Bonn; SFB Discussion Paper*; No. B-269.

**Wesche, K.** (1996); "The stability of European money demand: An investigation of M3H", *Konstanz Seminar on Monetary Theory and Monetary Policy*.

## **European Monetary Institute Staff Paper Series**

*Publication date in italics*

- |   |   |                          |
|---|---|--------------------------|
| 1 | An analysis of sectoral balances in EU countries<br><i>(May 1996)</i>   | N O Kennedy              |
| 2 | Empirical assessment of monetary policy instruments<br>and procedures (MPIP) in EU countries<br><i>(May 1996)</i>       | J L Escrivá<br>G P Fagan |
| 3 | Open market operations in EU countries<br><i>(May 1996)</i>   | A Aspetsberger           |
| 4 | The Role of Short Rates and Foreign Long Rates in the<br>Determination of Long-Term Interest Rates<br><i>(May 1996)</i> | J P C Fell               |
| 5 | Public Pensions, Pension Reform and Fiscal Policy<br><i>(March 1997)</i>  | E P Davis                |
| 6 | Issues in the ECU markets and some tentative explanations<br>for some apparent puzzles<br><i>(March 1997)</i>           | J P C Fell<br>A Levy     |