UNIVERSITÀ DEGLI STUDI DI ANCONA
DIPARTIMENTO DI ECONOMIA

EU-WIDE MONEY DEMAND: AN ASSESSMENT OF COMPETING APPROACHES

LUCA PAPI, CARLO MONTICELLI

QUADERNI DI RICERCA n. 63

QUADERNI DI RICERCA

UNIVERSITÀ DEGLI STUDI DI ANCONA

DIPARTIMENTO DI ECONOMIA

EU-WIDE MONEY DEMAND: AN ASSESSMENT OF COMPETING APPROACHES

LUCA PAPI, CARLO MONTICELLI

QUADERNI DI RICERCA n. 63

Dipartimento di Economia
Inv. n.
2255
ANCONA

maggio 1995

Comitato scientifico:

Piestro Alessandrini
Paolo Ercolani (coordinatore)
Stefano Manzocchi
Riccardo Mazzoni

EU-WIDE MONEY DEMAND: AN ASSESSMENT OF COMPETING APPROACHES

by

Luca Papi * and Carlo Monticelli **

This paper is preliminary and should not be quoted without the consent of the authors. We gratefully acknowledge financial support from CNR. Earlier versions of this paper have been presented at the European Economic Association Ninth Annual Congress. (3-5 September 1994, Maastricht) and at the conference on "The transmission mechanism of monetary policy", jointly organized by the P. Baffi Centre af Bocconi University and Catholic University of Milan (11 February 1995, Milan).

* Department of Economics, University of Ancona, Via Birarelli, 11, Ancona, Italy.

** Bank of Italy, Research Department, Via Nazionale, 91, Rome, Italy.

Introduction

The investigation of the properties of money demand functions defined for a group of EU 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) - have estimated area-wide money demand equations for different definitions of the money stock and for different groups of EU countries. The interest in this approach and the significance of the encouraging results so far obtained stem from two arguments.

First, 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 EU 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 EU 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, 1992). 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 EU is already sufficient to warrant the existence of area-wide money demands which possess desirable properties in terms of stability and predictability.

Second, the analysis of the demand for money for the EU-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. Moreover, even if the money demand remains stable in some EU 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 EU-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 EU-wide monetary aggregates. Compared to other empirical work, we develop the analysis in two main directions. First, we explore the economic properties of several EU-wide monetary aggregates which are extended to include different measures of cross-border deposits (CBD). CBD considered here consist of the deposits of the private non-financial sector held with financial intermediaries located in countries other than those in which the holders are resident. Second, we use two money demand approaches so far unexplored at the EU-wide level: the buffer stock approach and the weigthed aggregates approach.

The paper is organised as follows. Section 1 considers the preliminary issues related to the definition of area-wide variables. 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 EU-wide measures, i.e. the aggregates obtained from the sum of national broad monetary definitions. In particular, Section 2 presents the empirical evidence for traditional narrow and broad measures of money (M1 and M2). Section 3 is devoted to various definitions of extended aggregates. Section 4 presents an application of the buffer stock approach. Sections 5 contains the results of a first attempt to construct weighted aggregates at the area level. Section 6 presents concluding remarks.

[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).

1. The EU-wide variables

A preliminary question in choosing the variables for money demand at the sopranational level concerns the selection of countries which form the relevant area. The following empirical analysis refers to all the countries in the EU except Greece, Luxembourg and Portugal, which were excluded because of data limitations. In quantitative terms, this omission is minor given that the three countries account for approximately less than 5 per cent of the EU's GDP (see table 1); thus the group of countries included in the research can be regarded as an accurate proxy for the whole EU.

Once the group of countries has been choosen, the next three issues involved in the definition of EU-wide variables are the following: the selection of the relevant economic variables to include in the demand for money; the identification of the correspondent national concepts; and the choice of the aggregation method. In selecting the relevant variables we use a traditional specification of money demand. We consider four different concepts of money: a narrow monetary aggregate (M1); a broad monetary aggregate (M2); a set of monetary aggregates which are extended to include different measures of cross-border deposits (CBD); and finally a definition which represents a first attempt to construct a weigthed monetary aggregate for the EU-area. More details for the two latter definitions are provided below. All the aggregates are the quarterly averages of monthly seasonally adjusted figures.

The scale variable is represented by an income measure Y, either real GDP or GNP[2] depending on data availability, while the price variable is the corresponding deflator (P). The interest rate variables employed in the analysis[3] are the deposit interest rate[4], a proxy for the return of money, and 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 EU countries.

The question of the aggregation method has been dealt with differently for price variables and for quantity variables. For price variables, such as interest rates and price indexes, we need a weighted scheme to allow for different size of countries. In this analysis variables are weighted by the relative share of national GDP in the GDP of the

[2] Wealth, which could be appropriate for a broad monetary aggregate, was not used because of data limitations in some countries.

[3] ***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.***

[4] 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 from BIS data bank).

whole EU-area. This method takes into account changes in relative shares of GDP which do not bring correspondent changes in relative shares of EU currencies in the ECU basket. An indication of the different weights used by the different methods is given in table 1 which contains for each european country the wheights relative to different methods (shares of the ECU basket, of the M1, M2 and GDP for the whole EU-area). The method to convert quantity variables (money and income) can be referred to nominal exchange rates or PPP rates; both can be then referred to current values or to a fixed base period. In our analysis we use nominal exchange rates with the ECU, since money balances are demanded both for transactions and as a store of value. The emphasis on this method corresponds to the fact that current and future actual purchasing power in terms of foreign goods and assets is best measured by market exchange rates. Furthermore intra EU spillover effects are trasmitted through variables expressed at current exchange rates. The sample period spans from the first quarter of 1979 (inception of the EMS) to the first quarter of 1992.

2. Empirical results for traditional monetary aggregates

In the empirical analysis we follow the usual prescriptions of modern dynamic time series econometrics. The first step is to ascertain the order of integration of the EU-wide variables and to assess whether the series exhibit time trends. For the sake of brevity, only a few stationarity tests are reported for the main variables in the table 2; for the remaining variables (mainly other "extended" and weighted monetary aggregates) and for remaining tests the results are similar to those reported in table 2. Integration tests were performed on the logarithm of the EU-wide variables (with the sole exception of interest rates), 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 of countries does not provide 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, 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. Therefore, cointegration analysis is 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.

The empirical analysis of money demand for the EU area has to deal with a recurrent question in the applied literature: the comparison of performances of a narrow versus a broad monetary aggregate. In terms of composition, these aggregates show some differences among the national definitions of the european countries. Broad monetary aggregates not only should be more comparable, but due to financial innovation they should exhibit less volatility and lower interest rate semi-elasticity. These considerations have been corroborated by national money demand studies and can contribute to explain why monetary policies have usually focused on broad monetary aggregates. To assess if similar results apply for the whole area money demand we estimated equations for M1 and M2. In this context, we use a traditional specification in which money demand in real terms is related to a scale variable, to a measure of opportunity cost and to a vector of deterministic components.

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). In this analysis, the assumption is retained because the theoretical arguments which underpin it seem compelling. Furthermore, preliminary tests for some of the aggregates based on the Johansen method supported the validity of the restriction. In line with the mixed findings on the trend characteristics of the variables, and as a test of the robustness of the results, a linear trend (denoted by *segt*)[5] is also added to the specification[6].

Table 3 presents the results of the long-run equations for M1 and M2 definitions of EU-wide money. Starting with the second row (which refers to the broad definition of money (m2-p)), test results do not reject the hypothesis that the simple trivariate model of money demand for m2 cointegrates irrespective of the insertion of time trends in the specification. This finding confirms the results of previous studies providing further support to the assumption that the degree of economic and financial integration within the EU is already sufficient for an area-wide demand for broad money to be stable in the long-run.

