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ALL THE MONEY IN EUROPE?

An investigation of the economic properties of EC-wide extended monetary aggregates

by

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All the money in Europe?

An investigation of the economic properties of EC-wide extended monetary aggregates

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This paper explores the economic properties of several EC-wide monetary aggregates which are extended to include different measures of cross-border holdings (CBHs). The EC-wide aggregate obtained by simply adding national definitions of broad money is used as a benchmark, since econometric analysis confirms previous findings that it can play a useful role in the coordination of monetary policy at the European level. Cointegration analysis and error-correction modelling in fact show that the demand for it is stable and predictable, with a statistical performance which compares most favourably with national equations. And Granger-causality tests, conducted in both bivariate and multivariate settings for a wide range of specifications, indicate that it has predictive value for both nominal and real Community income.

Aggregates including CBHs perform differently according to the definition. "Very broad" measures (which include EC-residents' CBHs kept outside the EC or non-EC-residents' CBHs kept within the EC but denominated in non-EC currencies) are poorly linked with EC-wide income, since they do not pass cointegration tests and do not Granger-cause Community income. In contrast, extended definitions "focused on the EC" (which hinge on the inclusion of CBHs denominated in EC-currencies and/or kept within the EC) are shown to possess the economic properties necessary for money measures to be useful for monetary policy and economic analysis. Although such extended aggregates do not yet outperform the traditional measure of EC-wide broad money, the results suggest that they may shortly become an increasingly important tool for monetary analysis at the EC level.

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Table of Contents

Tables and Figures

Tables

Figures

Introduction

The investigation of the properties of money demand functions defined for a group of EC countries as a whole is one of the novel strands in the empirical research on the demand for money. Following the path-breaking work of Bekx and Tullio (1989) and Kremers and Lane (1990), a number of authors - surveyed in detail by van Riet (1992, 1993) - have estimated area-wide money demand equations for different definitions of the money stock and for different groups of EC countries. The interest in this approach and the significance of the encouraging results so far obtained stem from two arguments.

Firstly, the estimation of area-wide equations may be regarded as an effective technical device to overcome, at least in part, the problems encountered in the specification of stable and well-performing national money demand functions for several EC countries (see the surveys by Boughton, 1991; Monticelli and Strauss-Kahn, 1992). Single-country equations typically omit foreign variables, partly as a consequence of the high degree of correlation between European interest rates and partly as a result of the difficulties in identifying the variables of interest. In contrast, the increasing degree of economic and financial integration within the EC has been associated with an intensification of international portfolio diversification and with growing currency substitution. These developments call for a re-examination of the role of foreign variables on the residents' demand for monetary assets. Cross-country spillover effects can be captured in a simple way by aggregating money demand equations across countries which have strong economic and financial interlinkages. The specification bias affecting traditional single-country equations is thus reduced, although an aggregation bias may be introduced in the area-wide equation to the extent that there are different money demand relationships in the different countries in the group (Pesaran *et al.,* 1989; Kremers and Lane, 1992a). Recent evidence shows that an area-wide money demand performs at least as well as the best national equations, suggesting that the aggregation bias is relatively small and that the degree of integration within the EC is already sufficient to warrant the existence of area-wide money demands which possess desirable properties in terms of stability and predictability.

Secondly, the analysis of the demand for money for the EC-area as a whole has important implications for the conduct of monetary policy both during the transition to Economic and Monetary Union (EMU) - when national monetary policies will be co-ordinated through the European Monetary Institute - and in Stage Three of EMU, when a single policy will be managed by the European System of Central Banks. In Stage Three, monetary policy will be set on the basis of area-wide monetary and thus the

study of money demand equations aggregated across countries provides a useful analytical tool to assist policy implementation in the early days of EMU.[1] During the transition, the progress of economic and financial integration, the increase of international portfolio diversification and the intensification of phenomena of currency substitution might increase the volatility of single-country money demands, impairing further the controllability of the money stock at the national level. Conversely, the money demand for the area as a whole could become significantly more stable than in any individual country and monetary policy could be effectively implemented only at the Community level with reference to area-wide monetary relationships.[2] Moreover, even if the money demand remains stable in some EC countries, a well-performing money demand at the area level can provide a valuable benchmark for the co-ordination of national monetary policies, since it implies that EC-wide monetary aggregates contain useful information about the economic conditions and the monetary stance of the Community as a whole.

The purpose of this paper is to provide new empirical evidence on the economic properties of EC-wide monetary aggregates focusing on one aspect so far unexplored: the role of cross-border holdings (CBHs). CBHs considered here consist of the monetary assets of the private non-financial sector held with financial intermediaries located in countries other than those in which the holders are resident. European CBHs have been growing rapidly in recent years, becoming an increasingly important aspect of the developments in the financial and monetary sphere. Preliminary analysis at the country level has obtained promising results, pointing to the potential improvements in the definition of national monetary aggregates obtainable by including CBHs (Angeloni *et al.,* 1991; Giucca and Levy, 1992). Furthermore, the inclusion of (some) CBHs in an EC-wide broad monetary aggregate seems warranted on the grounds of logical consistency: French residents' Deutsche Mark deposits in German banks, say, should be part of the measure of the European money stock since they are held in Europe by European residents and are denominated in a European currency. Yet, the empirical

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1 Two caveats are, however, in order. First, the move to a single monetary policy will be such an important structural change that it might have devastating consequences on the stability of money demand equations. Secondly, the uncertainty surrounding which countries will participate in EMU from the outset implies that studies of area-wide economic relationships should consider different groups of countries. Other issues concerning the conduct of monetary policy in Stage Three of EMU are discussed in Monticelli and Viñals (1993).

2 The use of an area-wide monetary instrument to implement monetary policy would *ipso facto* entail the move to a more symmetrical arrangement in the coordination of national monetary policies (Russo and Tullio, 1988). Indeed, with an area-wide monetary instrument and nominal exchange rate stability, real shocks, even of an asymmetric origin, would hit countries of similar size with similar intensity (Monticelli, 1993).

analysis of area-wide money demands for groups of EC countries has so far neglected CBHs, since it has relied on area-wide measures of money obtained from the sum of national aggregates, thereby underestimating the European money stock. On the other hand, there seems to be little reason a priori why Arab sheikhs' dollar deposits in London, as opposed to those held in the Cayman Islands, should be linked with developments in output and prices in the Community. Hence, the empirical question *whether* the inclusion of CBHs can improve the usefulness of an area-wide monetary aggregate for policy purposes has to be addressed in terms of *which* CBHs may potentially be considered a part of an EC-wide measure of money.

The paper is organised as follows. Section 1 considers the preliminary issues relating to the definition of area-wide variables. In particular, the general criteria underlying the specification of area-wide monetary aggregates extended to include CBHs are discussed, leading to six different extended measures of broad money. The economic properties of these aggregates are then explored in the subsequent Sections, using as a benchmark the results from the analysis of the traditional EC-wide measure, i.e. the aggregate obtained from the sum of national broad monetary definitions. In order to enhance the robustness of the assessment, the empirical research on traditional and extended EC-wide measures is based on various techniques. Section 2 is devoted to cointegration analysis to investigate the stability of the money demand equations. In Section 3, error-correction models are estimated to evaluate the properties of the shorter-run dynamics of monetary relationships. In Section 4, Granger-causality tests are performed to assess the predictive content of the different monetary aggregates. Section 5 presents the conclusions.

1. Traditional and extended money measures

1.1 The criteria underpinning money measures

The operational definition of measures of the money stock involves two general issues. The first regards the identification of the range of assets which possess the characteristics (such as the use as a means of payment, liquidity, short maturity) considered as "money". The guidance provided by economic theory on this matter is vague and rather controversial (see Osborne, 1984). Thus, the issue is settled in a pragmatic way: different monetary aggregates with a varying breadth of coverage are typically constructed in each country and their definitions are from time to time revised to accommodate the introduction of new financial instruments or changes in the

characteristics of traditional instruments.[3] An analysis of the asset composition of monetary aggregates lies beyond the scope of this paper. However, it has to be kept in mind that the asset composition of national measures of money and of the aggregates extended to include CBHs may not coincide exactly. Although data on CBHs exclude assets with maturities above one year, reporting institutions apply the rules of the country where they are located and such rules have not yet been fully harmonised across Community countries, let alone across wider constituencies.

The second issue relates to the application of the following three criteria, which underlie the measure of the money stock of a particular geographical area, typically (but not necessarily) a nation.

R. Residence of the holder: the aggregate should include the monetary assets held by residents in the area (irrespective of the currency of denomination and of the location of the issuer with whom the assets are held).

L. Location of the issuer: the aggregate should include the monetary assets issued by the intermediaries located in the area (irrespective of the currency of denomination and of the residence of their holders).

C. Currency of denomination: the aggregate should include the monetary assets denominated in the currency(ies) of the area (irrespective of the location of the issuers and of the residence of the holders).

At least one, but possibly more (including all), of the above criteria must be applied in order to define a monetary aggregate for the area. The resulting measures of money will however be different, unless the extent of international financial integration is so low that residents in a particular area keep all their monetary assets with intermediaries located in that area and hold only assets denominated in domestic currency.

The result of the application of these criteria at the national level can be represented by Table 1, which is adapted from Goodhart (1990). The national aggregate defined in accordance with the residence of the holder criterion will be composed of the assets represented by cells b, c, d and e; the one in accordance with the location of the issuer by cells d, e, f and g; the one in accordance with currency denomination by cells a, b, d and f. Currently, in most EC countries monetary aggregates are defined by applying more than one criterion, typically (but not always) the criteria of residence and

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[3] It may be recalled that the definition of the "money-holding" and "money-issuing" sectors also presents conceptual and practical difficulties.

location[4], which yield a measure corresponding to cells d and e. The preference granted in practice to these criteria, however, has rarely been examined by econometric analysis and is mainly the result of convenience in data collection.

Table 1: Definition of national monetary aggregates

	NRA	RA	RH	NRH
Domestic currency	a	b	d	f
Foreign currency		c	e	g

Column NRA - represents **N**on-**R**esidents' monetary assets held **A**broad denominated in domestic currency (cell a).

Column RA - represents **R**esidents' monetary assets held **A**broad whether denominated in domestic (cell b) or foreign (cell c) currency.

Column RH - represents **R**esidents' monetary assets held with **H**ome intermediaries denominated in domestic (cell d) or foreign (cell c) currency.

Column NRH - represents **N**on-**R**esidents' monetary assets held with **H**ome intermediaries denominated in domestic (cell f) or foreign (cell g) currency.

When considering area-wide measures of money, i.e. when the money stocks of different countries are aggregated, a further issue arises: the consistency between national and area-wide measures with respect to the three above criteria. Indeed, straightforwardly adding up national aggregates across countries yields a consistent area-wide measure only if one, and only one, of the three criteria is applied in each and every country. If different criteria are, jointly or singly, applied in the constituent countries, the sum of national aggregates will be inconsistent and will involve omissions and/or duplications. Conversely, if any combination of the criteria is applied in each and every country, the sum of national aggregates will systematically underestimate the area-wide measure consistently defined on the basis of the same criteria with reference to the whole area. The intuition underlying this result is simple: foreign, but 'within-the-area', variables become 'domestic' with reference to the area as a whole. Thus, for example, Deutsche Mark in France and French francs in Germany are foreign

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[4] In the UK, for example, the criterion **C.** is also applied and hence monetary aggregates (with the exception of M3H) do not include residents' monetary assets denominated in foreign currency even when they are held in the UK. Cell e is thus excluded from the measures of money, which consist of cell d only.

Table 2: Definition of EC-wide aggregates

	NO	EO	EW	EH	NW	
EC currencies	1	2	3	4	5	EC currency of the country where the bank is located
			6	7	8	Other EC currencies
Non-EC currencies		9	10	11	12	

Column NO - represents Non-EC residents' monetary holdings, denominated in EC currencies, held at intermediaries located Outside the EC.
Column EO - represents EC-residents' cross-border holdings Outside the EC.
Column EW - represents EC residents' cross-border holdings Within the EC.
Column EH - represents EC-residents' holdings with intermediaries at Home, i.e. located in their country of residence.
Column NW - represents Non-EC residents' cross-border holdings Within the EC.

Table 2 illustrates the relationship between the application of the three criteria at the national and at the EC level.[5] Thus, for example, if national aggregates are set out according to the national residence of the holder and the national location of the issuer (as is the case with the traditional broad monetary aggregates considered in this study), their sum will be equal to column EH. In contrast, the EC-measure resulting from the application at the EC-level of the same criteria includes column EW in addition (i.e. EC residents' CBHs held within the EC).

Table 2 is also useful to illustrate the definitions of the EC-wide monetary aggregates analysed in the paper. They are the following (superscripts indicate the criteria applied at the EC level to identify the CBHs included in the extended definition, with the exception of T which stands for traditional):

- M^T = Sum of traditional national broad monetary aggregates (column EH);

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[5] In order to obtain Table 2, foreign currencies, intermediaries located abroad and non-residents have to be split into EC and non-EC components for each country. This partition has the following implications for Table 1: (i) cells c, e and g are partitioned by a horizontal line to separate EC foreign currencies from non-EC foreign currencies; (ii) column NRH is divided by a vertical line to distinguish the holdings of EC non-residents from those of non-EC non-residents; (iii) column RA is split by a vertical line to differentiate residents' cross-border holdings held within the EC from those held outside the Community; and (iv) column NRA should be divided into four sub-sets resulting from the distinction EC/non-EC applied to both the residence of foreign holders and the location of intermediaries located abroad.

- M^R = M^T extended to include EC-residents' CBHs irrespective of their location and currency denomination (columns EH+EW+EO);
- M^L = M^T extended to include CBHs held within the EC irrespective of the residence of the holder and the currency denomination (columns EH+EW+NW);
- $M^{R,L}$ = M^T extended to include EC-residents' CBHs held within the EC irrespective of their currency denomination (columns EH+EW);
- $M^{R,C}$ = M^T extended to include EC-residents' CBHs denominated in EC currencies irrespective of their location (column EH+cells 2, 3, 6);
- $M^{L,C}$ = M^T extended to include CBHs held with banks located within the EC and denominated in EC currencies irrespective of the residence of the holders (columns EH+cells 3, 5, 6, 8);
- $M^{R,L,C}$= M^T extended to include EC-residents' CBHs denominated in EC currencies and held with intermediaries located in the EC (column EH+cells 3, 6).