However, some small differences emerge among the three m2 specifications. 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. When the linear trends are added to the specification, the income elasticity is significantly reduced,

[5] The period spanned by *segt* was chosen on the basis both of the hints provided by the stationarity tests and the results in Monticelli and Strauss-Kahn (1993). 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.

[6] In the last 15 years, M1 and M2 followed quite different paths (see Figure 5.1); for this reason, we use different segmented trends for the two aggregates. In particular, for M1 the trend spans from 1984:3 - 1990:1, whereas for M2 it spans from 1986:1 to 1989:4.

reaching values that are not inconsistent 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) and with the assumtion that broad money is a superior good. 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 deregulation accelerated, raising both the liquidity of and 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 1. Trends are certainly ad hoc regressors to capture the effects of these developments and ideally economic variables should be used instead of such proxies for the intensity of financial innovation and measures of real and financial wealth. Unfortunately, data limitations for several EU 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 M2 are stable across specifications. They lie on the low side of the range of semi-elasticities usually reported in national studies for European countries[7], 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 where more attention is paid to financial innovation. In fact, 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. These developments have weakened the validity of the hypothesis that monetary assets are non-interest bearing. In a effort to overcome this limitation, we have tried a different specification replacing the interest regressor with the differencial between the three-month interbank rate and the return on time deposits.

The results from the model with the interest rate differential, reported in Table 4, are on the whole very encouraging. The cointegration results obtained in the previous model

[7] In this respect the United Kingdom represents an exception: Hall et al. (1991) could not find any significant response of money demand to interest rates.

are confirmed but the stimates of the long run parameters are closer to the values which could be expected on the basis of economic theory. Iincome elasticities tend to he lower and, more importantly, interest rate semi-elasticities are significantly higher.

Quite different results are obtained for the narrow monetary aggregate (M1). In this case cointegration is found only in one of the three models considered and in particular when two trends are included (see Table 3). That model presents a plausible value for the interest rate semi-elasticity (higher than M2) but the income elasticity appears too high (1.29) in the light of what economic priors are for narrow aggregates (we expect lower values for transactive balances and therefore in the case of narrow aggregate income elasticity should be lower than for wider aggregates). Finally, the money demand function for M1 has been estimated also with the interest differential. In the latter case the results confirm the conclusions obtained in the case of M2 (see Table 4).

Before completing the empirical analysis with the study of short run dynamics, we checked the properties of the long run equation using Johansen's methodology (Johansen 1988). Using this method it is possible to test both the hypothesis of a single cointegration vector and restrictions on the values of long run equation parameters.

Table 5 about here

The results are presented in the Table 5 which, in addition to the test of the existence of a single cointegration vector, reports both the estimates of the coefficients and the test that these coefficients are equal to those obtained by OLS method. For M1 the results of *Trace* and *Lambda max* tests confirm the presence of a single cointegration vector. More mixed are the results in the case of M2 where we cannot refuse the existence of a second and perhaps a third cointegration vector. However these results must be interpreted with caution since we compared statistics values with the critical values contained in Johansen and Juselius (1990) which do not provide for segmented trends in the equations. Furthermore the fact that for both the aggregates we are not able to reject the hypothesis estimates of the long run equation are equal to those obtained in the first stage of the Engle and Granger method, provides a further element in favour of the hypothesis of the unicity of the cointegration vector. In conclusion, although some ambiguities remain about the unicity of the cointegration vector, the results of the Johansen procedure seem to confirm the validity of the results obtained by the Engle and Granger method which are robust also to changes in the estimation method.

Having analysed the behaviour of the long-run relationship, we need to investigate the short run dynamics of money demand. The estimation of dynamic models of money demand complements the empirical analysis of the long-run equations in two respects. First, 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. Second, 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 by error-correction models (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. Hence, for the sake of brevity, results from the single-stage approach are not reported. We report below the results of the estimation of the broad aggregate demand function (m2-p) and of the narrow aggregate demand function (m1-p).

The specification search used Hendry's general-to-specific modelling strategy to arrive at the following dynamic equations. ECM_{-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.

$$\Delta(m2-p)_t = \underset{}{0.001} + \underset{(-0.53)}{0.321}\ (\Delta(m2-p)_{t-1} + \Delta(m2-p)_{t-2}) + \underset{(5.05)}{0.668}\ \Delta y_t + \underset{(6.39)}{-0.232}\ \Delta y_{t-1} - \underset{(-1.96)}{0.193}(\Delta R_t + \Delta R_{t-1}) - \underset{(-3.24)}{0.552}\ ECM_{t-1} \quad (-5.29)$$

$R^2 = 0.716$ $\sigma = 0.0047$ DW = 1.94

$$\Delta(m1-p)_t = \underset{}{-0.001} + \underset{(-0.95)}{0.313}\ \Delta(m1-p)_{t-1} + \underset{(3.03)}{0.214}\ \Delta(m1-p)m_{t-2} + \underset{(2.01)}{0.247}\Delta(m1-p)_{t-4} + \underset{(2.65)}{0.403}\ \Delta y_t - \underset{(-2.20)}{0.366}\Delta R_t - \underset{(-1.88)}{0.341}\Delta R_{t-1} - \underset{(-3.88)}{0.463}\ ECM_{t-1}$$

$R^2 = 0.736$ $\sigma = 0.0067$ DW = 1.89

Both equations have very satisfactory statistical performances. Both models explain a high share of the variation in real money growth. They pass all the diagnostic tests here omitted for the sake of brevity. The estimated equation standard errors compare 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 UE 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 specially in the 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[8], this finding is yet another indication of the good economic and statistical properties of the above money demand function. The satisfactory statistical performance is also corroborated by the good track of the real money growth (see Figure 2 for the broad money case).

3. "Extended" monetary aggregates

European CBD have been growing rapidly in recent years, becoming an increasingly important aspect of the developments in the financial and monetary sphere. However, the empirical analysis of area-wide money demands for groups of EU countries has so far neglected CBD, since it has relied on area-wide measures of money obtained from the sum of national aggregates, thereby underestimating the European money stock. Hence, the empirical question *whether* the inclusion of CBD can improve the usefulness of an area-wide monetary aggregate for policy purposes has to be addressed in terms of *which* CBD may potentially be considered part of a EU-wide measure of money.
Therefore, the empirical analysis of this section aims at investigating the economic and statistical characteristics of different monetary aggregates extended to different typology of CBD.

[8] 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.

So far we used traditional definitions of monetary aggregates to obtain the area-wide aggregate as a simple sum of national monetary aggregates. However, this method meets the consistency requirement, i.e., it does not give rise to omissions or duplications, only if every country follows one and the same of the following three criteria: residence of the holder, location of the issuer, currency of denomination. Usually, central banks use an hybrid method based on the first two criteria. When considering area-wide measures of money this practice, which for deposits includes only deposits of residents held with banks located within the country, will systematically understimate the area-wide money consistently defined on the basis of the same criteria with reference to the whole area. This underestimate appears particularly relevant in the light of the high growth of CBD in the recent years.

The consideration of CBD in the money measure is not only an abstract question of logical coherency but raises an important economic concern: establishing which criterion (or combination of criteria) gives rise to the best monetary aggregate in terms of predictability and stability. In other words, we have to decide which kind of CBD we have to add to the traditional definition of money. The answer to this question can be only provided by the empirical analysis, given that only for some kinds of CBD we have strong theoretical reasons to exclude them from the relevant monetary aggregate.

Table 6 presents a CBD classification of the possible solutions. The table contains 13 cells on 5 columns. The first column (**N-BO**) denotes Non resident CBD held with Banks located Outside the area; the second column (**R-BO**) represents Resident CBD held with Banks located Outside the area; the third column (**N-BI**) represents Non resident CBD held with Banks locate Inside the area. The forth column (**R-BI**) represents Resident held with Banks located Inside the area; finally the fifth column (**R-BC**) represents money as usually defined in official definitions that is Resident CBD held with Banks located Inside the country. In the latter case deposits are not CBD if such deposits can be denominated in foreign currencies (cells 8 and 13). In any case, all the cells do not take into consideration the currency of denomination of the correspondent deposits.

The definitions of area-wide money which can be obtained by the application of different criteria are the following:

M^T = traditional money obtained by the sum of the national aggregates such as defined by central banks[9]. In terms of the Table 6 we have:

$$M^T = \text{column R-BP}$$

[9] We assume that all EU countries define money as the sum of relevant istruments held by residents with banks located within the country, irrespective of the currency of denomination. In fact, this definition represents the most widespread procedure among central banks.

M^R = money obtained by the sum of M^T and by resident CBD irrespective of the location of the issuer and of the currency of denomination. In terms of Table 6 they are represented by columns **R-BO**, **R-BI** and **R-BC** (shadow area), viz:

$$M^R = M^T + \text{column R-BO} + \text{column R-BI}$$

M^L = Money obtained by the sum of M^T and by CBD hold with banks located in the area but irrespective of the residence of the holder and of the currency of denomination. In terms of Table 6, we are considering the last three columns: **N-BI**, **R-BI** and **R-BC** (the area within the double line), viz:

$$M^L = M^T + \text{column N-BI} + \text{column R-BI}$$

M^V = Money obtained by the sum of M^T and by CBD denominated in the area currencies but irrespective of the residence of the holder and of the location of the bank. In terms of Table 6, the relevant cells are the first eight (the area within the thick black line) that is:

$$M^V = M^T + \text{cells 1, 2, 3, 4, 6 and 7}$$

M^{RL} = Money obtained by the sum of M^T and by resident CBD hold with banks located in the area but irrespective of the currency of denomination. The relevant cells result from the overlapping of the residence criterion area and of the bank location criterion area, viz:

$$M^{RL} = M^R \cap M^L = M^T + \text{column R-BI}$$

M^{RV} = Money obtained by the sum of M^T and by resident CBD denominated in the area currencies but irrespective of the location of the bank, viz:

$$M^{RV} = M^R \cap M^V = M^T + \text{cells 2, 4, and 7}$$

M^{LV} = Money obtained by the sum of M^T and by CBD hold with banks located in the area and denominated in area currencies but irrespective of the residence of the holder, viz:

$$M^{LV} = M^L \cap M^V = M^T + \text{cells 3, 4, 6 and 7}$$

M^{RLV} = Money obtained by the sum of M^T and by resident CBD hold with banks located in the area and denominated in area currencies, viz:

$$M^{RLV} = M^R \cap M^L \cap M^V = M^T + \text{cells 4 and 7}$$

Among these definitions the last one is obviously the narrowest and presumably most related to spending decisions. Conversely M^V which includes also non resident CBD hold with banks located outside the area should not show significant links with spending made inside the area. For these reasons we have not taken into account M^V in the econometric analysis.

Table 7 presents the econometric results of the long run equations for the different definitions of EU-wide monetary aggregates. The table also contains the M2 results since these results can be considered a benchmark to assess the performance of the extended aggregates. All the specifications are similar to those considered for the traditional aggregates. The second and the third rows of Table 7 show that the demand for aggregates which include "broad" measures of CBD (i.e., measures based on the application of one defining criterion only) fail 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 EU. M^R in fact, contains EU residents' CBD located outside Europe, possibly in off-shore financial centres, and denominated in non-EU currencies. Delocalisation of deposits outside the EU 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-EU 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 CBD (see Alworth and Andresen, 1992). Similar reasons account for the lack of cointegration for M^L. The latter aggregate includes non-EU residents' CBD kept with intermediaries located in European financial centres - such as London or Luxembourg - which can be expected to attract funds from outside the Community more in relation to the financial services they provide than as a result of the developments in EU-wide aggregate income. Cointegration instead holds for the other extended aggregates, which include the narrower measures of CBD 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 EU-wide link between aggregates extended for CBD, output and the interest rate may be less strong and dependable than for the money measure which excludes CBD. 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 that portfolio considerations play a more important role than transactions motives in the demand for CBD, 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 already shown in chapter three EU-

residents have increasingly tended to place the CBD they keep within the Community in EU currencies. Therefore, combinations of these criteria yield measures of CBD 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-EU residents' CBD denominated in non-EU currencies, although kept with financial intermediaries located in the EU, (these CBD account for a large part of the difference between m^L and $m^{L,C}$) are not linked with spending decisions within the EU.

The results for the dynamic money demand functions for the extended monetary aggregates are presented in the Table 8, together with the results for M2 (first row).

For all aggregates, including m^R and m^L, the statistical performance of the equation is quite good, the dynamics quite similar to that obtained for the traditional money and the error-correction term has high *t*-statistics. The ECM values of extended aggregates are always smaller than traditional aggregates and this result seems consistent with the hypothesis of higher adjustment costs in the case of assets hold abroad. The high statistical significancy of the ECM term is somewhat puzzling, since it conflicts with the results of the cointegration tests (Table 7), 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 show that the statistical performance worsens for all aggregates. 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. Although only tentative conclusions can be drawn, this evidence 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.

Although with some caution, we can assert that the economic and statistical characteristics of extended aggregates are quite good especially in the cases of aggregates where residence criterion is involved; in particular m^{RLV} is the aggregate with the best performance. However, extended aggregates never outperform the traditional definition of money, 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 EU level, if the progress of financial and economic integration is associated with significant additional delocalisation of deposits.

4. An application of the buffer stock approach

In the present and following sections we apply buffer stock and divisia index approaches to the analysis of area-wide money demand. Because of difficulties involved in collecting data for different countries we have followed very simple formulation for both approaches. In both cases, we can specify a money demand equation in two ways: we derive a buffer variable and a weighted monetary aggregate from a simple sum of national variables, or derive a buffer variable and the weighted aggregate directly using variables relative to the whole area. The empirical analysis has applied both models.

The buffer stock approach has been implemented using a simple shock absorber formulation where money demand is represented in the following way:

[1] $$(m-p)_t^d = f(\mathbf{x}) + \zeta m_t^i + u_t$$

[2] $$m_t^a = g(\mathbf{z})$$

Equation 1 presents money demand as sum of two components: $f(\mathbf{x})$ represents the desired money and m^i represents the transitory and unexpected money. The latter is defined by the difference between the quantity of money and the expected money as obtained from equation 2, where $\mathbf{z}$ is a set of variables used by operators to forecast money. Forecast errors determine m^i which affects money demand through the parameter ζ. Equation 2 denotes the mechanism for the construction of buffer variable. As regards this variable construction, many solutions have been suggested in the literature. In the case of money demand for a group of countries, these solutions are even more numerous because every solution can be applied at the national or area level. The calculation of the buffer variable at the area level implies that operators of every country use the same mechanism to form expectations on money growth; besides, this solution does not consider the effects of foreign circunstances (restricted to area countries) in affecting money expectations. On the countrary, if in forming expectations operators do not consider spillover effects within the area it will be more correct to construct the area buffer variable summing forecast errors made at the country level[10].