The above list omits M^C, the aggregate extended to include CBHs denominated in EC currencies irrespective of the localisation of the intermediaries and of the residence of the holders. The omission is motivated by the prior belief that non-EC residents' CBHs held outside the EC - such as the deposits denominated in Deutsche marks which US residents hold in Hong Kong (represented by cell 1 in Table 2) - cannot realistically be expected to have a link with output and price developments within the Community.

Before moving to the empirical analysis of the role of CBHs in EC-wide monetary relationships, it has to be stressed that the factors underlying the importance of extended aggregates (independently of the definition) relative to traditional money measures are distinct from those which support the validity and usefulness of EC-wide monetary aggregation. The relevance of CBHs derives from the delocalisation of deposits, that is from the decoupling of the country of residence of the holder from the country where the intermediary issuing the liability is located. The economic rationale for the definition of area-wide aggregates is instead provided by currency substitution, international portfolio diversification, and, more in general, by the spillover effects across integrated economies which render the demand for money sensitive to changes in foreign, but "within-the-area", variables. These factors, however, need not lead to significant changes in the *location* of monetary assets even when they exert an important influence on the choice between monetary and non-monetary assets and on decisions regarding the currency composition of assets. Large shifts in the currency denomination of

monetary holdings, for example due to currency substitution, may not imply fluctuations in the size of CBHs, although they will in any case have a significant impact on the stability of the demand for money and on the controllability of the traditional monetary aggregates. When shifts in currency denomination take place, money demand is influenced by variables which are traditionally excluded from the specification and which are typically outside the control of the "domestic" central bank. For the sake of analytical simplicity, macroeconomic models usually employed to explore the implications of currency substitution (see e.g. the classic paper by Girton and Roper, 1981) implicitly identify the criterion of the location of the issuer with the criterion of currency denomination. As a result, currency substitution automatically implies deposit delocalisation. In contrast, the empirical counterpart to the theoretical notion of money is sensitive to the choice of the criteria underlying its measurement. Therefore, whereas the implications for the conduct of monetary policy derived from theoretical models holds irrespective of whether currency substitution indeed coincides with shifts of funds abroad, the consequences for the aggregates extended to include CBHs will instead be different.

1.2 The EC-wide variables

The empirical analysis includes all the countries in the EC except Greece, Luxembourg and Portugal, which were excluded because of limitations in the available data.[6] In quantitative terms, this omission is minor (the three countries account for approximately 4% of the Community's GDP) and thus the group of countries included in the research can be regarded as an accurate proxy for the whole EC.

The analysis could have focused on smaller groups of EC countries - such as the original ERM participants, the original narrow-band ERM participants or even a narrower subset of "core" countries - on the grounds of the higher degree of economic and financial integration within those particular areas. Preference was instead accorded to the entire Community for two reasons. In the first place, a wide range of economic policies are decided and implemented at the Community level (suffice to quote the Common Agricultural Policy or the Single Act) and the EMU project is ultimately addressed to the whole Community (opt-out clauses aside). Secondly, the exploration of area-wide monetary relationships for the whole EC is more challenging than for smaller subsets of closely integrated countries (say, Germany and the Benelux countries). Indeed, any empirical finding suggesting the robustness of area-wide relationships has more significance and further-reaching policy implications the wider the area for which

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[6] CBHs kept in Luxembourg are however included in the analysis.

it is obtained. Monetary analysis for different subsets of countries however remains a very promising line for future enquiries because it can provide important insights on the actual extent of international integration within different areas and on the factors underlying the performance of EC-wide or ERM-wide equations (see Artis *et al.*, 1992; Lane and Poloz, 1992). Furthermore, this research might be regarded as an indispensable analytical background to the conduct of monetary policy in the early days of Economic and Monetary Union, in the light of the uncertainty regarding the countries which will participate from the inception.

Once the group of countries has been identified, the aggregation method has to be determined. For variables expressed in the same units, such as rates and indices, the use of a weighted averaging scheme is standard, with the shares of the real income variables in the aggregate employed as weights. The selection of the method to convert quantity variables (money and income) into a common currency is more controversial, as three alternative rates have been used in the literature: (i) current exchange rates; (ii) fixed base-period exchange rates; and (iii) purchasing power parity (PPP) rates.[7] However, the theoretical underpinnings of each method have not been explored to date[8] and hence not even tentative conclusions have yet been reached on the issue.

In this paper, preference is given to the use of current exchange rates, selecting the ECU as the numeraire. This method is intuitively appealing and provides a consistent market evaluation of the stocks of financial assets across countries and currencies. Furthermore, it is in line with the notion that money balances (be they transactions or precautionary balances) are held because of their (current and future) effective purchasing power, which, in terms of foreign goods and assets, is appropriately measured by market exchange rates. Nevertheless, in order to assess the robustness of the empirical findings, the analysis is replicated employing quantity variables converted at PPP rates. While tables reporting econometric results in the text refer to aggregate variables converted at current exchange rates, Appendix I includes similar tables replicating the results for area-wide variables constructed by PPP exchange rates.

Appendix II contains a detailed description of the national variables selected for aggregation. National broad monetary aggregates form the basis of the traditional, "non-extended", area-wide measure of money M^T. Broad aggregates, rather than narrow ones, are chosen since they are currently used as targets or indicators in a majority of EC

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[7] For example, method (i) has been used in Gray *et al.*, (1976) and Gurney and In't Veld (1991); method (ii) in McKinnon (1982) and Bekx and Tullio (1989); method (iii) in Kremers and Lane (1990).

[8] For example, in the exchange between Arnold (1992) and Kremers and Lane (1992b), the way in which method (iii) should be applied is discussed in detail without clarifying *why* this particular conversion method should be used.

countries and hence they may be expected to have a greater bearing on the implementation of monetary policy, either at the national or at the area-wide level. Moreover, this selection is in line with the main thrust of the study: it would be contradictory to compare "very broad" money measures - i.e. definitions extended to include CBHs - with a narrow aggregate. The income variable Y is either real GDP or GNP, depending on availability, while the price variable is the corresponding deflator (P). Two interest rates are employed in the analysis[9]: r_S, the three-month interbank rate, which can be expected to proxy the return on the whole range of assets alternative to money, given its pivotal role for the entire term structure in many EC countries; and r_D, the interest rate on time deposits, which should provide a proxy for the return on the interest-bearing component of the money stock.

EC-wide, traditional broad money (M^T) is plotted in Figure 1, together with the CBHs represented by columns EO, EW and NW in Table 2. As the difference in the right-hand and left-hand scales shows, CBHs, no matter how defined, represent only a small proportion of the traditional measure of broad money. CBHs have however been steadily rising in the 1980s, with a sharp acceleration in recent years. Several factors account for this development: the increase in international integration which is associated with the need for larger monetary balances abroad to support real and financial transactions, as cross-border transfers are not always dependable in terms of timeliness; the lifting of restrictions on capital movements which opens the opportunity to diversify portfolios and to avoid domestic regulations, such as capital income taxation or reserve requirements; and the improvement in telecommunications which simplifies the management of funds held abroad. International integration has been particularly intense within the EC. As a result, EC-residents' CBHs within the Community have expanded very rapidly (especially since France and Italy lifted capital controls) both in absolute amount and as a proportion of total EC-residents' CBHs (Figure 2). The proportion of EC-residents' CBHs denominated in Community currencies has also risen markedly (Figure 2).

To illustrate the impact of CBHs on monetary relationships, Figure 3 depicts, in addition to the short-term interest rate, three different measures of EC-wide velocity of

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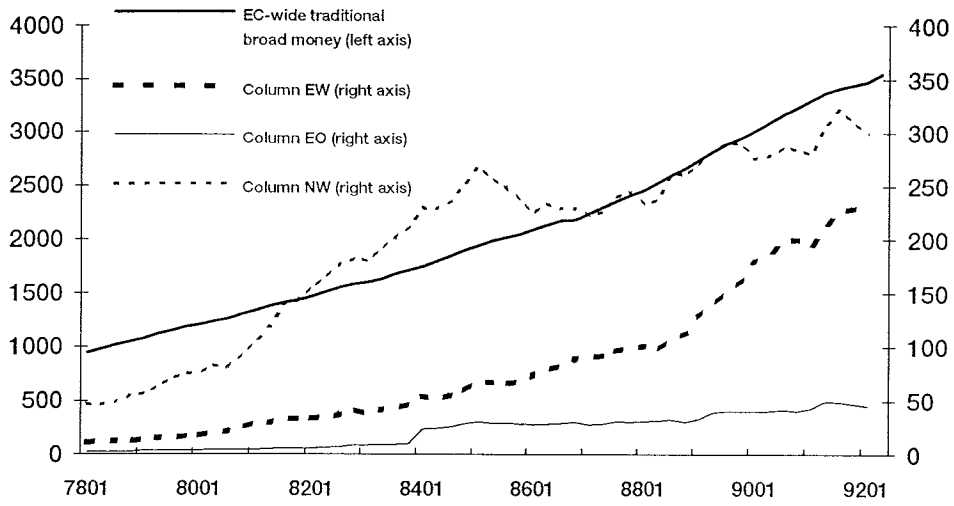
9 In preliminary estimates, a long-term interest rate (yield on government bonds) was also considered. However, when both the short and the long interest rates are included in the specification, severe multicollinearity problems arise. When the long interest rate replaces the short rate, results are qualitatively similar, although slightly inferior on the basis of the standard statistical criteria. The short-term rate has therefore been preferred throughout the analysis.

Figure 1. EC-wide broad money and cross-border holdings (ECU billions)



EW: EC-residents' cross-border holdings within the EC
EO : EC-residents' cross-border holdings outside the EC
NW: Non-EC-residents' cross-border holdings within the EC

Figure 2. Composition of EC-residents' cross-border holdings

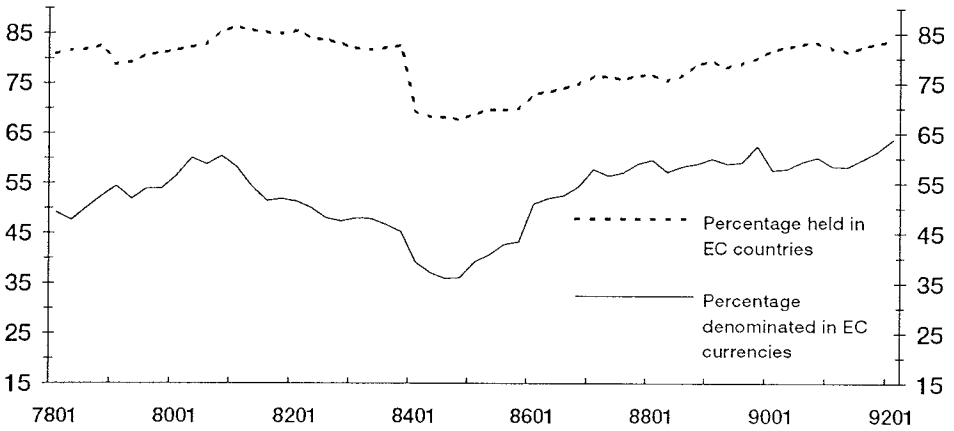
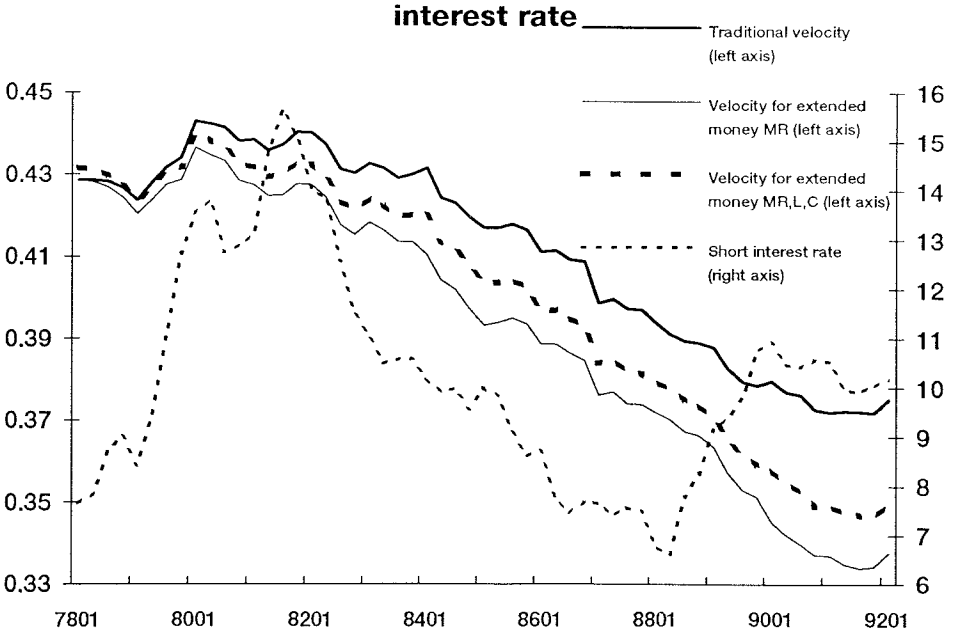


Figure 3. EC-wide velocity and short term interest rate



money: the first one for the traditional broad monetary aggregate (M^T); the second one for the aggregate extended to include EC-residents' CBHs irrespective of their location (M^R); and the third one for the aggregate including EC-residents' CBHs kept within the Community and denominated in EC currencies ($M^{R,L,C}$).

2. Cointegration analysis

2.1 Order of integration and time trends

The first step in the empirical analysis is to ascertain the order of integration of the EC-wide variables and to assess whether the series exhibit time trends. This investigation is not only the preliminary stage of cointegration analysis but is also a necessary background to the Granger-causality tests performed in Section 4, since the asymptotic distributions of the causality tests are sensitive to the trend and "unit root" characteristics of the variables, as shown by Stock and Watson (1989) and by Sims, *et. al* (1990).

Stationarity tests[10] were performed on the logarithm of the EC-wide variables[11] (denoted by lower cases of the notation presented in the previous Section), exploring the possibility that the series might have up to two unit roots and time trends up to second order. The results quite clearly support the view that all the series, both in nominal and in real terms, are non-stationary and exhibit a single unit root, i.e. differencing only once is sufficient to obtain stationary variables. As is often the case, less clear-cut results are obtained regarding the order of the deterministic components in the specification, particularly for money and income. Replicating the analysis for different sub-samples does not help to obtain a more definite picture, as the trend properties of the variables seem to vary over the sample. The results are mixed and difficult to interpret in a consistent manner, but tend to suggest that real money and output could be integrated of order one around a linear trend starting only in the mid-1980s.

Table 3 reports an illustrative sample of integration tests for a subset of variables.[12] The first two sections present three well-known integration test statistics from specifications with and without a time trend. The third section shows the *t*-statistic on

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[10] More precisely, the $t_\mu, t_\alpha, t_\beta, \Phi_1, \Phi_2, \Phi_3$ test statistics described in Dickey and Fuller (1981); their counterparts proposed by Phillips (1987) and Phillips and Perron (1988); and the q_f^τ, $q_f^{\tau^2}$ statistics put forward by Stock and Watson (1987). For a comprehensive review of stationarity tests, see Dolado *et al.* (1990) and the August 1992 issue of the *Oxford Bulletin of Economics and Statistics*.

[11] The logarithmic transformation is not applied to EC-wide interest rates since the long-run equations are specified in semi-logarithmic form.

[12] Results for the other monetary aggregates and interest rates are similar to those obtained for m^T and for r_S respectively.

Table 3: Tests for integration
(1979:1-1992:1)†

	Unit root tests							
	Drift			No drift			t-statistics for a regression of Δx on:	
Series	*DF*	*ADF*	Z_t	*DF*	*ADF*	Z_t	time	constant
Δm^T	-4.58**	-3.90*	-4.62**	-4.19**	-3.62**	-4.11**	-1.73(‡)	4.26**
$\Delta(m^T-p)$	-4.40**	-3.19‡	-4.52**	-4.01**	-2.82*	-4.11**	1.87(‡)	2.94**
Δy	-7.28**	-4.13*	-7.49**	-7.03**	-3.21*	-7.17**	1.79(‡)	.40
Δ(y+p)	-6.33**	-3.91*	-6.54**	-5.19**	-3.67**	-5.27**	-2.82**	5.38**
Δp	-4.36**	-2.48	-2.31	2.62‡	-1.97	-4.72**	-3.65**	4.30**
Δi_S	-4.28**	-4.09*	-4.47**	-4.28**	-3.85**	-4.49**	.26	-.23

† Significant at the 1%(**), 5%(*) and 10%(‡). *DF* and *ADF* denote the "Dickey Fuller" and the "Augmented Dickey Fuller" *t*-ratio statistics, respectively (Dickey and Fuller, 1981). Z_t denotes the corrected *t*-ratio statistic proposed by Phillips (1987) and Phillips and Perron (1988). Critical values for these statistics are from McKinnon (1991).

the constant and the time trend from a regression of the first difference of each series on these two regressors (plus its own lags to correct the standard errors).

On the whole, the evidence on the trend features of the variable is not conclusive, even because the power of tests for unit roots and for time trends may be low. Therefore, both cointegration and Granger-causality analysis are conducted conditionally on different assumptions regarding the presence of a time trend (either spanning the entire sample or starting in the mid-1980s) in the specification of the cointegrating vector and of the VAR system respectively.

2.2 Long-run EC-wide money demand

The investigation starts with an assessment of the long-run stability of the demand for EC-wide money: this property must be satisfied if a monetary aggregate is to be helpful in the conduct of monetary policy, independently of whether it is used as an intermediate target or as an information variable. The stability of the demand for money is explored on the basis of a simple, traditional specification for the long-run equation:

$$(m-p)_t = \alpha_0 + \alpha_1 y_t + \alpha_2 r_{S_t} \qquad (1)$$

Some researchers have recently questioned the imposition of homogeneity with respect to the price level, claiming that data often reject this restriction (see e.g. Boughton, 1991; Fase and Winder, 1992). The assumption is however retained because the theoretical arguments which underpin it seem absolutely compelling. Furthermore,

preliminary tests for some of the aggregates, omitted here for brevity, supported the validity of the restriction. In line with the earlier discussion of the trend characteristics of the variables, and as a test of the robustness of the results, a linear trend from 1986:1 to 1989:4 (denoted by *segt*)[13] is also added to the specification, either on its own or together with a time trend spanning the entire sample.

Table 4 presents the results of the long-run equations for the different definitions of EC-wide money. Inspection of the Table may begin with the first row - which refers to m^T, the traditional definition of broad money excluding CBHs - since these results can be considered as a benchmark to assess the performance of the extended aggregates. Irrespective of the insertion of time trends in the specification, test results do not reject the hypothesis that the simple trivariate model of money demand for m^T cointegrates.[14] This finding confirms the key result of Monticelli and Strauss-Kahn (1991) for a longer sample and for the new national definitions of broad money[15]: the degree of economic and financial integration within the EC is already sufficient for an area-wide demand for broad money to be stable in the long-run. Area-wide monetary aggregates stand as a valuable tool to analyse and interpret monetary developments within the Community.

The income elasticity in the model with no time trends is high (1.69), above the estimates typically obtained from national equations and rather difficult to account for on economic grounds. When the linear trends are added to the specification, the income elasticity is significantly reduced, reaching values in line with estimates exceeding unity which are found for Italy (e.g. Muscatelli and Papi, 1990), Belgium (e.g. Jeanfils, 1992), Germany (e.g. Schmid and Herrman, 1991) and France (e.g. de Bandt, 1991). The sensitivity of the income elasticity to the non-stochastic component of the specification is open to two complementary interpretations. From a statistical point of view, it stresses the importance for cointegration analysis of a thorough exploration of the trend characteristics of the variables, calling for a close examination of *deterministic* trends since they may have a profound effect on the statistical inference about *stochastic* trends (see, e.g. Perron, 1989; Sims, *et al.*, 1990). From an economic point of view, time trends may pick up the effects of other determinants of money demand which are missing in the simple trivariate model. In the second half of the 1980s, financial innovation and

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13 The period spanned by *segt* was chosen on the basis both of the hints provided by the stationarity tests and of the results in Monticelli and Strauss-Kahn (1991). Perron (1989; 1990) proposes parametric tests to identify the presence of breaks in the trend characteristics of economic series. This type of analysis, however, is beyond the scope of this paper.

14 Further support to the hypothesis of co-integration is provided by the significance of the error-correction term in the dynamic equations discussed in the next section.

15 Since 1991, new (harmonised) definitions of broad money have been introduced in Denmark, Spain, Italy and the Netherlands. Detailed information on the changes in the definitions are contained in the respective central bank *Bulletins*.

Table 4: Cointegration analysis
Basic model
(1979:1-1992:1)†

Monetary aggregates	Constant				Constant, segt				Constant, segt, t			
	Coefficients on		*Test Statistics*		*Coefficients on*		*Test Statistics*		*Coefficients on*		*Test Statistics*	
	y	r_S	*DF*	*PP*	*y*	r_S	*DF*	*PP*	*y*	r_S	*DF*	*PP*
m^T-p	1.69	-.53	-5.59**	-5.71**	1.41	-.58	-4.87**	-5.03**	1.25	-.49	-5.15*	-5.19*
m^R-p	2.02	-.62	-3.05	-3.34	2.08	-.61	-3.19	-3.51	1.51	-.29	-4.32(‡)	-4.53(‡)
m^L-p	1.87	-.85	-2.00	-2.05	2.21	-.80	-2.01	-2.07	.85	-.04	-2.82	-3.10
$m^{R,L}$-p	1.93	-.60	-3.47(‡)	-3.75	1.86	-.61	-3.30	-3.55	1.33	-.32	-4.55*	-4.69*
$m^{R,C}$-p	1.96	-.55	-3.89‡	-4.25*	1.87	-.56	-3.65	-3.97*	1.44	-.32	-4.63*	-4.81*
$m^{L,C}$-p	1.95	-.62	-3.88(‡)	-4.17*	1.89	-.63	-3.70	-3.97*	1.41	-.36	-4.90*	-5.02*
$m^{R,L,C}$-p	1.92	-.58	-3.96*	-4.29*	1.82	-.60	-3.67	-3.96*	1.38	-.35	-4.78*	-4.92*

† Significant at the 1%(**), 5%(*) and 10%(‡). *Segt* denotes a linear trend spanning the period 1986:1-1989:4 while *t* denotes a time trend over the whole sample. *DF* and *PP* denote the "Dickey Fuller" cointegration test (Dickey and Fuller, 1981) and the test statistic proposed by Phillips (1987) and Phillips and Perron (1988). The *PP* test was performed in a specification with four lags. Critical values are from McKinnon (1991).

Table 5: Cointegration analysis
Specification with the interest rate differential
(1979:1-1992:1)†

Monetary aggregates	Constant				Constant, segt				Constant, segt, t			
	Coefficients on		*Test Statistics*		*Coefficients on*		*Test Statistics*		*Coefficients on*		*Test Statistics*	
	y	$r_S - r_D$	*DF*	*PP*	*y*	$r_S - r_D$	*DF*	*PP*	*y*	$r_S - r_D$	*DF*	*PP*
m^T-p	1.73	-1.10	-5.23**	-5.34**	1.33	-1.34	-5.25**	-5.20**	1.19	-1.14	-5.21*	-5.13*
m^R-p	2.06	-1.51	-3.71	-3.90*	1.96	-1.57	-3.58	-3.72	1.49	-.89	-4.24(‡)	-4.41(‡)
m^L-p	1.92	-2.11	-2.56	-2.49	2.07	-2.02	-2.48	-2.41	.86	-.32	-2.71	-2.97
$m^{R,L}$-p	1.97	-1.39	-4.00*	-4.19*	1.75	-1.52	-3.77	-3.84	1.30	-.88	-4.61*	-4.67*
$m^{R,C}$-p	1.99	-1.27	-4.43*	-4.69**	1.77	-1.40	-4.06(‡)	-4.22(‡)	1.41	-.90	-4.64*	-4.76*
$m^{L,C}$-p	2.00	-1.41	-4.43*	-4.63*	1.79	-1.53	-4.17(‡)	-4.27(‡)	1.37	-.94	-4.98*	-5.04*
$m^{R,L,C}$-p	1.96	-1.32	-4.47*	-4.69*	1.72	-1.46	-4.15(‡)	-4.26(‡)	1.35	-.93	-4.86*	-4.92*

† Significant at the 1%(**), 5%(*) and 10%(‡). *Segt* denotes a linear trend spanning the period 1986:1-1989:4 while *t* denotes a time trend over the whole sample. *DF* and *PP* denote the "Dickey Fuller" cointegration test (Dickey and Fuller, 1981) and the test statistic proposed by Phillips (1987) and Phillips and Perron (1988). The *PP* test was performed in a specification with four lags. Critical values are from McKinnon (1991).

deregulation accelerated, both raising the liquidity of and increasing the returns on the interest-bearing assets included in broad aggregates. These assets have thus become more attractive instruments in the portfolio allocation of wealth, leading to the steady decline in velocity which is shown in Figure 3. Trends are certainly ad hoc regressors to capture the effects of these developments and ideally economic variables should be used instead such as proxies for the intensity of financial innovation and measures of real and financial wealth, which for example is an essential ingredient of the demand for broad money in the UK (Hall *et al.,* 1990). Unfortunately, data limitations for several EC countries do not allow any improvement in this direction in the specification of the area-wide model. However, it is reassuring that the time trends, besides their statistical justification, may be given a reasonable economic interpretation in terms of the structural developments in the financial field which took place in the sample period.

The estimates of the interest rate semi-elasticity of the demand for m^T are stable across specifications. They lie rather on the low side, presumably as a consequence of the significant and rising proportion of interest-bearing assets included in broad money. This argument provides the motivation for an alternative specification of the model which is presented later in this Section.

Turning to the definitions of money extended for CBHs, the second and the third rows of Table 4 show that the demand for aggregates which include "broad" measures of CBHs (i.e. measures based on the application of one defining criterion only, see the description of m^R and m^L in page 7) fails to cointegrate. This finding is not surprising when it is recalled that these monetary aggregates include some assets which could hardly be expected to have a direct link with spending decisions within the EC. m^R in fact contains EC residents' CBHs located outside Europe, possibly in off-shore financial centres, and denominated in non-EC currencies. Delocalisation of deposits outside the EC presumably involves higher transaction costs and is more closely connected with the avoidance of domestic regulations than delocalisation within the Community, while the denomination in non-EC currencies exposes the holder to a particularly intense exchange risk. These considerations suggest that the absence of a stable money demand for this aggregate is plausible from an economic viewpoint and indicate that only an explicit analysis of portfolio allocation can provide insights on the factors underlying the demand for CBHs.[16] Similar reasons account for the lack of cointegration for m^L. The latter aggregate includes non-EC residents' CBHs kept with intermediaries located in European financial centres - such as London or Luxembourg - which can be expected

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[16] Alworth and Andresen (1992) provide a stimulating analysis of the determinants of the demand for CBHs which focuses in particular on the choice of the location for funds held abroad.

to attract funds from outside the Community more in relation to the financial services they provide than as a result of the developments in EC-wide aggregate income.

Cointegration instead holds for the other extended aggregates, which include the narrower measures of CBHs based on the joint application of two (or three) defining criteria. Test statistics for cointegration have however lower significance than for the traditional definition of broad money, suggesting that, even though cointegration holds, the EC-wide link between aggregates extended for CBHs, output and the interest rate may be less strong and dependable than for the money measure which exclude CBHs. Irrespective of the presence of time trends in the specification, the income elasticity of the demand for extended aggregates is systematically higher than for the traditional definition of broad money. This finding hints at the fact that portfolio considerations play a more important role than transactions motives in the demand for CBHs, no matter which definition is considered. The pattern of interest rate semi-elasticities is instead more variable across extended aggregates and turns out to be quite sensitive to the presence of trends. Both the long-run coefficients and the values of cointegration tests are however quite similar for the extended aggregates defined by applying the residence criterion jointly with (one of) the other two criteria (i.e. $m^{R,L}$; $m^{R,C}$; and $m^{R,L,C}$). This result stems from the fact that, as suggested by Figure 2, EC-residents have increasingly tended to place the CBHs they keep within the Community in EC currencies. Therefore, combinations of these criteria yield measures of CBHs which have approximately the same size and which possess similar economic properties. In contrast, the results obtained for $m^{L,C}$ are markedly different from those for m^{L}, providing evidence to support the view that non-EC residents' CBHs denominated in non-EC currencies, although kept with financial intermediaries located in the EC, (these CBHs account for a large part of the difference between m^{L} and $m^{L,C}$) are not linked with spending decisions within the Community.