In the literature, the buffer stock approach has been usually opposed to the ECM dynamic approach. Both are usually considered as two quite distinct attempts to represent the process of adjustment of money demand function (i.e., Boughton and Tavlas 1991). In this analysis we do not follow this juxtaposition, which in our view, is questionable and we use jointly both the ECM term and the buffer variable within the same equation. In particular, we include a buffer variable among the variables which

[10] The buffer variable was obtained summing expected money antilogs, taking the log and subtracting it from the area money log.

determine the dynamic structure, whereas long run propierties are determined using a traditional specification. In other words, we include a buffer variable in the second stage of the Engle and Granger method[11].

Forecasts on money growth were obtained by an autoregressive model both at national and EU-area level. The two buffer variables, calculated for the broad aggregate M2, show very similar profile and size. The estimation results are presented in the first and third row of Table 9[12]. In both cases, the buffer term is always significant and in sign and size is in line with economic prescriptions. Very similar too are the other features of the equation compared to the traditional aggregate (reported in the fifth row of table 9). The ECM coefficient is practically the same, whereas the dynamic structure is slightly different since a regressor is not significant in the case of buffer stock formulation. By and large, we can say that money carries out a buffer role and if this function is not explicitly considered its effect is represented by other regressors.

Since in the buffer stock approach, results might be conditional on the method employed in formulating forecasts of money growth, we use also the Kalman filter as additional method to construct money forecasts. The results are quite similar to those obtained above. The only difference concerns the size of buffer variable which, in the latter case, is slightly bigger. Following the same procedure as the previous case, we include forecasting errors in the short run specification of money demand. Results are reported in the second and fourth row of table 9. Also with the Kalman filter procedure, the buffer term coefficient appears statistically significant, whereas practically unchanged are the other regressors. The only variation concerns the ECM coefficient now smaller. Besides the standard error of the equation diminuishes substantially. In sum, the exercises presented in this section provide further confirmation of the strong performance of the EU-area money demand function and in addition they indicate that buffer stock variables can improve the performance of models based on the ECM approach.

5. Area-wide weighted aggregates

Monetary aggregates as usual defined in official statistics are obtained as a simple sum of various financial instruments. This method does not take into account the different degree of liquidity of each instrument, but rather it assumes perfect substitutability among them. In this section, we present a first attempt to construct a weighted aggregate

[11] Cuthbertson and Taylor (1987) follow a similar procedure within a general to specific approach.

[12] The exercises with the buffer variable were conducted for the M2 aggregate. The choice of the most appropriate definition of money to apply the buffer stock approach is controversial. However, recently Mizen (1992) has suggested empirical and theoretical reasons in favour of broad aggregates.

for the whole EU-area following the simplest formulation. We consider financial instruments forming part of the definition of M2 classifying them in only two sets. The empirical analysis will focus on the Currency Equivalent Aggregate, proposed by Rotemberg, Driscoll and Poterba (1991). The M2 components considered are M1, which represents the most liquid instrument and therefore with a weight equal to one, and the set of instruments summed to M1 to obtain M2 which represents the less liquid componet with a weight less than one. The return on the latter component is the average deposit interest rate. Long run public bonds have been choosen as a benchmark asset.

Because of lags and inertia in portfolio switching it is not right to interpret interest changes as alterations in the liquidity services provided by the different assets; in this respect, we use four period moving averages arguing that individuals do not continuosly adjust their portfolios and that they form their expectations on the basis of average changes in interest rates during the year.

As in the case of buffer stock approach, we can also construct area-wide variables for weighted aggregatesas a sum of national weighted variables or working directly on area-wide variables. In the first case the weighted measure of area-wide money (denoted as Σ CE) is obtained by summing weighted aggregates of different countries, viz:

[3] $$\Sigma CE = \sum_s \sum_i \frac{R_{Bs} - R_{is}}{R_{Bs}} M_{is}$$

where s is the index relative to countries, i to financial instruments and R_{Bs} is the rate of return of the benchmark asset of country s.

The second method constructs the weighted aggregate (denoted *CE EU*) using data for the whole area, viz:

[4] $$CE\,UE = \sum_i \frac{R_{BUE} - R_{iUE}}{R_{BUE}} M_{iUE}$$

where $R_{iUE} = \sum_s \omega_s R_{is}$, $M_{iUE} = \sum_s M_{is}$ and ω_s is the weight for country s in the formula of the rate of return of i-th financial instrument.

The velocities of circulation for the two weighted aggregates calculated on the basis of the two methods present a higher variability compared to traditional aggregates and are more similar to the pattern of M1 velocity. This feature should depend on the method we use to construct weighted aggregates which give a weight equal to unity to all financial instruments included in M1. Before presenting empirical results it is worthwhile to discuss why we introduce an interest rate variable in a specification for weighted aggregates. For traditional aggregates we have used the following long run money demand function:

[5] $$(m-p)_t = a_0 + \alpha y_t + \beta_0 R_{pt} + \beta_1 R_{at} + u_t$$

wher R_p and R_a are the return on money and on alternative assets.

In particular, in the previous pages we applied two special cases of equation 5, that is, $\beta_0 = 0$ and $\beta_0 = -\beta_1$. When we refer to weighted aggregates the formulation of equation 5 becomes:

[6] $$(CE-p)_t = a_0 + \alpha y_t + \beta_2 CO_t + u_t$$

where the interest rate variables have been modified for two main reasons. First, since the weighted aggregate is a measure of liquidity (currency equivalent), we do not have to include a rate of return on the aggregate. Second, the opportunity cost measure has to represent a weighted average of the different opportunity costs associated with liquidity services provided by the various financial instruments. In particular, we shall have:

[7] $$CO_t = \sum_i \frac{R_t - R_{it}}{1 + R_{it}} \left(\frac{M_{it}}{CE_t} \right)$$

where every R-R_i represents the interest rate lost for holding the ith instrument and where the discount factor takes into account that interest is paid in the next period.

As in the case of traditional aggregates, following the integration results, cointegration analysis included deterministic trends. These specifications produced the best performance. The correspondent results are reported in table 10, both for the aggregate obtained at EU-area level (*CE-EU*), and for the aggregate constructed as a sum of weighted national aggregates (ΣCE). For both procedures cointegration results were very similar. However, income elasticities are quite different whereas the two procedures have provided similar coefficients for opportunity cost with values higher than for M2 and analogous to those obtained in the M1 case. These values are also higher compared to those obtained in national studies (e.g., Gaiotti 1994; Ayuso and Vega 1993; Fisher and al. 1993). This feature might be due to our construction method which assigned a higher weight to M1 components.

The analysis of weighted aggregate was completed with estimates of short run dynamics. Equations are reported below equations, both for the procedure at the national level and at EU-area level, viz::

$$\Delta(\Sigma CE - p)_t = -0.001 + 0.425\Delta(\Sigma CE - p)_{t-1}$$
$$(-0.31) \quad (4.29)$$
$$+0.808\Delta y_t - 0.448\Delta CO_t - 0.504 MCE_{t-1}$$
$$(2.47) \qquad (-4.66) \qquad (-3.83)$$

$R^2 = 0.61$ $\sigma = 0.015$ DW = 1.72

$$\Delta(CE\,UE - p)_t = 0.001 + 0.201(\Delta(CE\,UE - p)_{t-1} + \Delta(CE\,UE - p)_{t-2})$$
$$(0.22) \quad (1.94)$$

$$+0.704\Delta y_t - 0.692\Delta(\quad)O_t + 0.31\Delta CO_{t-1} - 0.504MCE_{t-1}$$
$$(1.73) \quad (-2.78) \quad (1.44) \quad (-3.78)$$

$R^2 = 0.35$ $\sigma = 0.021$ DW = 1.89

In both equations, the ECM term has a high and significant coefficient, but the explanatory power is lower compared to traditional monetary aggregates. The latter aspect seems a common feature of weighted aggregates and might reflects difficulties in representing the pattern of these aggregates which usually are more volatile. Between the two weighted aggregates the one constructed at national level performs better and has simpler dynamics.