As already noted, one of the most significant aspects of the recent process of financial innovation and deregulation is the increase in the proportion of monetary assets which bear interest. Moreover, there has also been a strengthening of the link between such a return and the interest rate conditions prevailing in the wholesale money market. These developments have weakened the validity of one of the assumptions underlying equation (1), namely the hypothesis that monetary assets are non-interest bearing. In an effort to overcome this limitation, the interest regressor r_S has been replaced by $r_S - r_D$, that is by the difference between the three-month interbank rate and

the return on time deposits.[17] The latter, however, cannot be expected to be a particularly good proxy either for the marginal return on the EC-wide monetary aggregates (as other more sophisticated instruments provide higher yields which are more responsive to market conditions) or for the average return (as the proportion of interest-bearing assets included in the national definitions of money varies widely across EC countries). The average rate on time deposits of r_D is likely to be even less representative of the own return on money for the extended aggregates including CBHs, as their return, both marginal and average, can be expected to differ from the return on national money measures. Nevertheless, in the absence of any statistical information on the interest paid on CBHs and of uniform, comparable series for the own return on national definitions of money, no significant improvement over r_D seems possible at present without embarking on specific research in the field.

The results from the model with the interest rate differential, which are shown in Table 5, are on the whole very encouraging and indicate that the more accurate measurement of the own return on EC-wide monetary aggregates is a promising area for further research on the monetary relationships at the EC level. The cointegration results for the different definitions of EC-wide money confirm the evidence obtained from the basic model, but the estimates of the long-run parameters are closer to the values which could be expected on the basis of economic priors. Income elasticities tend to be lower (except for the specification which does not include any time trend) and, more importantly, interest rate semi-elasticities are significantly higher. A note of caution however emerges from the increased sensitivity of the interest rate coefficients to the presence of time trends in the model. This feature, which is far milder in the case of the traditional definition m^T, emphasises the limitations of r_D as a proxy for the own return on money, especially in relation to extended measures which include CBHs.

3. Dynamic money demand equations

The estimation of dynamic models of money demand complements the empirical analysis of the long-run equations in two respects. Firstly, the evaluation of the performance of dynamic equations is a crucial test to ascertain whether monetary relationships are sufficiently stable and predictable for developments in money to provide useful guidance in the conduct of monetary policy. Secondly, from a statistical point of view, the estimation of error-correction models provides a test on the robustness of the conclusions from cointegration analysis. Not only does the Granger Representation Theorem - which states that the cointegrated series can be represented

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[17] The insertion of the differential is preferred to the inclusion of the two rates separately in order to overcome the multicollinearity problems which were encountered in preliminary estimations.

by error-correction models (Granger, 1983; Engle and Granger, 1987) - establish the fundamental rationale to cross-check the empirical results from the two approaches, but more recently Kremers *et al.* (1992) have argued that the standard *t*-ratio for the coefficient on the error-correction regressor in the dynamic equation is a more powerful test for cointegration than other more commonly applied methods, such as the Dickey-Fuller test.

The estimation of the error-correction models follows both the single-stage approach - which leaves the long-run coefficients of money demand unconstrained - and the two-stage approach, which employs the lagged cointegrating residual to represent the feedback towards the long-run equilibrium and thus imposes the long-run coefficients obtained from the static regression. However, the two procedures yield virtually identical results and the appropriate *F*-test (denoted *Equality test* in the presentation of the results) never rejects the joint hypothesis that the estimates of the long-run coefficients of the money demand obtained from the single-stage unconstrained equation are equal to coefficients obtained from the cointegrating equation (1). Hence, for the sake of brevity, results from the single-stage approach are not reported.

The specification search used Hendry's general-to-specific modelling strategy to arrive at the following dynamic equation for the traditional definition of broad money. The equation was subject to a set of misspecification tests (for a description, see Hendry, 1989) which are reported directly under the regression together with the sample period, the adjusted R^2 and the estimated standard error of the equation. $ECMT_{-1}$ denotes the lagged residual from the cointegrating regression which includes both time trends. The restrictions imposed on the coefficients of the dynamic specification were tested and could not be rejected at the 10% level.

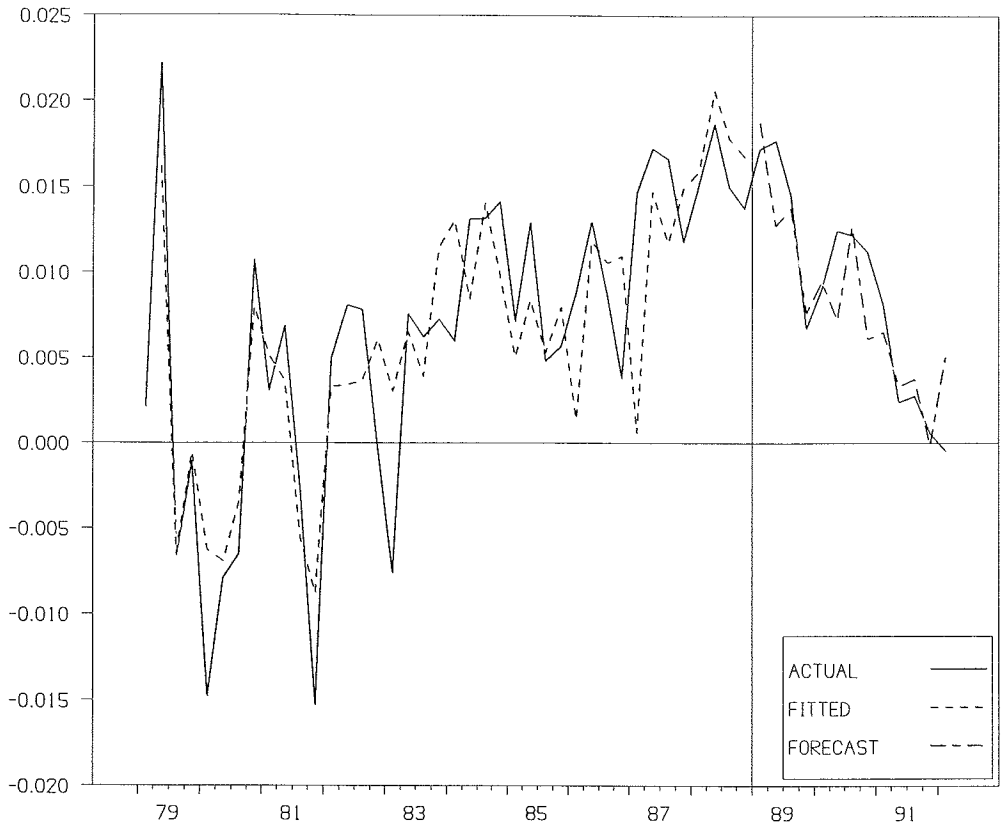
$$\begin{aligned}\Delta(m^T-p)_t = {} & \underset{(0.53)}{0.001} + \underset{(5.05)}{0.321}\left(\Delta(m^T-p)_{t-1}+\Delta(m^T-p)_{t-2}\right) + \underset{(6.39)}{0.668}\,\Delta y_t \\ & \underset{(-1.96)}{-0.232}\,\Delta y_{t-1} - \underset{(-3.24)}{0.193}\left(\Delta r_{S_t}+\Delta r_{S_{t-1}}\right) - \underset{(-5.29)}{0.552}\,ECMT_{-1} \qquad (2)\end{aligned}$$

$T = 1979{:}2\text{-}1992{:}1$	$AR(1)_1^1 = 0.01$	$ARCH(4,38) = 0.31$
$\overline{R}^2 = 0.716$	$AR(4)_1^4 = 1.93$	$CHOW(9,37) = 0.36$
$S.E.\,percent = 0.468$	$NORM(2) = 0.71$	$CHOW(17,29) = 0.30$
$DW = 1.94$	$HET(10,35) = 1.79$	$RESET(3,43) = 2.30$

The statistical performance of this equation is very satisfactory. It passes the diagnostic tests and tracks real money growth well (see Figure 4a). Its stability is

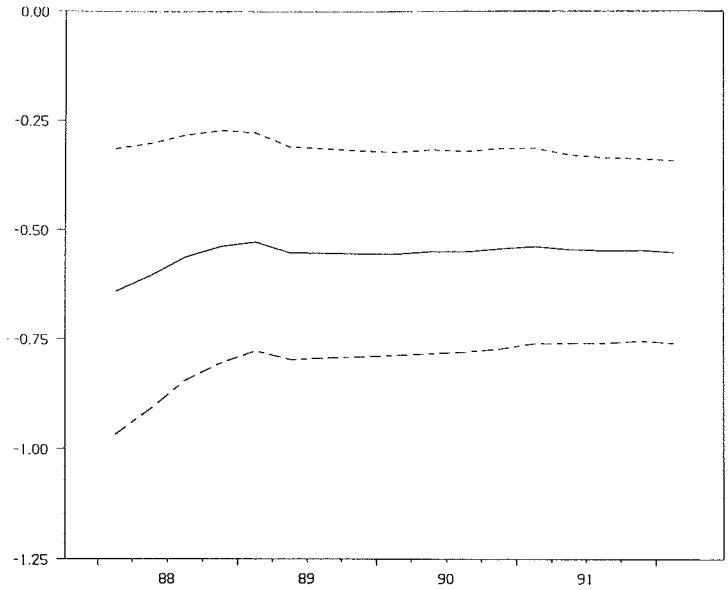
EC-Wide money demand: dynamic equation

Figure 4a: Real money growth: actual, fitted, forecast



Estimation period is 1979: 2 - 1988: 4; conditional forecast period is 1989: 1 - 1992: 1. CHOW (13,33) test for parameter stability is .30 (98.7).

Figure 4b: Recursive estimates of the error-correction term (±2S.E.)



Sequence of estimated coefficients on the error-correction term obtained by successively extending the sample by a single observation from 1979: 2 - 1988: 1 to 1979: 2 - 1992: 1.

corroborated by the values of the Chow tests and is illustrated by the quality of the forecast (shown in Figure 4a) and by the results of recursive estimation over the successive samples obtained by adding one observation from 1979: 2 - 1988: 1 to 1979: 2 - 1992: 1 (Figure 4b depicts the coefficient of the error-correction term). The estimated equation standard error compares favourably with those of national money demand functions (see e.g. Fase and Winder, 1992) and of the previous area-wide studies for groups of EC countries (see the survey by van Riet, 1993).

The pattern of dynamic responses to changes in real income and in the rate of interest is fairly simple and plausible from an economic point of view. The error-correction term is strongly significant and above the 1% critical value in McKinnon's (1991) tables (which Kremers *et. al*, 1992, conjecture to be the appropriate ones), providing further support for the hypothesis of cointegration. The value of the coefficient is relatively high for an equation for broad money, implying that slightly more than 50% of the correction of shocks from equilibrium takes place within one quarter. If the traditional argument by Goodfriend (1985) that the misspecification of money demand equations typically results in very low estimates of the adjustment coefficients is accepted[18], this finding is yet another indication of the good economic and statistical properties of the above money demand function.

Table 6, panel A, compares the results of equation (2) - which models real changes in m^T, the EC-wide aggregate based on the traditional definitions of broad money - with the results for the dynamic money demand functions for the other monetary aggregates which include CBHs. For all aggregates, including m^R and m^L, the statistical performance of the equation is quite good and the error-correction term has high *t*-statistics. This finding is somewhat puzzling, since it conflicts with the results of the cointegration tests, which corroborated the hypothesis of no cointegration for m^R and m^L, the aggregates that include "broad" measures of CBHs. Since results from cointegration analysis have shown the relevance of time trends, dynamic money demand functions are estimated for a different specification in order to gain further insights into the issue: the error-correction term $ECMT_{-1}$ is replaced by ECM_{-1}, the lagged cointegrating residual from the long-run equation with no time trends. The results from this new specification, which are reported in Table 6, panel B, show that the statistical performance worsens for all aggregates, including m^T. The extent of the deterioration, however, differs quite markedly, especially in terms of the significance of the error-correction term. In particular, the *t*-statistic decreases sharply for m^R and m^L,

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[18] Kremers and Lane (1992) have shown that this argument also applies when the misspecification arises from the omission from national money demand equations of regressors which can capture currency substitution and other international spillover effects.

Table 6: Dynamic money demand equations
(1979:2 - 1992:1)†

(A) ECM from long-run equation with segt and t

Dependent variable	Regressors: $ECMT_{-1}$	c	$\Delta(m^i\text{-}p)_{-1} + \Delta(m^i\text{-}p)_{-2}$	Δy	Δy_{-1}	Δr_S	$\Delta r_{S_{-1}}$	$\overline{R}^2$	*SE* x *100*	*DW*	*Equality test*
$\Delta(m^T\text{-}p)$	-.552 (-5.29)	.001 (.53)	.321 (5.05)	.668 (6.39)	-.232 (-1.96)	-.193 (-3.24)	-.193 (-3.24)	.716	.468	1.94	.249
$\Delta(m^R\text{-}p)$	-.314 (-4.09)	.001 (1.08)	.230 (4.09)	.733 (6.13)			-.362 (-3.12)	.648	.564	1.87	.890
$\Delta(m^L\text{-}p)$	-.369 (-3.91)	.001 (.68)	.257 (3.27)	.683 (5.11)			-.351 (-2.42)	.521	.682	1.73	.523
$\Delta(m^{R,L}\text{-}p)$	-.421 (-5.05)	.001 (1.08)	.313 (5.02)	.653 (6.33)	-.234 (-2.06)		-.352 (-3.56)	.720	.474	1.90	.169
$\Delta(m^{R,C}\text{-}p)$	-.375 (-4.74)	.001 (1.24)	.307 (4.86)	.643 (5.96)	-.239 (-2.04)		-.349 (-3.44)	.711	.487	2.01	.421
$\Delta(m^{L,C}\text{-}p)$	-.379 (-4.37)	.001 (1.29)	.236 (4.26)	.656 (5.79)			-.372 (-3.52)	.666	.516	1.98	.583
$\Delta(m^{R,L,C}\text{-}p)$	-.420 (-4.91)	.001 (.91)	.313 (4.94)	.675 (6.37)	-.218 (-1.84)	-.194 (-3.22)	-.194 (-3.22)	.711	.476	1.94	.301

(B) ECM from long-run equation with no trends

Dependent variable	Regressors: ECM_{-1}	c	$\Delta(m^i\text{-}p)_{-1} + \Delta(m^i\text{-}p)_{-2}$	Δy	Δy_{-1}	Δr_S	$\Delta r_{S_{-1}}$	$\overline{R}^2$	*SE* x *100*	*DW*	*Equality test*
$\Delta(m^T\text{-}p)$	-.392 (-3.51)	.0 (.30)	.328 (4.48)	.702 (5.54)	-.241 (-1.72)	-.255 (-3.87)	-.255 (-3.87)	.640	.527	1.85	.107
$\Delta(m^R\text{-}p)$	-.112 (-1.68)	.002 (1.20)	.239 (3.74)	.617 (4.73)			-.407 (-2.86)	.550	.638	1.74	.046
$\Delta(m^L\text{-}p)$	-.051 (-1.13)	.003 (1.68)	.165 (1.91)	.602 (3.99)			-.426 (-2.32)	.381	.775	1.67	.052
$\Delta(m^{R,L}\text{-}p)$	-.124 (-1.80)	.002 (1.22)	.251 (4.12)	.569 (4.79)			-.456 (-3.67)	.590	.568	1.68	.083
$\Delta(m^{R,C}\text{-}p)$	-.211 (-2.64)	.001 (1.06)	.339 (4.52)	.558 (4.65)	-.265 (-1.83)		-.430 (-3.56)	.626	.553	1.84	.168
$\Delta(m^{L,C}\text{-}p)$	-.144 (-1.94)	.002 (1.30)	.252 (3.98)	.545 (3.44)			-.441 (-3.44)	.565	.589	1.84	.251
$\Delta(m^{R,L,C}\text{-}p)$	-.199 (-2.53)	.001 (.73)	.272 (4.57)	.640 (5.31)		-.293 (-3.86)	-.293 (-3.86)	.611	.547	1.79	.153

† *t*-statistics in parenthesis. *Equality test* denotes the *F*-test that the estimates of the long-run coefficients of the money demand obtained from the single-stage unconstrained equations (omitted here for the sake of brevity) are jointly equal to the coefficients obtained from the static cointegrating equation (1). All test statistics are below the 5% critical values. *DW* is the Durbin-Watson test statistic which, although not valid since the lagged dependent variable appears among the regressors, provides a general indication of the equation performance. Several other diagnostic tests were carried out (Lagrange multiplier tests for various orders of autocorrelation, heteroscedasticity and *ARCH*; *RESET* tests; test for the normality of the residuals, various *CHOW* tests for parameter stability) and all passed at the 1% level. All the restrictions imposed on the dynamic specification (such as the constraint that the coefficients on the change in the interest rate and on its lag are equal) are not rejected by the appropriate *F*-test at the 5% level.

reaching values even below the threshold of the 5% critical value from the standard distribution. Although only tentative conclusions can be drawn, this evidence indeed supports the hypothesis that, even if cointegration holds also for m^R and m^L, it is more tenuous than for all the other aggregates.

As the results from the specification with ECM_{-1} are inferior to those from the first set of equations, it seems more appropriate to assess the performance of the aggregates extended to include CBHs with reference to panel A of Table 6. The dynamic money demands for the extended aggregate possess good statistical properties by the usual standard - especially in the case of $m^{R,L}$ and $m^{R,L,C}$ - pointing to the fact that aggregates including CBHs can provide useful information about economic developments at the EC level. Nevertheless, they never outperform the traditional definition of money[19], which consequently remains the preferred monetary aggregate. The difference in performance is, however, very small, suggesting that extended aggregates may well become an increasingly important tool for monetary analysis at the EC level, if the progress of financial and economic integration is associated with significant additional delocalisation of deposits.

The estimates of the coefficient on the error-correction term are systematically lower in the equations for the extended aggregate than for m^T, although they remain quite high by usual standards for broad aggregates. This finding is consistent with the reasonable expectation that adjustment costs are higher for assets held abroad than for assets held at home. The pattern of dynamic responses is very similar to that for traditional money, with only two exceptions: the lagged change in income does not enter some equations and the impact of changes in the short interest rates takes place only after one quarter (except for $m^{R,L,C}$; in this case, as for m^T, part of the impact is contemporaneous).

4. Money-income causality

Since the seminal articles by Sims (1972, 1980a), Granger-causality tests to assess whether movements in money help to predict developments in income have become a popular tool of analysis to investigate monetary relationships. The diffusion of this technique has certainly been favoured by the straightforward implementation and the minimal reliance on controversial theoretical tenets. Yet, in spite of its simplicity and lack of ambiguity, the approach has been somewhat tainted by the disconcerting heterogeneity of the conclusions reached even with reference to the same country and

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[19] In the analysis conducted for EC-wide variables based on the conversion of national series using PPP rates, the dynamic money demand equations for some aggregates including "narrow" measures of CBHs occasionally perform better than the money demand function for m^T (see Appendix 2).

the same sample. Empirical results have appeared to be very sensitive to the choice between a bivariate and a multivariate framework (Sims, 1980b, is the best known example), although this finding is itself open to several interpretations (McCallum, 1983). Also the selection of the variables included in the multivariate approach has proved to be a source of conflicting results, as recently exemplified by Friedman and Kuttner (1992) who have found that the incorporation of the commercial paper-Treasury bill spread eliminates the predictive content of money in the US case. At the same time, developments in cointegration theory have cast some doubts on the statistical foundations of the approach, as the results can be expected to be sensitive to the trend properties of the data, both stochastic and deterministic. Indeed, Stock and Watson (1989) have claimed that the puzzles in the evidence on the issue of money-income causality ultimately depend on the adoption of different techniques to "detrend" time series and on the application of the traditional F-distribution for test statistics which instead have non-standard distributions. In fact, as demonstrated by Sims *et al.* (1990), the use of F-tests to draw inferences on whether money Granger-causes income is correct only conditionally on the validity of certain maintained hypotheses on the stochastic and deterministic trends of the variables, which, however, may be difficult to test. Following this line of inquiry, Feldstein and Stock (1993) reach opposite conclusions to those of Friedman and Kuttner (1992) when the lagged money demand cointegrating residual is included, alongside the lags of money, in the specification of the equation for income and in the definition of the Granger-causality tests.

Against this background, empirical research on money-income causality is unlikely to supply uncontroversial results, especially in the presence of the mixed conclusions on the trend characteristics of the variables which have been discussed in Section 2. With no pretence to exhaustiveness or claim to innovation, the approach followed here attempts to provide additional information on the robustness of the conclusions by examining several alternative specifications in terms of the lag structure; of the choice between a bivariate and multivariate framework; and of the inclusion of variables in addition to the autoregressive component. Since in the literature the exploration of money-income causality has been conducted with reference to both nominal income (e.g. Feldstein and Stock, 1993) and real output (e.g. Stock and Watson, 1989; Friedman and Kuttner, 1989), both analyses are carried out.

The data representations employed to investigate whether EC-wide monetary aggregates contain useful information about future developments in EC-wide income can be conveniently summarised by the following equation:

$$\Delta x_t = \beta v_t + \gamma(L)\Delta z_{t-1} + \delta(L)\Delta x_{t-1} + \varphi(L)\Delta m^i_{t-1} + \varepsilon_t \qquad (3)$$

x_t denotes income and hence either $x_t = y_t$ or $x_t = (y+p)_t$ according to whether real or nominal output is considered. v_t stands for a vector of non-differenced explanatory variables which, according to the specification is equal to the constant c or to the vectors $(c, segt_t, t_t)$, (c, ECM_{t-1}), $(c, segt_t, t_t, ECM_{t-1})$, $(c, ECMT_{t-1})$; where t and $segt$ are the time trends defined in the previous Section and ECM_{t-1} $(ECMT_{t-1})$ is the lagged residual from the cointegrating regression (1) in the specification with no time trends (with both t and $segt$). z_t represents a vector of additional regressors which is empty in the bivariate model; it has r_{St} as the only element in the trivariate model; and is equal to (r_{St}, p_t)in the four variable case. m^j denotes the different definitions of EC-wide aggregates and hence j= T; R; L; R,L; R,C; L,C; R,L,C. As usual, L is the lag operator. $\beta, \gamma, \delta, \varphi$ are vectors of coefficients (γ is a matrix in the four-variable model) and ε_t is a stationary disturbance term. To assess whether EC-wide aggregates Granger-cause Community income the usual restrictions that the coefficients on lagged Δm_t^j are zero $(\varphi(L) = 0)$[20] are tested by means of the traditional F-statistic, which has the standard distribution if either $\Delta x_t, \Delta z_t, \Delta m_t^j$ are all stationary variables or the specification of v_t is adequate to "control for" stochastic or deterministic trends (Sims *et al.,* 1990). The selected lag-length is four for all variables and, in the second set of specifications, is four for all variables with the exception of Δm_t^j, for which it is one. In all cases the lag length was sufficient to obtain white noise residuals.

Tables 7 and 8 report the results of the Granger-causality tests (in parenthesis the p-values, multiplied by 100, from the standard F-distribution) performed within the framework of the specifications summarised in equation (3). In both tables, panels A and B refer to Granger-causality for nominal and real income respectively, while columns detail the different specifications for v_t and rows the different monetary aggregates m^j. Table 7 shows the results from the bivariate case, with the left-hand part for the equations with four lags of both the change in money and the change in income; and the right-hand part for the equations with four lags of the change in income and one lag of the change in money. Table 8 addresses multivariate cases, with the left-hand and right-hand parts for the three- and four-variable equations respectively. All

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[20] When the error-correction is included in the specifications, the restriction that its coefficient is equal to zero is tested jointly with the usual restrictions on lagged changes in money.

Table 7: Money-income causality tests. Bivariate system (1980:1 - 1992:1)†

(A) Money and nominal income

Monetary aggregates	4 lags of money					1 lag of money				
	Specification					Specification				
	c	*c, segt,t*	*c,ECM*	*c,segt,t,ECM*	*c,ECMT*	*c*	*c, segt,t*	*c, ECM*	*c,segt,t,ECM*	*c,ECMT*
m^T	1.67 (17.5)	1.42 (24.7)	4.43 (.3)	2.89 (2.7)	2.45 (5.0)	5.94 (1.9)	4.58 (3.8)	10.30 (.0)	6.96 (.3)	6.12 (.5)
m^R	.29 (88.0)	.17 (95.4)	.56 (73.1)	.35 (88.1)	.56 (72.7)	.52 (47.4)	.16 (69.2)	.98 (38.4)	.66 (52.2)	.93 (40.2)
m^L	.65 (63.1)	.27 (89.7)	.54 (74.4)	.24 (94.1)	.55 (73.8)	1.56 (21.8)	.21 (65.1)	.77 (47.2)	.24 (79.0)	.77 (47.1)
$m^{R,L}$	.67 (61.5)	.46 (76.7)	1.28 (29.1)	.76 (58.1)	1.02 (41.8)	2.37 (13.1)	1.46 (23.4)	3.02 (5.9)	1.79 (18.0)	2.46 (9.7)
$m^{R,C}$	.67 (61.8)	.43 (78.4)	1.51 (20.9)	.84 (53.1)	1.17 (34.1)	2.17 (14.8)	1.43 (23.8)	3.44 (4.1)	1.91 (16.1)	2.59 (8.7)
$m^{L,C}$	.64 (63.5)	.50 (73.3)	1.44 (23.2)	.86 (52.0)	1.16 (34.8)	1.88 (17.8)	1.27 (26.7)	3.30 (4.7)	1.92 (16.0)	2.60 (8.6)
$m^{R,L,C}$	.83 (51.7)	.61 (65.8)	1.76 (14.5)	1.03 (41.2)	1.33 (27.1)	2.81 (10.1)	2.02 (16.3)	4.10 (2.4)	2.42 (10.1)	3.14 (5.3)

(B) Money and real income

Monetary aggregates	4 lags of money					1 lag of money				
	Specification					Specification				
	c	*c, segt,t*	*c,ECM*	*c,segt,t,ECM*	*c,ECMT*	*c*	*c, segt,t*	*c, ECM*	*c,segt,t,ECM*	*c,ECMT*
m^T	2.81 (3.8)	2.82 (3.8)	6.26 (.0)	4.33 (.3)	3.38 (1.2)	3.20 (8.1)	11.32 (.2)	9.88 (.0)	8.94 (.1)	4.67 (1.5)
m^R	2.01 (11.2)	1.61 (19.1)	3.51 (1.0)	2.31 (6.4)	2.68 (3.5)	.09 (76.8)	1.98 (16.7)	3.65 (3.5)	1.41 (25.7)	1.72 (19.2)
m^L	2.26 (7.9)	1.28 (29.5)	2.80 (3.0)	1.87 (12.4)	2.18 (7.6)	.14 (70.9)	1.00 (32.2)	1.66 (20.3)	.58 (56.6)	.39 (68.1)
$m^{R,L}$	2.48 (6.0)	1.97 (11.9)	4.52 (.2)	3.07 (2.0)	2.94 (2.4)	.74 (39.4)	5.19 (2.8)	6.26 (.4)	3.78 (3.1)	2.67 (8.1)
$m^{R,C}$	3.10 (2.6)	2.66 (4.8)	5.36 (.1)	3.68 (.8)	3.71 (.8)	1.25 (27.0)	5.86 (2.0)	7.23 (.2)	4.29 (2.1)	3.43 (4.2)
$m^{L,C}$	2.99 (3.0)	2.25 (8.2)	4.89 (.1)	3.33 (1.4)	3.40 (1.2)	.85 (36.0)	4.44 (4.1)	7.00 (.2)	3.93 (2.8)	3.20 (5.1)
$m^{R,L,C}$	3.12 (2.5)	2.58 (5.2)	5.44 (.1)	3.75 (.8)	3.62 (.9)	1.38 (24.7)	6.76 (1.3)	7.83 (.1)	5.00 (1.1)	3.60 (3.6)

† The *F*-statistic tests the hypothesis that all of the coefficients on the lags of Δm^j (and on *ECM* or on *ECMT* when appropriate) are zero. In parenthesis, *p*-values times 100. The *p*-values are based on the usual *F*-distribution. *c* denotes a constant, *segt* a linear trend spanning the period 1986:1-1989:4; *t* a time trend over the whole sample; *ECM (ECMT)* the lagged value of the residual of the cointegrating regression (specification with no time trends and with both *t* and *segt* respectively).