6. Conclusion

Area-wide money demand was analysed using various definitions of money: we investigated the performance of narrow and broad concepts of money (M1 and M2), of different extended aggregates and of two weighted monetary aggregates. Money demand equations were estimated in real terms through basic specifications where the RHS variables were income, the rate of return on money and on alternative assets and in some formulations a trend was included. Cointegration analysis for traditional aggregates points out a stable long run relationship among money and the above-mentioned variables. Income and interest rate coefficients are plausible, with values for income elasticity similar to the higher values obtained in national studies, whereas for interest rates, semielasticity values are similar to lower values obtained in national studies. Results more in line with average national studies and with economic theory were obtained using interest rate differentials. Results using Engle and Granger method were confirmed by the Johansen method.

Short run dynamics features were analysed by single stage and two stage approaches. Both procedures gave rise to similar results with good performance both in terms of statistical reliability and forecasting power. The dynamic structure following changes in income and interest rate are simple and economically plausible. The ECM term has the right sign and it is highly significant corroborating the assumption of cointegration among variables.

For the extended aggregates the results were mixed. For the wider definitions, i.e., those obtained applying only one CBD classification criterion, cointegration was not found. On the countrary, cointegration holds for extended aggregates defined on the basis of more than one CBD criterion. For these aggregates, statistical performances and dynamic structures are similar to those of traditional measures of money. ECM terms are always very significant but values are smaller than those of traditional definitions of

money. Among extended aggregates the best results were obtained for definitions which include the residence criterion and in particular, M^{RLV} is the aggregate with the best performance in short run and long run specifications. Nevertheless, extended aggregates never outperform the traditional definition of money, which consequently still remains the preferred monetary aggregate.

We also applied the buffer stock and the weighted aggregate approaches to area-wide money demand. In both cases the relevant variables were constructed both at the national and area levels. The buffer term was always significant and its value in line with theoretical prescriptions: the corresponding equation has simpler dynamics and a lower standard error compared to standard specifications. Robust results were obtained also for weighted aggregates: we found cointegration and plausible values for income elasticity and for the opportunity cost variable. The equations for the weighted aggregates had a high and significant ECM term, simple dynamics but a lower explanatory power compared to traditional aggregates.

REFERENCES

Alworth, J. S., and Andresen, S. (1992) 'The Determinants of Cross-Border Non-Bank Deposits and the Competitiveness of Financial Market Centres', *Money Affairs*, 5. 105-133.

Ayuso, J., and Vega, J. L. (1993) 'Weighted Monetary Aggregates. The Spanish Case', Banco de España, Documento de Trabajo, n. 9303.

Bekx, P., and Tullio, G. (1989) 'A Note on the European Monetary System, and the Determination of the DM–Dollar Exchange Rate', *Cahiers Economiques de Bruxelles*, 123, 329-343.

Boughton, J. M. (1991) 'Long-Run Money Demand in Large Industrial Countries', *IMF Staff Papers*, 38, 1-32.

Boughton, J. M., and Tavlas, G. S. (1991) 'What Have We Learned about Estimating the Demand for Money? A Multicountry Evaluation of Some New Approaches', IMF Working Papers, n. 91/16.

Cuthbertson, K., and Taylor, M. (1987) 'Monetary Anticipations and the Demand for Money. Some Evidence for the UK', *Weltwirtschaftliches Archiv*, 123, 509-520.

de Bandt, O. (1991) 'Politique Monétaire et Agrégats de Monnaie en France', *Bulletin Trimestriel de La Banque de France*, 78. 79-93.

Engle, R. F., and Granger, C. W. J. (1987) 'Cointegration and Error Correction. Representation, Estimation and Testing', *Econometrica*, 55, 251-276.

Fase, M. M. G., and Winder, C. C. A. (1992) 'The Demand for Money in the Netherlands and the Other EC Countries', De Nederlandsche Bank Research Memorandum, n. 92/14.

Fisher, P., Hudson, S., and Pradhan, M. (1993) 'Divisia Index for Money. An Appraisal of Theory and Practice', Bank of England Working Papers, n. 18.

Gaiotti, E. (1994) 'Measuring Money with a Divisia Index. An Application to Italy', Banca d'Italia, Temi di Discussione, n. 223.

Goodfriend, M. (1985) 'Reinterpreting Money Demand Regressions', in Brunner, K., and Meltzer, A. H. (eds.), *Understanding Monetary Regimes*, Carnegie-Rochester Conference Series on Public Policy, n. 22. Amsterdam, North Holland, 207-242.

Hall, S. G., Henry, S. G. B., and Wilcox, J. B. (1991) 'The Long Run Determination of UK Monetary Aggregates', in Henry, S. G. B., and Patterson, K. D. (eds.), *Economic Modelling at the Bank of England*. London, Chapman and Hall, 127-166.

Jeanfils, P. (1992) 'La Demande de Monnaie', *Banque Nationale de Belgique*, Mimeo.

Johansen, S. (1988) 'Statistical Analysis of Cointegrating Vectors', *Journal of Economic Dynamics and Control*, 12, 231-254.

Johansen, S., and Juselius, K. (1990) 'Maximum-Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money', *Oxford Bulletin of Economics and Statistics*, 52, 169-210.

Kremers, J. J. M., Ericsson, N. R., and Dolado, J. J. (1992) 'The Power of Cointegration Tests', *Oxford Bulletin of Economics and Statistics*, 54, 325-347.

Kremers, J. J. M., and Lane, T. D. (1992) 'The Implications of Cross-Border Monetary Aggregation', IMF Working Papers, n. 92/71.

McKinnon, J. (1991) 'Critical Values for Cointegration Tests', in Engle, R. F., and Granger, C. W. J. (eds.), *Long-Run Economic Relationships. Readings in Cointegration*, Oxford, Oxford University Press, 267-277.

Mizen, P. (1992) 'Should Buffer Stock Theorists be Broad or Narrow-Minded? Some Answers from Aggregate UK Data, 1966–1989', *The Manchester School*, 60, 403-418.

Monticelli, C., and Strauss-Kahn, M. O. (1992) 'Broad Monetary Aggregates and Money Demand in European Countries. Where Do We Stand?', *Economies et Sociétés*, 9, 147-193.

—— (1993) 'European Integration and the Demand for Broad Money', *The Manchester School*, 61, 345-366.

Monticelli, C., and Viñals, J. (1993) 'European Monetary Policy in Stage Three. What are the Issues?', CEPR Occasional Papers, n. 12.

Muscatelli, A., and Papi, L. (1990) 'Cointegration, Financial Innovation and Modelling the Demand for Money in Italy', *The Manchester School*, 58, 242-259.

Perron, P. (1989) 'The Great Crash, the Oil Price Shock and the Unit Root Hypothesis', *Econometrica*, 57, 1361-1401.

—— (1990) 'Further Evidence for Breaking Trend Functions in Macroeconomic Variables', Princeton University Working Papers, n. 350.

Pesaran, M. H., Pierse, R. G., and Kumar, M. S. (1989) 'Econometric Analysis of Aggregation in the Context of Linear Prediction Models', *Econometrica*, 57, 861-88.

Rotemberg, J., Driscoll, J., and Poterba, J. (1991) 'Money, Output and Prices. Evidence from a New Monetary Aggregate', Working Papers EFA, n. 3384.