Table 8: Money-income causality tests. Multivariate system (1980:1 - 1992:1)†

(A) Money and nominal income

	$y+p, m^j, r_S$					$y+p, m^j, r_S, p$				
	Specification					Specification				
Monetary aggregates	*c*	*c, segt,t*	*c,ECM*	*c,segt,t,ECM*	*c,ECMT*	*c*	*c, segt,t*	*c, ECM*	*c,segt,t,ECM*	*c,ECMT*
m^T	6.58 (1.4)	5.55 (2.4)	7.58 (.2)	4.54 (1.7)	4.41 (1.9)	12.33 (.1)	8.26 (.7)	7.46 (.2)	5.11 (1.2)	6.09 (.5)
m^R	.46 (50.1)	.15 (69.8)	.78 (46.8)	.35 (70.5)	.55 (58.3)	1.49 (23.1)	.58 (45.3)	.72 (49.3)	.75 (48.1)	.73 (49.0)
m^L	1.52 (22.5)	.19 (66.2)	.75 (47.8)	.15 (86.4)	.91 (41.2)	1.43 (23.9)	.62 (43.8)	.79 (46.0)	.45 (64.4)	.80 (45.8)
$m^{R,L}$	2.41 (12.9)	1.66 (20.6)	2.39 (10.5)	1.21 (30.9)	1.68 (20.1)	4.90 (3.3)	2.87 (10.0)	2.45 (10.1)	1.81 (18.0)	2.38 (10.8)
$m^{R,C}$	2.19 (14.7)	1.58 (21.7)	2.81 (7.3)	1.34 (27.5)	1.89 (16.6)	4.35 (4.4)	2.55 (12.0)	2.25 (12.1)	1.84 (17.6)	2.12 (13.6)
$m^{L,C}$	1.87 (17.9)	1.36 (25.0)	2.59 (8.8)	1.22 (30.6)	1.74 (18.9)	3.39 (7.4)	2.13 (15.4)	1.81 (17.9)	1.60 (21.8)	1.65 (20.6)
$m^{R,L,C}$	2.95 (9.4)	2.35 (13.4)	3.27 (4.9)	1.72 (19.4)	2.26 (11.8)	5.63 (2.3)	3.51 (7.0)	2.90 (6.9)	2.22 (12.5)	2.74 (7.9)

(B) Money and real income

	y, m^j, r_S					y, m^j, r_S, p				
	Specification					Specification				
Monetary aggregates	*c*	*c, segt,t*	*c,ECM*	*c,segt,t,ECM*	*c,ECMT*	*c*	*c, segt,t*	*c, ECM*	*c,segt,t,ECM*	*c,ECMT*
m^T	4.47 (4.1)	10.87 (.2)	7.67 (.2)	6.77 (.3)	3.73 (3.3)	14.51 (.1)	11.16 (.2)	7.46 (.2)	5.72 (.8)	7.19 (.2)
m^R	.78 (38.2)	1.85 (18.2)	1.89 (16.5)	1.02 (37.0)	1.03 (36.8)	2.92 (9.6)	1.92 (17.5)	1.45 (24.8)	.97 (38.9)	1.61 (21.5)
m^L	.01 (90.9)	.59 (44.7)	.47 (62.7)	.31 (73.2)	.03 (96.9)	1.39 (24.7)	.79 (38.0)	.69 (50.8)	.48 (62.5)	.79 (46.1)
$m^{R,L}$	1.95 (17.0)	4.79 (3.5)	3.82 (3.1)	2.79 (7.5)	1.94 (15.7)	7.25 (1.1)	5.31 (2.8)	3.53 (4.0)	2.66 (8.5)	3.71 (3.5)
$m^{R,C}$	3.10 (8.6)	5.62 (2.3)	4.68 (1.5)	3.24 (5.1)	2.70 (8.0)	7.47 (1.0)	5.60 (2.4)	3.64 (3.7)	2.81 (7.5)	3.78 (3.3)
$m^{L,C}$	2.23 (14.3)	4.28 (4.6)	4.39 (1.9)	2.89 (6.8)	2.36 (10.8)	5.66 (2.3)	4.32 (4.5)	2.79 (7.6)	2.25 (12.2)	2.87 (7.1)
$m^{R,L,C}$	3.05 (8.9)	6.47 (1.5)	5.13 (1.1)	3.80 (3.2)	2.84 (7.1)	8.83 (.5)	6.69 (1.4)	4.31 (2.1)	3.34 (4.8)	4.46 (1.9)

† The *F*-statistic tests the hypothesis that all of the coefficients on the lags of Δm^j (and on *ECM* or on *ECMT* when appropriate) are zero. In parenthesis, *p*-values times 100. The *p*-values are based on the usual *F*-distribution. *c* denotes a constant, *segt* a linear trend spanning the period 1986:1-1989:4; *t* a time trend over the whole sample; *ECM (ECMT)* the lagged value of the residual of the cointegrating regression (specification with no time trends and with both *t* and *segt* respectively). All specifications with 1 lag for money and 4 lags for all other variables.

specifications in Table 8 include one lag of the change in money and four lags of the change in all the other variables.[21]

As before, the discussion of the results starts with m^T, the traditional definition of broad money which excludes CBHs. The general conclusion which emerges from the econometric analysis is that movements in EC-wide broad money help to predict movements in area-wide income, both nominal and real. With only three exceptions[22] out of forty specifications, all the Granger-causality tests are above the 5% critical value, and above the 1% value in the majority of cases. Naturally, the statistical validity of these tests is conditional on specific assumptions about the unit root and trend behaviour of the various series, which may be evaluated only with difficulty. Notwithstanding this caveat, the robustness of the results across specifications supports a considerable degree of confidence in the conclusion that EC-wide broad money is a useful predictor of future movements in both nominal and real Community income.

Comparing results across specifications provides additional insights, especially because the general patterns apply not only to the results for m^T, but hold in qualitative terms also for the other measures of money which include CBHs. Firstly, including the lagged residual from the cointegrating equation (with or without time trends) in the specification tends to increase the significance of the Granger-causality tests. This finding is consistent with the evidence supporting cointegration which has been discussed in the preceding Sections: as shown in Granger (1988), the existence of cointegration between I(1) series implies causation in at least one direction. The link between cointegration analysis and the investigation of Granger-causality is not only relevant from a statistical point of view but is also important on economic grounds. The long-run stability of the demand for money implies that departures from equilibrium will set in motion predictable adjustment processes which will tend to assign an informational content to movements in money. On the empirical front, the link between cointegration and causality analysis warns against drawing inferences on whether money Granger-causes income, without exploring the impact on test results of changes in the specification to insert lagged residuals from static money demand equations.

The second noteworthy feature which emerges from the comparison across specifications is that, in general, *F*-statistics are higher when tests are carried out for one

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[21] The results for the specifications with four lags of all variables including money are not reported for the sake of brevity, but are available from the author upon request.

[22] Two exceptions are from the specifications for nominal income with no lagged residual from the cointegrating regression and with four lags of both the change in money and in income (Table 7, panel A, top-left corner). The third exception is from the specification for real income with neither time trends nor lagged cointegrating residual and with one lag of the change in money (Table 7, panel B, top-left corner of the right-hand part).

lag of the change in money only. This finding indicates that the first lag of money has the highest informational content, which in turn suggests that monetary adjustments are carried out more rapidly than is often thought to be the case (see, for example, Fase and Winder, 1992). This conclusion is also supported by the relatively high values of the coefficients on the error-correction term in the dynamic money demand equations which were discussed in the previous Section. Although it would be tempting to derive implications on the speed of the transmission of monetary policy impulses to the economy, it should be recalled that the analysis is based on *broad* monetary aggregates, which in general are not controllable with particular accuracy or timeliness. Thus, the evidence which points to the high informational content of the first lag of the change in broad money does not have any implication on the speed of transmission of changes in monetary policy instruments to broad money measures. Furthermore, in the absence of behavioural hypotheses, the finding that money Granger-causes income is open to a wide range of interpretations about the specific features of the transmission of changes in monetary policy instruments to the financial and real sectors of the economy.

Finally, it may be noted that test statistics in the multivariate framework are not significantly lower than in the bivariate approach; on the contrary, in several instances tests are higher. This characteristic provides strong support for the use of an EC-wide monetary aggregate as a leading indicator, since the sensitivity of the results to the inclusion of additional explanatory variables has long been one of the main causes of conflicting conclusions on money-income causality, as emphasised recently by the findings of Friedman and Kuttner (1989; 1992).

Moving to the measures of money which includes CBHs, a clear distinction emerges between the results for the definitions which are based on the application of a single criterion (i.e. m^R and m^L) and the results for the other extended aggregates. In only three cases are Granger-causality tests for m^R and m^L above the 5% critical value, but they are never above the 1% threshold and, more importantly, never within the framework of a multivariate equation. Movements in "broad" measures of CBHs do not seem to convey significant information about future developments in income. This conclusion is not surprising, in view of the previous results, which have shown that m^R and m^L fail to cointegrate with income and the interest rate. As already noted, these aggregates include assets (such as EC-residents' deposits held outside Europe and denominated in non-EC currencies or non-EC residents' deposits held in financial centres located in the EC) which may be expected to be poorly linked with spending decisions since they are probably held mainly on the basis of portfolio considerations.

The other extended aggregates - that is those derived from the joint application of two (or three) criteria - are on the other hand useful in forecasting movements in both

nominal and real income. In most cases, Granger-causality tests are above the 5% critical value and in several instances also above the 1% threshold. As with cointegration analysis, results for the different aggregates are very similar and do not point to one particular measure clearly outperforming the others, although there are some hints that the "narrowest definition among the extended measures" (that is $m^{R,L,C}$) possesses the highest informational content.

Even when they are above the 5% or 1% significance levels, the test statistics for extended aggregates are systematically lower than the corresponding values for the traditional measure of broad money. A greater weight attached to portfolio considerations and higher transaction costs are the most natural explanations for the result. On the one hand, the result is reassuring, since it suggests that the usual neglect of CBHs for the analysis of monetary developments has not been so far associated with a loss of information. On the other hand, the increase in the size of EC-residents' CBHs (especially those located in the EC and denominated in EC-currencies) has been particularly rapid in recent years and the difference in the performance of traditional and extended aggregates (especially for $m^{R,L,C}$) is relatively small: the conclusion that the omission of CBHs from monetary aggregates does not impair their usefulness could be reversed in the near future.

The inferiority, at present, of the informational content of aggregates extended to include CBHs should not be misinterpreted as casting implicit doubts on the validity and usefulness of EC-wide monetary aggregation. As argued in Section 1.1, the importance of CBHs stems from the delocalisation of deposits, while the rationale for the definition of area-wide aggregates is provided by currency substitution, international portfolio diversification and, more in general, by the spillover effects across closely integrated economies. Although they may take place at the same time, the various phenomena are distinct and therefore no conclusion on the usefulness of EC-wide monetary aggregation can be drawn from the comparison between traditional money measures and extended definitions.

5. Conclusions

The econometric evidence presented in this paper confirms, for an extended sample and new data, that the degree of economic and financial integration within the EC is already sufficient for EC-wide monetary aggregates to be useful for the analysis of economic developments within the Community and for the coordination of national monetary policies. Cointegration analysis and error-correction modelling show that the EC-wide demand for money is stable and predictable, with a statistical performance which compares most favourably with national equations. Granger-causality tests,

conducted in both bivariate and multivariate settings for a wide range of specifications, demonstrate that movements in EC-wide money help to predict developments in both nominal and real income.

As for all the conclusions derived from econometric evidence, further tests of their robustness are desirable to increase their reliability for analysis and policy. To this effect, several possibilities are open, but one seems particularly interesting: the assessment of area-wide monetary relationships for different subsets of EC countries. This approach may provide important insights into the factors underlying the performance of EC-wide equations. It may also be regarded as an indispensable analytical background to the conduct of monetary policy in the early days of Economic and Monetary Union, in the light of the uncertainty surrounding which countries will participate from the outset.

The main novelty of the paper is the analysis of the role of cross-border holdings (CBHs) for monetary analysis at the EC level, which had previously been considered only with reference to single countries. Several aggregates extended to include different measures of CBHs are defined and their economic properties assessed. Extended aggregates are shown to perform differently according to the definition. "Very broad" measures of EC money (which contain EC-residents' CBHs kept outside the EC and denominated in non-EC currencies or non-EC residents' CBHs kept within the EC but denominated in non-EC currencies) are poorly linked with EC-wide income, since they fail to pass cointegration tests and to Granger-cause Community income. In contrast, extended definitions "focused on the EC" (which hinge on the inclusion of CBHs denominated in EC currencies and/or kept within the EC) have a good performance. However, no extended aggregate yet outperforms the EC-wide measure of money obtained from adding traditional national definitions: contrary to the conclusions at the country level reached by Angeloni *et al.* (1991), the traditional definition of broad money remains the preferable aggregate for the analysis at the EC level.

It should be emphasised that the rationale for studying EC-wide monetary relationships is different from the motive behind the exploration of the role of CBHs. Therefore, the finding that extended EC-wide monetary aggregates which include CBHs do not outperform the traditional definition does not cast any doubt on the validity and usefulness of EC-wide monetary aggregation. Nor does it imply that CBHs should be neglected when analysing financial developments. Indeed, the relevance of EC-wide monetary relationships stems from currency substitution, international portfolio diversification and more in general from spillover effects across closely integrated economies, which make national demands for money sensitive to foreign, but "within the area", variables. These phenomena, however, need not be associated with significant

shifts in the location of monetary assets which imply changes in the size of CBHs. For analytical simplicity, standard macroeconomic models do not distinguish between currency substitution and the delocalisation of deposits, but this distinction is crucial for the selection of the empirical measure of area-wide money. Secondly, the difference in econometric performance between the traditional measure of EC-wide money and extended aggregates including CBHs is small. Thus, extended aggregates already perform well enough to warrant their use as helpful additional money measures and to suggest that extended aggregates may become an increasingly important tool for monetary analysis at the EC level in the near future.