Schmid, P., and Herrman, H. (1991) 'Federal Republic of Germany. Old and New Problems Posed by a Target-Guided Monetary Policy', in *The Orientation of Monetary Policy and the Monetary Policy Decision-Making Process*, Basle, Bank for International Settlements, 68-86.

van Riet, A. G. (1992) 'European Integration and the Demand for Money in the EC', *De Nederlandsche Bank Quarterly Bulletin*, 3, 33-43.

Table 1. Wheights for aggregation[1]

	Wheights in ECU basket[2]	M2 share[3]		M1 share[3]		GNP share
	1992	1979.1-1989.4	1990.1-1992.1	1979.1-1989.4	1990.1-1992.1	1992
France	19.0	20.2 (19.6)	19.1 (19.2)	22.9 (21.1)	19.2 (18.7)	19.2
Germany	30.1	24.2 (20.6)	24.7 (22.4)	22.3 (18.9)	25.6 (22.7)	23.2
Italy	10.15	14.1 (5.3)	13.0 (12.1)	20.2 (23.5)	16.3 (16.7)	18.4
UK	13.0	18.5 (20.0)	19.7 (21.3)	13.7 (14.8)	16.6 (18.1)	17.7
The main four countries	72.25	77.0 (65.5)	75.5 (75.0)	79.1 (78.3)	77.7 (76.2)	78.5
Belgium	7.6	4.2 (4.0)	4.4 (4.3)	3.5 (3.3)	3.2 (3.2)	3.1
Denmark	2.45	1.4 (1.2)	1.5 (1.2)	2.6 (2.0)	3.2 (2.6)	1.7
Greece	0.8	1.4 (1.4)	1.4 (1.4)	1.5 (1.5)	1.5 (1.5)	1.7
Irland	1.1	0.5 (0.5)	0.4 (0.4)	0.3 (0.3)	0.3 (0.3)	0.7
Netherlands	9.4	6.0 (5.1)	6.5 (6.7)	5.7 (5.4)	6.4 (7.1)	4.7
Portugal	0.8	1.6 (1.6)	1.6 (1.6)	1.5 (1.5)	1.5 (1.5)	1.5
Spain	5.3	7.7 (10.1)	7.8 (8.9)	5.7 (7.5)	6.6 (7.5)	8.1

[1] The complement to 100 reflects Luxemburg's share, here not included.
[2] Weights are calculated on central parities.
[3] Average share of the whole EU-area money calculated on the basis of current exchange rates. Shares calculated on the basis of PPP rates are shown in brackets.

Table 2. Tests for Integration (1979:1-1992:1)[1]

	Unit roots tests						t-statistics for a regression of Δx on:	
	Drift			No drift				
Series	DF	ADF	Z_t	DF	ADF	Z_t	trend	constant
Δm1	-4.86**	-4.40**	-5.06**	-4.89**	-4.45**	-5.03**	1.83‡	2.46**
Δ(m1-p)	-4.10**	-3.96*	-4.28**	-3.73**	-3.61**	-3.86**	1.77‡	3.11**
Δm2	-4.58**	-3.90*	-4.62**	-4.19**	-3.62**	-4.11**	-1.73‡	4.26**
Δ(m2-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‡	0.40
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**
ΔR	-4.28**	-4.09*	-4.47**	-4.28**	-3.85**	-4.49**	0.26	-0.23

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

Table 3. Cointegration analysis (1979:1-1992:1)[1]

Monetary Aggregates	Constant				Constant, segt				Constant, segt, t			
	Coefficient on		Test statistics		Coefficients on		Test statistics		Coefficients on		Test statistics	
	y	R	DF	PP	y	R	DF	PP	y	R	DF	PP
m1-p	1.40	-0.31	-3.44	-3.47‡	0.023	0.15	-3.02	-3.03	1.29	-0.90	-5.19**	-5.19**
m2-p	1.69	-0.53	-5.59**	-5.71**	1.41	-0.58	-4.87**	-5.03**	1.25	-0.49	-5.15*	-5.19**

[1] Significant at the 1 % (**), 5 % (*) and 10 % (‡). Segt denotes a linear trend (see footnote in the main text), while t denotes a time trend over the whole sample. DF and PP denote the "Dickey-Fuller" cointegration test and the test statistics proposed by Phillips (1987) and Phillips e Perron (1988). The PP test was performed in a specification with four lags. Critical values are from McKinnon (1991).

Table 4.Cointegration analysis (1979:1-1992:1)[1]
(Specification with the interest rate differential)

Monetary Aggregates	Constant				Constant, segt				Constant, segt, t			
	Coefficients		Test statistics		Coefficients		Test statistics		Coefficients		Test statistics	
	y	R	DF	PP	y	R	DF	PP	y	R	DF	PP
m1-p	1.43	-0.07	-2.74	-3.68‡	-0.012	0.62	-3.23	-3.25	1.022	-1.66	-4.43**	-4.45
m2-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*

[1] See footnote in table 3.

Table 5. Cointegration analysis (Johansen method)

	Null hypothesis	Trace test	Lambda max test	Cointegration vector		Equality test[1]
				Coeff. on y	Coeff. on R	
M2	r = 0	51.31**	24.49*	1.26	0.29	1.43
	r ≤ 1	26.82**	16.97*			
	r ≤ 2	9.85*	9.85*			
M1	r = 0	39.64**	22.87*	1.37	1.09	1.56
	r ≤ 1	16.77	8.96			
	r ≤ 2	7.81	7.81			

**/* Test statistics higher than critical values at the 1 %. Critical values for *Trace* test and *Lamba max* test are from Johansen and Juselius [1990].

[1] χ^2 test for the restriction that parameters are equal to estimates obtained in the first stage of Engle and Granger method.

Table 6. Classification of *cross border deposits*

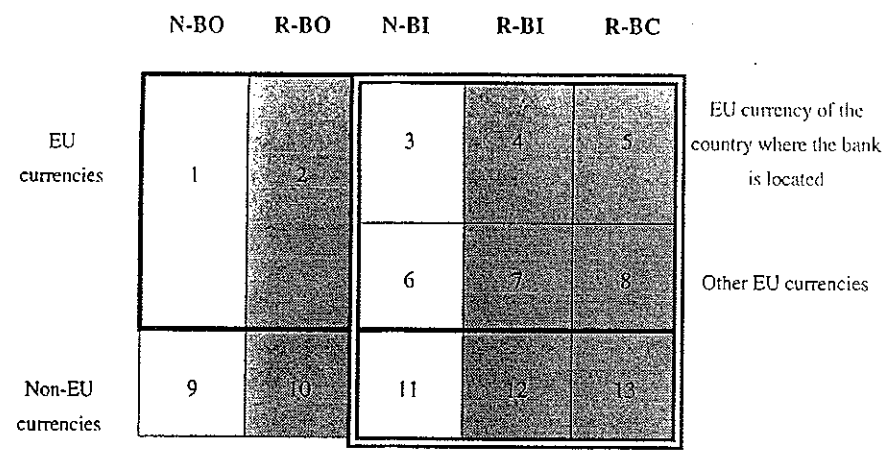


Table 7. Cointegration analysis (1979:1-1992:1)[1]

Monetary aggregates	Constant				Constant, segt				Constant, segt, t			
	Coefficients		Test statistics		Coefficients		Test statistics		Coefficients		Test statistics	
	y	R	DF	PP	y	R	DF	PP	y	R	DF	PP
m^{I}-p	1.69	-0.53	-5.59**	-5.71**	1.41	-0.58	-4.87**	-5.03**	1.25	-0.49	-5.15*	-5.19*
m^{R}-p	2.02	-0.62	-3.05	-3.34	2.08	-0.61	-3.19	-3.51	1.51	-0.29	-4.12‡	-4.53‡
m^{L}-p	1.87	-0.85	-2.00	-2.05	2.21	-0.80	-2.01	-2.07	0.85	-0.04	-2.82	-3.10
m^{R-L}-p	1.93	-0.60	-3.47‡	-3.75	1.86	-0.61	-3.30	-3.55	1.33	-0.32	-4.55*	-4.69*
m^{R-C}-p	1.96	-0.55	-3.89‡	-4.25*	1.87	-0.56	-3.65	-3.97*	1.44	-0.32	-4.63*	-4.81*
m^{L-C}-p	1.95	-0.62	-3.88‡	-4.17*	1.89	-0.63	-3.70	-3.97*	1.41	-0.36	-4.90*	-5.02*
m^{R-L-C}-p	1.92	-0.58	-3.96*	-4.29*	1.82	-0.60	-3.67	-3.96*	1.38	-0.35	-4.78*	-4.92*

[1] See footnote in table 3.

Table 8. Dynamic money demand equations (1979:2 - 1992:1)[1]

Dependent variable	Regressors: ECM_{t-1}	constant	$\Delta(m^j-p)_{t-1} + \Delta(m^j-p)_{t-2}$	Δy	Δy_{t-1}	ΔR	ΔR_{t-1}	$\bar{R}^2$	SE x 100	DW	Equality test
$\Delta(m^T-p)$	-0.552	0.001	0.321	0.668	-0.232	-0.193	-0.193	0.716	0.468	1.94	0.249
	(-5.29)	(0.53)	(5.05)	(6.39)	(-1.96)	(-3.24)	(-3.24)				
$\Delta(m^R-p)$	-0.314	0.001	0.230	0.733			-0.362	0.648	0.564	1.87	0.890
	(-4.09)	(1.08)	(4.09)	(6.13)			(-3.12)				
$\Delta(m^L-p)$	-0.369	0.001	0.257	0.683			-0.351	0.521	0.682	1.73	0.523
	(-3.91)	(0.68)	(3.27)	(5.11)			(-2.42)				
$\Delta(m^{R,L}-p)$	-0.421	0.001	0.313	0.653	-0.234		-0.352	0.720	0.474	1.90	0.169
	(-5.05)	(1.08)	(5.02)	(6.33)	(-2.06)		(-3.56)				
$\Delta(m^{R,C}-p)$	-0.375	0.001	0.307	0.643	-0.239		-0.349	0.711	0.487	2.01	0.421
	(-4.74)	(1.24)	(4.86)	(5.96)	(-2.04)		(-3.44)				
$\Delta(m^{L,C}-p)$	0.379	0.001	0.236	0.656			-0.372	0.666	0.516	1.98	0.583
	(-4.37)	(1.29)	(4.26)	(5.79)			(-3.52)				
$\Delta(m^{R,L,C}-p)$	-0.420	0.001	0.313	0.675	-0.218	-0.194	-0.194	0.711	0.476	1.94	0.301
	(-4.91)	(0.91)	(4.94)	(6.37)	(-1.84)	(-3.22)	(-3.22)				

[1] ECM term is from long run equation with trend. 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 tor the sake of brevity) are jointly equal to the coefficents obtained from the static cointegration equation. All test statistics are below the 5% critical values.

Table 9. Specifications of money demand with *buffer* variable (1979:2 - 1992:1)

(dependent variable: Δm2-p)

Buffer variable	Regressors: buffer	ECM_{t-1}	$\Delta(m2-p)_{t-1}$	$\Delta(m2-p)_{t-2}$	$\Delta(m2-p)_{t-1}+\Delta(m2-p)_{t-2}$	$\Delta(m2-p)_{t-4}$	$\Delta R-\Delta R_{t-}$	Δy	Δy_{t-1}	$\bar{R}^2$	SE x 100	DW
BUFFER-CEE [1]	0.36	-0.54	-	0.45	-	-	-0.002	0.68	0.23	0.72	0.47	2.02
	(3.1)	(-5.1)		(4.6)			(-2.9)	(6.4)	(-1.9)			
BUFFER-CEE [2]	0.55	-0.22	0.72	0.12	-	-	-	0.30	-0.19	0.88	0.30	2.00
	(9.2)	(-2.8)	(9.1)	(1.9)				(4.0)	(-2.4)			
Σ BUFFER [1]	0.51	-0.54	-	0.32	-	0.26	0.002	0.52	-0.28	0.71	0.46	1.72
	(3.7)	(-4.8)		(2.9)		(2.5)	(3.1)	(4.3)	(-1.9)			
Σ BUFFER [2]	0.46	-0.38	0.48	0.18	-	-	-0.001	0.50	-0.20	0.77	0.43	2.10
	(3.1)	(-3.4)	(4.2)	(1.9)			(-1.4)	(4.5)	(-1.7)			
without buffer variable	-	-0.55	-	-	0.32 (5.0)	-	-0.002	0.67	-0.23	0.72	0.47	1.94
		(-5.3)					(-3.2)	(6.4)	(-2.0)			

[1] The buffer variable is obtained from an autoregressive model and is lagged one period.

[2] The buffer variable is obtained from the Kalman filter.

Table 10. Cointegration analysis for weighted aggregates (1979:1-1992:1)[1]

Aggregates	Coefficients			Cointegration tests	
	y	R	CO	DF	PP
CE.EU-p	1.03		-0.98	-3.94*	-4.71*
ΣCE-p	1.45		-0.74	-3.99*	4.69**
m1-p	1.29	-0.90		-5.19**	-5.19**
m2-p	1.25	-0.49		-5.15*	-5.19*

[1] Significant at the 1 % (**) and 5 % (*). Specification with constant, linear and segmented trend. DF and PP denote the "Dickey-Fuller" cointegration test and the test statistics proposed by Phillips (1987) and Phillips e Perron (1988). The PP test was performed in a specification with four lags. Critical values are from McKinnon (1991).



QUADERNI DEL DIPARTIMENTO DI ECONOMIA

1 **Marco CRIVELLINI**, *"Vincoli organizzativi- imprenditoriali allo sviluppo: una stilizzazione all'approccio di Ancona"*, aprile 1983.

2 **Paolo ERCOLANI**, *"Prezzi relativi e sviluppo economico: un'analisi dell'evidenza empirica"*, luglio 1983.

3 **Riccardo MAZZONI**, *"Costi comparati e sviluppo regionale: un'analisi empirica"*, maggio 1984.

4 **Paolo ERCOLANI**, *"Sviluppo economico e mutamenti di struttura"*, ottobre 1984.

5 **Valeriano BALLONI**, *"Processi di integrazione nelle ristrutturazioni industriali"*, ottobre 1984.

6 **Franco SOTTE, Luisa QUATTRINI, Simone RUSPOLI**, *"Indagine sulle tipologie aziendali nell'agricoltura delle Marche"*, maggio 1985.

7 **Geminello ALVI**, *"Due scritti eterodossi sulla scienza in economia e la sua storia"*, maggio 1985.

8 **Luca PAPI**, *"Scelte e conseguenze della politica monetaria del primo dopoguerra"*, giugno 1986.

9 **Massimo TAMBERI**, *"Il modellaccio 2: analisi storica dei parametri diretti"*, febbraio 1988.

10 **Luca PAPI**, *"Dynamic specification in U.K. Demand for Money Studies"*, marzo 1988.

11 **Enzo PESCIARELLI**, *"Smith, Bentham and the Development of Contrasting Ideas on Entrepreneurship"*, giugno 1988.