Nevertheless, the remarks on the usefulness of extended aggregates only apply to definitions which include "narrow measures" of CBHs "focused on the EC" and therefore, from the point of view of monetary analysis, the answer to the question "All the money in Europe?" is "No, thank you".

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Appendix 1
Data Sources

Broad monetary aggregates (1992 definitions): All aggregates, published by national central banks, are quarterly averages of monthly, seasonally-adjusted figures. Belgium: M3H; Denmark: M3H (= M2 national less Treasury Bills); Germany: M3 (to avoid a break in the series, for the most recent observations the rate of change in M3 for all Germany following unification was applied to the series for M3 for West Germany prior to unification); Spain: M3H; France: M3H; Ireland: M3; Italy: M3H (=M2 national); Netherlands: M3H (corrected for items in transit and breaks); United Kingdom: M3H.

Real income: Real income is measured by real GDP and obtained from the BIS data bank for all countries except Denmark, Spain and the Netherlands (estimates from national central banks) and for Belgium and Ireland (OECD Economic outlook; yearly data interpolated), where GNP is used.

GNP/GNP implicit price deflators: All deflators derive from the same source as the corresponding seasonally-adjusted income variables.

Short-term interest rates: All short-term interest rates are the quarterly average of daily figures (three-month interbank, BIS data bank), except for Ireland, where quarterly averages of end-month values were provided by the Central Bank of Ireland.

Deposit rates: For Belgium, Denmark and Spain, the series is the interest rate on time deposits; for France, Italy, the Netherlands and the United Kingdom, the interest rate on savings deposits (all deposits) has been used (all from BIS data bank). The area-wide interest rate on deposits excludes data for Denmark, Greece, Ireland, Luxembourg and Portugal as they are not readily available .

Exchange rates: Current ECU exchange rates are quarterly averages of the spot rates implied by the official definition of the ECU. PPP exchange rates are constructed by the European Commission and published in *European Economy*. The annual series are converted into quarterly ones by linear interpolation.

Cross-border holdings (CBHs): Data on CBHs are from the BIS banking statistics and include assets with initial maturities below (or equal to) one year. Measures of CBHs obtained from the joint application of the criteria **R** and **C** (see page 3 in the text) do not include CBHs denominated in Danish kroner, Greek drachmas, Spanish pesetas or Portuguese escudos, as reporting banks do not single out these currencies in their statistical returns. For measures obtained from criteria **L** and **C**, the underestimation is however smaller, because Danish and Spanish banks do report non-residents' CBHs denominated in kroner and pesetas, respectively.

Appendix 2
Empirical results for the EC-wide variables obtained by PPP rates

The selection of the method to convert national variables into a common currency is controversial. The main paper uses exchange rates on the basis of the arguments discussed in Section 1.2. However, to assess the robustness of the conclusions, the econometric analysis is replicated for the EC-wide variables obtained by purchasing power parity (PPP) rates. This appendix presents the econometric results for these variables using the same structure of tables as in the main text. Three Figures compare EC-wide series obtained by using the two conversion methods.

The fundamental conclusions discussed in the main text are confirmed: the EC-wide demand for traditional broad money is stable and predictable with a good statistical performance; changes in EC-wide money help to predict movements in both nominal and real income; aggregates extended to include "broad measures" of CBHs (that is m^R and m^L) are poorly linked with EC-wide income and their predictive power is limited; extended aggregates obtained from the joint application of two (or three) defining criteria (i.e. $m^{R,L}$; $m^{R,C}$; $m^{L,C}$ and $m^{R,L,C}$) possess the desirable economic and statistical properties required for EC-wide monetary analysis, even though they do not yet outperform the traditional measure of broad money. Therefore, the following remarks highlight only the main differences with the analysis based on current exchange rates.

Developments over time. The Figures depict some key EC-wide variables obtained by the two conversion methods. Figure A1 shows that nominal money based on PPP rates has grown faster than nominal money based on current exchange rates over the sample. Interest rates are very similar, as they only differ because of changes in the national shares of Community income which are used as weights in EC-wide aggregation. Figure A2 illustrates that the measure of EC-wide money based on current exchange rates is more volatile as a result of the fluctuations in nominal exchange rates. However, on the occasion of the 1987 realignment, also the PPP measure of money recorded a very sharp change. The EC-wide income variable changes in a similar fashion under the alternative conversion method and, in practice, EC-wide velocity, shown in Figure A3, is little affected by the selection of current versus PPP rates.

Cointegration analysis. In both the models with the short-term interest rate and with the interest rate differential, the value of cointegration tests in the specifications with no time trends tends to be slightly higher in the analysis of variables based on PPP rates, while the converse holds true for the specifications which include time trends. For all

aggregates, the long-run income elasticities in the PPP case are lower as regards the specifications with no time trends and with only the time trend spanning the period from 1986:1 to 1989:4, irrespective of which interest rate variable is adopted. For the specifications with both time trends, the estimates of the long-run coefficients on income are essentially invariant to the choice of the conversion method, which in addition, seems to have only a small impact on the estimates of the long-run interest rate semi-elasticity for all aggregates and specifications.

Dynamic money demand equations. The overall statistical performance of the equations - as summarised by the size of standard error and by the adjusted R^2 - is, in the large majority of cases, superior in the PPP case. The improvement is particularly marked for the extended aggregates based on the application of more than one criterion (most notably for $m^{R,L,C}$), and especially for the specifications which include the lagged residual from the cointegrating regression with no time trend. An important feature of the estimates for the PPP case is that the equation for $m^{R,L,C}$ (with the error-correction term derived from the specification with time trends) performs better than the equation for the traditional definition of broad money. The dynamics in the equations with variables based on PPP rates are different (but still fairly simple) and are typically characterised by lower coefficients on the error-correction term, which are nonetheless still high when compared to the values normally encountered in the national demand equations for broad money. The *t*-ratio for the coefficient on the error-correction term is systematically higher in the equations for the PPP case and, for some "narrow" extended aggregates (including $m^{R,L,C}$), is even above that for the traditional definition of broad money.

Money-income causality. With only a few exceptions (mainly concentrated in the four-variable model for nominal income), the Granger-causality tests with reference to the traditional definition of EC-wide money are systematically higher (often significantly so) in the PPP case. For the aggregates extended to include CBHs, it is more difficult to make generalisations valid across all specifications. However, the comparison between Tables 7, 8 and 7PPP, 8PPP shows a clear tendency for test statistics to be higher in the PPP case, with the majority of exceptions clustering again in the four-variable model for nominal income.

EC-wide variables: conversion by PPP and current exchange rates

Figure A1. EC-wide broad money and short term interest rate (1979Q1=100)

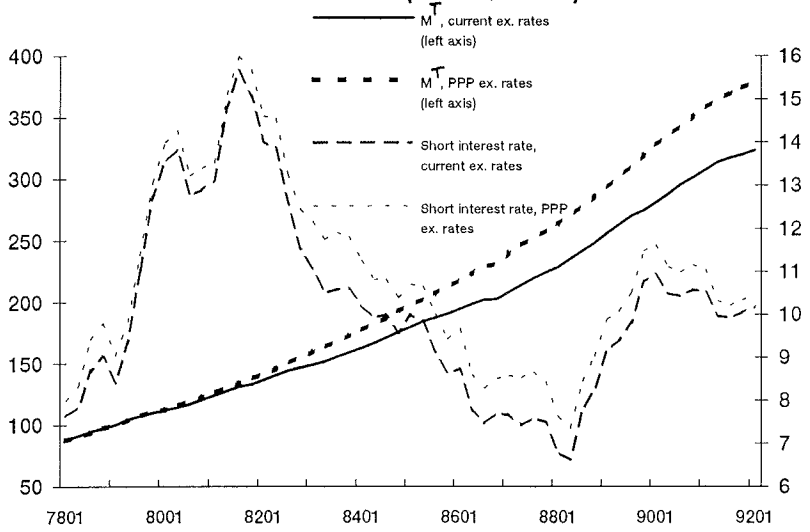

Figure A2. EC-wide money growth (quarterly changes)

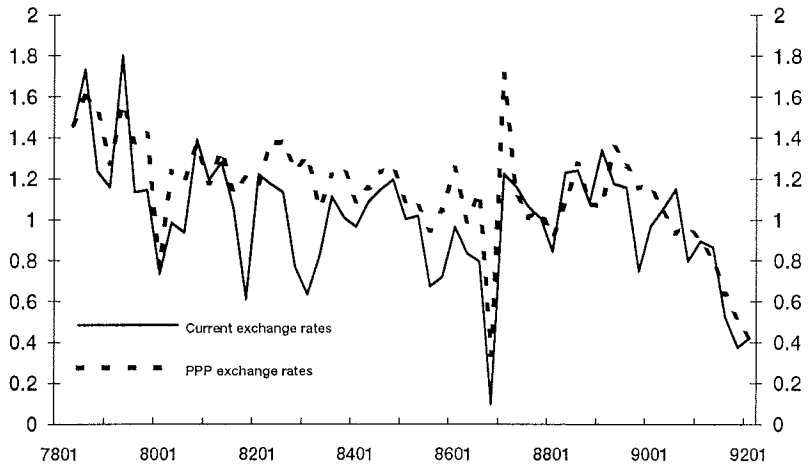

Figure A3. EC-wide velocity (1979Q1=100)

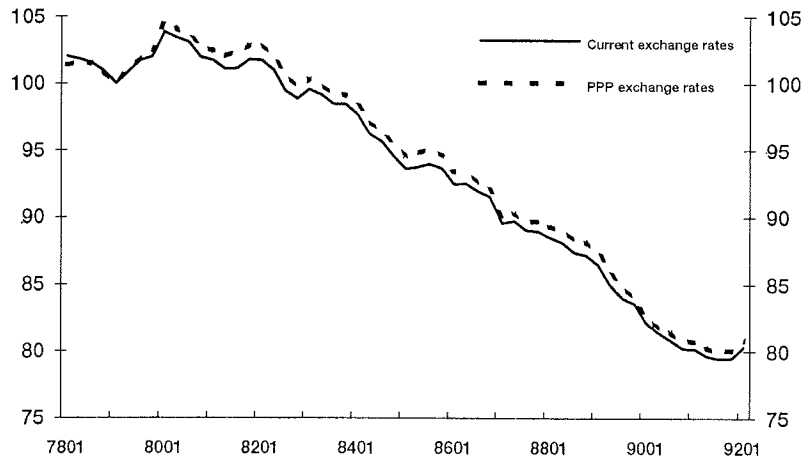

Table 4 PPP: Cointegration analysis

Basic model

(1979:1-1992:1)†

Monetary aggregates	Constant				Constant, segt				Constant, segt, t			
	Coefficients on		*Test Statistics*		*Coefficients on*		*Test Statistics*		*Coefficients on*		*Test Statistics*	
	y	r_s	*DF*	*PP*	*y*	r_s	*DF*	*PP*	*y*	r_s	*DF*	*PP*
m^T-p	1.48	-.20	5.06**	5.16**	1.19	-.50	4.48*	4.56*	1.24	-.49	4.60*	4.69*
m^R-p	1.70	-.06	4.61**	4.72**	1.60	-.17	3.89	4.14(‡)	1.52	-.18	3.80	4.04
m^L-p	1.59	-.46	2.04	2.22	1.86	-.17	2.84	3.24	.85	-.37	2.80	3.11
$m^{R,L}$-p	1.67	-.01	5.10**	5.14**	1.44	-.22	3.99(‡)	4.21(‡)	1.39	-.23	3.90	4.12(‡)
$m^{R,C}$-p	1.65	-.03	5.18**	5.20**	1.46	-.23	3.99(‡)	4.21(‡)	1.44	-.24	3.95	4.17(‡)
$m^{L,C}$-p	1.67	-.13	5.26**	5.32**	1.50	-.30	4.29(‡)	4.48*	1.42	-.32	4.16(‡)	4.34*
$m^{R,L,C}$-p	1.63	-.09	5.35**	5.40**	1.44	-.28	4.22(‡)	4.42*	1.38	-.30	4.12(‡)	4.31*

† Significant at the 1%(**), 5%(*) and 10%(‡). *Segt* denotes a linear trend spanning the period 1986:1-1989:4 while *t* denotes a time trend over the whole sample. *DF* and *PP* denote the "Dickey Fuller" cointegration test (Dickey and Fuller, 1981) and the test statistic proposed by Phillips (1987) and Phillips and Perron (1988). The *PP* test was performed in a specification with four lags. Critical values are from McKinnon (1991).

Table 5 PPP: Cointegration analysis

Specification with the interest rate differential

(1979:1-1992:1)†

Monetary aggregates	Constant				Constant, segt				Constant, segt,t			
	Coefficients on		*Test Statistics*		*Coefficients on*		*Test Statistics*		*Coefficients on*		*Test Statistics*	
	y	$r_s - r_D$	*DF*	*PP*	*y*	$r_s - r_D$	*DF*	*PP*	*y*	$r_s - r_D$	*DF*	*PP*
m^T-p	1.49	-.25	-5.21**	-5.37**	1.15	-1.17	-4.83**	-4.77**	1.25	-1.14	-5.08*	-5.03*
m^R-p	1.70	-.30	-4.43*	-4.56*	1.53	-.77	-3.43	-3.69	1.41	-.81	-3.33	-3.58
m^L-p	1.61	-1.20	-2.54	-2.63	1.82	-.64	-2.79	-3.11	.84	-.93	-3.08	-3.22
$m^{R,L}$-p	1.67	-.00	-5.04**	-5.09**	1.38	-.77	-3.76	-3.95(‡)	1.32	-.79	-3.67	-3.85
$m^{R,C}$-p	1.65	-.12	-5.08**	-5.11**	1.40	-.81	-3.70	-3.90(‡)	1.37	-.82	-3.66	-3.85
$m^{L,C}$-p	1.68	-.27	-5.26**	-5.33**	1.45	-.88	-4.23(‡)	-4.38*	1.38	-.90	-4.14(‡)	-4.27(‡)
$m^{R,L,C}$-p	1.63	-.20	-5.33**	-5.39**	1.39	-.86	-4.12(‡)	-4.27(‡)	1.33	-.88	-4.04	-4.17(‡)

† Significant at the 1%(**), 5%(*) and 10%(‡). *Segt* denotes a linear trend spanning the period 1986:1-1989:4 while *t* denotes a time trend over the whole sample. *DF* and *PP* denote the "Dickey Fuller" cointegration test (Dickey and Fuller, 1981) and the test statistic proposed by Phillips (1987) and Phillips and Perron (1988). The *PP* test was performed in a specification with four lags. Critical values are from McKinnon (1991).

Table 6 PPP: Dynamic money demand equations
(1979:2 - 1992:1)†

(A) ECM from long-run equation with segt and t

Dependent variable	Regressors						$\overline{R}^2$	*SE* x *100*	*DW*	*Equality Test*
	$ECMT_{-1}$	*c*	$\Delta(m^j\text{-}p\text{-}y)_{-1}$	$\Delta(m^j\text{-}p)_{-2}$	Δr_S	$\Delta r_{S_{-1}}$				
$\Delta(m^T\text{-}p)$	-.373 (-5.49)	.002 (2.87)	.369 (4.76)	.638 (8.92)	-.175 (-3.67)	-.175 (-3.67)	.781	.372	1.93	.539
$\Delta(m^R\text{-}p)$	-.283 (-4.92)	.003 (2.49)	.358 (3.49)	.568 (6.03)		-.272 (-2.53)	.662	.505	2.10	.629
$\Delta(m^L\text{-}p)$	-.324 (-3.49)	.004 (2.32)	.276 (2.37)	.508 (3.91)		-.314 (-2.24)	.414	.669	1.65	.707
$\Delta(m^{R,L}\text{-}p)$	-.341 (-6.22)	.003 (3.22)	.392 (4.73)	.551 (7.21)		-.293 (-3.48)	.762	.396	2.00	.641
$\Delta(m^{R,C}\text{-}p)$	-.287 (-5.72)	.003 (2.75)	.374 (4.60)	.603 (8.00)		-.276 (-3.34)	.770	.391	2.10	.586
$\Delta(m^{L,C}\text{-}p)$	-.335 (-5.75)	.003 (2.47)	.353 (4.28)	.618 (7.95)		-.276 (-3.14)	.743	.417	2.05	.451

(B) ECM from long-run equation with no trends

Dependent variable	Regressors						$\overline{R}^2$	*SE* x *100*	*DW*	*Test*
	ECM_{-1}	*c*	$\Delta(m^j\text{-}p\text{-}y)_{-1}$	$\Delta(m^j\text{-}p)_{-2}$	$\Delta r_{S_{-1}}$	$\Delta r_{S_{-4}}$				
$\Delta(m^T\text{-}p)$	-.225 (-5.05)	.002 (1.88)	.350 (4.67)	.696 (9.23)	-.174 (-2.10)	.322 (3.92)	.791	.368	1.91	1.603
$\Delta(m^R\text{-}p)$	-.266 (-4.70)	.003 (2.40)	.370 (3.54)	.569 (5.95)	-.245 (-2.25)		.652	.512	2.08	.454
$\Delta(m^L\text{-}p)$	-.123 (-1.60)	.005 (2.28)	.294 (2.12)	.437 (2.92)	-.476 (-2.99)		.300	.731	1.67	.571
$\Delta(m^{R,L}\text{-}p)$	-.261 (-5.93)	.002 (2.30)	.378 (4.64)	.619 (7.93)	-.205 (-2.46)	.257 (3.13)	.774	.390	1.70	1.890
$\Delta(m^{R,C}\text{-}p)$	-.236 (-5.63)	.002 (1.81)	.372 (4.76)	.671 (8.83)	-.201 (-2.52)	.252 (3.13)	.792	.376	1.88	1.917
$\Delta(m^{L,C}\text{-}p)$	-.286 (-5.76)	.002 (1.56)	.353 (4.44)	.687 (8.71)	-.211 (-2.48)	.251 (2.90)	.766	.403	1.87	1.324
$\Delta(m^{R,L,C}\text{-}p)$	-.243 (-5.37)	.002 (2.67)	.362 (4.64)	.626 (8.58)	-.240 (-3.05)		.781	.370	1.83	.606

† *t*-statistics in parenthesis. *Equality test* denotes the *F*-test that the estimates of the long-run coefficients of the money demand obtained from the single-stage unconstrained equations (omitted here for the sake of brevity) are jointly equal to the coefficients obtained from the static cointegrating equation (1). All test statistics are below the 5% critical values. *DW* is the Durbin-Watson test statistic which, although not valid since the lagged dependent variable appears among the regressors, provides a general indication of the equation performance. Several other diagnostic tests were carried out (Lagrange multiplier tests for various orders of autocorrelation, heteroscedasticity and *ARCH*; *RESET* tests; test for the normality of the residuals, various *CHOW* tests for parameter stability) and all passed at the 1% level. All the restrictions imposed on the dynamic specification (such as the constraint that the coefficients on the change in the interest rate and on its lag are equal) are not rejected by the appropriate *F*-test at the 5% level.

Table 7 PPP: Money-income causality tests. Bivariate system
(1980:1 - 1992:1)†

(A) Money and nominal income

	4 lags of money					1 lag of money				
	Specification					Specification				
Monetary aggregates	*c*	*c, segt,t*	*c,ECM*	*c,segt,t,ECM*	*c,ECMT*	*c*	*c, segt,t*	*c, ECM*	*c,segt,t,ECM*	*c,ECMT*
m^T	3.74	1.68	5.62	5.38	6.02	11.83	4.19	13.39	12.90	13.83
	(1.1)	(17.5)	(.1)	(.1)	(.0)	(.1)	(4.7)	(.0)	(.0)	(.0)
m^R	.77	.26	1.61	.67	1.24	.88	.01	2.64	1.11	1.75
	(55.1)	(90.3)	(17.9)	(64.8)	(31.0)	(35.5)	(91.8)	(8.3)	(33.9)	(18.6)
m^L	1.87	.61	1.61	2.84	1.52	3.83	.02	2.60	1.75	2.39
	(13.5)	(65.5)	(18.0)	(2.9)	(20.5)	(5.7)	(87.6)	(8.6)	(18.6)	(10.4)
$m^{R,L}$	1.05	.44	2.81	1.29	2.21	2.55	.52	6.20	2.48	4.70
	(39.2)	(78.2)	(2.9)	(28.9)	(7.3)	(11.8)	(47.6)	(.4)	(9.7)	(1.4)
$m^{R,C}$	1.59	.58	3.08	1.46	2.53	3.88	.79	5.95	2.63	4.55
	(19.6)	(67.9)	(1.9)	(22.8)	(4.5)	(5.5)	(38.1)	(.5)	(8.5)	(1.6)
$m^{L,C}$	1.87	.82	3.57	1.79	2.74	4.49	1.00	7.61	3.33	5.35
	(13.5)	(51.9)	(.9)	(13.8)	(3.2)	(4.0)	(32.2)	(.2)	(4.6)	(.9)
$m^{R,L,C}$	2.32	1.00	4.26	2.26	3.46	6.22	1.62	9.04	4.38	6.89
	(7.3)	(41.9)	(.3)	(6.9)	(1.1)	(1.7)	(21.0)	(.1)	(1.9)	(.3)

(B) Money and real income

	4 lags of money					1 lag of money				
	Specification					Specification				
Monetary aggregates	*c*	*c, segt,t*	*c,ECM*	*c,segt,t,ECM*	*c,ECMT*	*c*	*c, segt,t*	*c, ECM*	*c,segt,t,ECM*	*c,ECMT*
m^T	4.68	7.62	4.90	7.53	6.15	8.79	27.82	8.08	20.05	12.42
	(.3)	(.0)	(.1)	(.0)	(.0)	(.5)	(.0)	(.1)	(.0)	(.0)
m^R	1.74	2.47	3.46	2.13	2.99	.70	4.74	3.86	2.56	2.85
	(16.0)	(6.1)	(1.1)	(8.3)	(2.2)	(40.6)	(3.5)	(2.9)	(9.0)	(6.9)
m^L	1.83	2.28	5.55	3.73	2.33	.22	3.39	6.27	3.04	1.37
	(14.1)	(7.8)	(.1)	(.8)	(6.0)	(64.3)	(7.3)	(.4)	(5.9)	(26.5)
$m^{R,L}$	2.74	3.23	4.55	4.13	4.35	2.07	9.62	5.89	7.68	5.95
	(4.2)	(2.2)	(.2)	(.4)	(.3)	(15.7)	(.3)	(.6)	(.2)	(.5)
$m^{R,C}$	3.40	4.61	5.33	4.62	5.30	3.55	12.89	6.81	7.89	6.63
	(1.7)	(.4)	(.1)	(.2)	(.1)	(6.6)	(.1)	(.3)	(.1)	(.3)
$m^{L,C}$	3.18	4.07	5.12	4.28	4.58	3.52	10.36	8.23	7.68	6.66
	(2.3)	(.8)	(.1)	(.4)	(.2)	(6.7)	(.3)	(.1)	(.2)	(.3)
$m^{R,L,C}$	3.97	5.39	6.12	5.55	5.80	4.37	16.49	9.17	10.9	8.21
	(.8)	(.2)	(.0)	(.1)	(.0)	(4.2)	(.0)	(.0)	(.0)	(.1)

† The *F*-statistic tests the hypothesis that all of the coefficients on the lags of Δm^j (and on *ECM* or on *ECMT* when appropriate) are zero. In parenthesis, *p*-values times 100. The *p*-values are based on the usual *F*-distribution. *c* denotes a constant, *segt* a linear trend spanning the period 1986:1-1989:4; *t* a time trend over the whole sample; *ECM (ECMT)* the lagged value of the residual of the cointegrating regression (specification with no time trends and with both *t* and *segt* respectively).

Table 8 PPP: Money-income causality tests. Multivariate system
(1980:1 - 1992:1)†

(A) Money and nominal income

Monetary aggregates	$y+p, m^j, r_S$					$y+p, m^j, r_S, p$				
	Specification					Specification				
	c	*c, segt,t*	*c,ECM*	*c,segt,t,ECM*	*c,ECMT*	*c*	*c, segt,t*	*c, ECM*	*c,segt,t,ECM*	*c,ECMT*
m^T	9.19 (.4)	3.05 (8.9)	10.81 (.0)	8.37 (.1)	9.40 (.0)	9.23 (.4)	2.14 (15.3)	6.44 (.4)	5.18 (1.1)	5.61 (.8)
m^R	.49 (48.7)	.11 (73.9)	2.11 (13.5)	1.11 (34.1)	1.24 (30.1)	.58 (45.2)	.04 (84.0)	.32 72.8	1.12 (33.9)	.29 (75.3)
m^L	2.48 (12.3)	.01 (93.5)	1.90 (16.3)	1.73 (19.1)	1.35 (27.2)	1.02 (31.9)	.00 (99.1)	1.13 33.4	1.66 (20.7)	.61 (54.8)
$m^{R,L}$	1.84 (18.2)	.23 (63.4)	5.30 (.9)	2.22 (12.3)	3.52 (4.0)	2.69 (11.0)	.26 (61.5)	1.87 17.0	1.57 (22.4)	1.37 (26.8)
$m^{R,C}$	2.77 (10.4)	.40 (53.3)	4.64 (1.6)	2.15 (13.1)	3.24 (5.0)	2.65 (11.2)	.29 (59.6)	1.57 22.3	1.72 (19.6)	1.31 (28.2)
$m^{L,C}$	3.12 (8.5)	.50 (48.4)	6.23 (.5)	2.64 (8.5)	3.86 (3.0)	2.52 (12.2)	.29 (59.4)	2.05 14.5	1.86 (17.3)	1.34 (27.5)
$m^{R,L,C}$	4.48 (4.1)	.96 (33.3)	7.06 (.2)	3.32 (4.8)	4.83 (1.3)	4.45 (4.2)	.72 (40.1)	3.00 6.3	2.56 (9.3)	2.34 (11.2)

(B) Money and real income

Monetary aggregates	y, m^j, r_S					y, m^j, r_S, p				
	Specification					Specification				
	c	*c, segt,t*	*c,ECM*	*c,segt,t,ECM*	*c,ECMT*	*c*	*c, segt,t*	*c, ECM*	*c,segt,t,ECM*	*c,ECMT*
m^T	7.82 (.8)	23.28 (.0)	8.89 (.1)	14.02 (.0)	7.61 (.2)	22.75 (.0)	13.34 (.1)	11.40 (.0)	7.64 (.2)	11.10 (.0)
m^R	1.74 (19.5)	4.13 (4.9)	1.81 (17.8)	2.01 (14.9)	1.26 (29.6)	4.21 (4.8)	2.04 (16.2)	2.21 (12.5)	.99 (38.1)	2.40 10.6
m^L	.32 (57.6)	1.95 (17.0)	2.40 (10.4)	2.07 (14.1)	.82 (45.0)	2.02 (16.4)	.47 (50.0)	1.54 (22.9)	1.01 (37.6)	.98 38.5
$m^{R,L}$	3.66 (6.3)	9.29 (.4)	4.39 (1.9)	5.25 (1.0)	3.02 (6.0)	2.69 (11.0)	.26 (61.5)	5.64 (.8)	3.35 (4.8)	5.86 .6
$m^{R,C}$	5.55 (2.4)	11.38 (.2)	5.10 (1.1)	5.79 (.7)	3.93 (2.8)	11.59 (.2)	6.83 (1.3)	5.64 (.8)	3.47 (4.3)	5.75 .7
$m^{L,C}$	4.76 (3.5)	9.15 (.5)	5.98 (.6)	5.38 (.9)	3.92 (2.8)	9.44 (.4)	5.16 (3.0)	4.67 (1.6)	2.78 (7.7)	4.64 1.6
$m^{R,L,C}$	5.84 (2.0)	14.18 (.1)	6.98 (.3)	7.73 (.2)	4.89 (1.3)	15.04 (.0)	8.68 (.6)	7.37 (.2)	4.58 (1.8)	7.32 .2

† The *F*-statistic tests the hypothesis that all of the coefficients on the lags of Δm^j (and on *ECM* or *ECMT* when appropriate) are zero. In parenthesis, *p*-values times 100. The *p*-values are based on the usual *F*-distribution. *c* denotes a constant, *segt* a linear trend spanning the period 1986:1-1989:4; *t* a time trend over the whole sample; *ECM (ECMT)* the lagged value of the residual of the cointegrating regression (specification with no time trends and with both *t* and *segt* respectively). All specifications with 1 lag for money and 4 lags for all other variables.