12 **Alessandro STERLACCHINI**, *"Progresso tecnico, attività innovative e crescita della produttività: approcci teorici a livello inter- industriale"*, ottobre 1988.

13 **Carlo GIANNINI**, *"Cointegrazione, analisi di rango e stima consistente dello spazio di cointegrazione partendo dalle stime di un VAR in livelli"*, marzo 1989.

14 **Carlo GIANNINI, Rocco MOSCONI**, *"Non stazionarietà, integrazione, cointegrazione: analisi di alcuni aspetti della letteratura recente"*, marzo 1989.

15 **Valeriano BALLONI**, *"Strutture di mercato e comportamento strategico delle imprese. Il caso dell'industria americana degli elettrodomestici"*, 1989.

16 **Mauro GALLEGATI, Massimo TAMBERI**, *"Divergent Trajectories in Europe: An Analysis of the Recently Developed Countries"*, ottobre 1989.

17 **Enrico SANTARELLI**, *"R & D, Innovation, and the Signalling Properties of the firm's Financial Structure"*, maggio 1990.

18 **Daniela FELIZIANI**, *"Il dibattito internazionale sul tempo di lavoro: una nota introduttiva"*, settembre 1990.

19 **Massimo TAMBERI**, *"Pionieri, Imitatori e Processi di Catching- up"*, novembre 1990.

20 **Antonio Giulio CALAFATI**, *"Processo economico e ambiente naturale in K.W. Kapp"*, dicembre 1990.

21 **Carlo GIANNINI**, *"Topics in Structural Var Econometrics"*, luglio 1991.

22 **Andrea RICCI**, *"Il concetto di integrazione nella teoria economica: una breve rassegna critica"*, agosto 1991.

23 **Claudio CASADIO TARABUSI, Stefano BRESCHI**, *"A Selection Model of Economic Competition: The Role of Market Power and Technological Change"*, dicembre 1991.

24 **Stefano STAFFOLANI**, *"L'inserimento professionale dei giovani diplomati in Italia e in Francia"*, dicembre 1991.

25 **Enrico SANTARELLI, Alessandro STERLACCHINI**, *"Profili e determinanti settoriali della formazione di nuove imprese nell'industria italiana"*, aprile 1992.

26 **Giorgio FUÀ**, *"Appunti sulla crescita economica"*, aprile 1992.

27 **Stefano STAFFOLANI**, *"La flessibilità quantitativa nella gestione del fattore lavoro: una analisi teorica"*, aprile 1992.

28 **Carlo GIANNINI, Antonio LANZAROTTI, Mario SEGHELINI**, *"A Traditional Interpretation of Macroeconomic Fluctuations: the Case of Italy"*, maggio 1992.

29 **Riccardo MAZZONI**, *"I mercati locali del lavoro in Italia"*, luglio 1992.

30 **Alessandro BARTOLA, Franco SOTTE, Giuseppe BUONCOMPAGNI**, *"L'AIMA"*, luglio 1992.

31 **Renato BALDUCCI**, *"Crescita in regime di rendimenti di scala costanti"*, febbraio 1993.

32 **Carlo A. FAVERO**, *"Ottimizzazione intertemporale e metodi econometrici in economia"*, maggio 1993.

33 **Alessandro BARTOLA, Franco SOTTE, Andrea FANTINI, Raffele ZANOLI**, *"L'agricoltura nelle Marche. Tendenze settoriali e politica agraria"*, maggio 1993.

34 **Riccardo MAZZONI**, *Sviluppo economico e localizzazione produttiva*, giugno 1993.

35 **Alberto ZAZZARO**, *Costi di liquidità e costi di solvibilità: il ruolo delle banche locali nello sviluppo economico regionale*, giugno 1993.

36 **Domenico MIGNACCA**, *An Application of a Structural VAR Technique to Interpret UK Macroeconomic Fluctuations*, giugno 1993.

37 **Stefano MANZOCCHI, Domenico MARINUCCI**, *Technology Adoption Under Strategic Complementarity: "Less" Information Can Do Better*, giugno 1993.

38 **Antonio G. CALAFATI**, *Scelta e Azione*, giugno 1993.

39 **Gabriele CATTAROZZI**, *Gestione delle obbligazioni e curva di inviluppo*, luglio 1993

40 **Alberto ZAZZARO**, *Le banche in un'economia regionale: una rassegna della letteratura*, settembre 1993.

41 **Alessandro VAGLIO**, *A model of the audience for TV broadcasting implications for advertising competition and regulation* , ottobre 1993.

42 **Carlo A. FAVERO, Riccardo LUCCHETTI**, *Output, interest rates and the monetary trasmission mechanism: some empirical evidence for Italy*, ottobre 1993.

43 **Riccardo LUCCHETTI**, *Modelli in differenze con errori di misura*, 1993.

44 **Stefano STAFFOLANI**, *Lavoro a turni e durata di utilizzo del capitale*, novembre 1993.

45 **Alessandro STERLACCHINI**, *La ricerca universitaria in Italia*, novembre 1993.

46 **Daniela FELIZIANI**, *Organizzazione e regolamentazione degli orari di lavoro nei paesi industrializzati*, marzo 1994.

47 **Alessandro STERLACCHINI**, *The birth of new firms in Italian manufacturing*, marzo 1994.

48 **Franco SOTTE, Giuseppe BUONCOMPAGNI**, *An overview on public transfers in the Italian Agricultural Policy*, marzo 1994.

49 **Pietro ALESSANDRINI, Andrea RICCI**, *Squilibri demografici e scarsità di risparmio nell'economia mondiale*, marzo 1994.

50 **Alberto ZAZZARO**, *La specificità delle banche: teorie ortodosse e teorie eterodosse a confronto*, maggio 1994.

51 **Carlo MONTICELLI, Luca PAPI**, *La definizione di moneta in economie aperte e integrate: verso l'"eutanasia" del concetto di moneta nazionale?*, maggio 1994.

52 **Riccardo LUCCHETTI, Stefano STAFFOLANI**, *Orario di lavoro e occupazione: un approccio teorico con una applicazione alla grande industria italiana*, luglio 1994.

53 **Riccardo LUCCHETTI**, *Companion form representation of cointegrating VARs*, ottobre 1994.

54 **Paolo ERCOLANI**, *La terziarizzazione dell'occupazione. Analisi delle cause e dei problemi aperti*, dicembre 1994.

55 **Rossano BRUSCHI**, *La teoria delle aspettative razionali e la curva dei tassi di interesse a scadenza: un'applicazione al mercato monetario tedesco*, dicembre 1994.

56 **Roberto ESPOSTI, Pierpaolo PIERANI, Franco SOTTE**, *Fattori quasi fissi e produttività totale dei fattori in agricoltura. Teoria e applicazione ad una impresa marchigiana ex-mezzadrile*, gennaio 1995.

57 **Michela VECCHI**, *Human capital and excess labour*, febbraio 1995.

58 **Alberto BAGNAI, Stefano MANZOCCHI**, *Un'indagine empirica sulla mobilità dei capitali nei paesi in via di sviluppo*, marzo 1995.

59 **Domenico MIGNACCA**, *Comparing the impulse response functions of different models*, marzo 1995.

60 **Manuela VICONI**, *L'Unione Europea e gli shock esogeni ai sistemi economici*, marzo 1995.

61 **Paolo Emilio MISTRULLI, Roberto TORRINI**, *Salari di efficienza, costi di controllo e decentramento produttivo*, marzo 1995.

62 **Alessandro VAGLIO**, *Potere di mercato, consumi e crescita*, dicembre 1994.

63 **Luca PAPI, Carlo MONTICELLI**, *EU-Wide money demand: An assessment of competing approaches*, maggio 1995.