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BANCO DE ESPAÑA

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Juan Ayuso y Juan Luis Vega

SERVICIO DE ESTUDIOS
Documento de Trabajo nº 9303

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Juan Ayuso y Juan Luis Vega (*)

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In publishing this series the Bank of Spain seeks to disseminate studies of interest that will help acquaint readers better with the Spanish economy.

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1.- INTRODUCTION

An active monetary policy was first designed and applied in Spain in the early seventies. It followed a classical two-level framework, with a broad monetary aggregate as an intermediate target, selected on the basis of the stability of its relationship both to the final variables targeted by such policy and to the instrumental variables in the exercise thereof (controllability of the aggregate). Although this framework has become notably more flexible in recent years, the course of a broad aggregate remains one of the key indicators for monetary policy decision-making.

Yet since the early eighties, the continuous innovations in and liberalisation of the financial system have raised the degree of inter-substitutability of assets included and those not included in the intermediate targeted aggregate of monetary policy. That poses substantial problems when seeking to discern which part of the movements of such a target were attributable to what were called financial disturbances. The monetary authority's response to the worsening informativeness of the intermediate target was to broaden the aforementioned aggregate. Thus, liquid assets held by the public (ALP) replaced the broad-money aggregate M3 in this role in 1984[1] and, since then, ALP has undergone a series of changes culminating in 1992 in a far-reaching revision of the aggregate[2].

All these aggregates, however, had one feature in common. Once the boundary between assets deemed to be liquid ("money" in the terminology of standard macroeconomic models) and others ("bonds") was drawn, the broad aggregate could be obtained by simply aggregating the balances of the former. The theoretical assumption underlying this aggregation is the perfect substitutability of all the financial assets included. This assumption, taken to an extreme for illustrative purposes,

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[1] See Sanz (1988).

[2] See Banco de España, Boletin Económico, November 1991.

would imply that if, for instance, the Spanish State were to purchase by issuing cash all Treasury bills held outright by the public, the economy's money supply would remain unchanged and, therefore, none of the related macroeconomic variables (e.g. prices) should be affected.

The foregoing example illustrates a potential weakness of this type of aggregate. It has given rise to a current of literature concerned with devising a different aggregation methodology that pays regard to the imperfect substitutability of assets. In particular, an aggregation has been sought in which the different balances feature weightings that ultimately reflect the different degree of liquidity of each of the assets.

Along with the line of research addressing the theoretical basis of such an aggregation[3], many empirical papers have compared the properties of the weighted aggregates with those of the aggregates constructed on the basis of the simple addition of the components[4]. Whereas the theoretical superiority of the former as a measure of the economy's liquidity (and, therefore, of the monetary variable related to income and prices via a money demand function) appears patent, the empirical evidence is less conclusive. Thus, for example, Ford, Peng and Mullineux (1992) analyse the explanatory power of both types of aggregates over real activity in the United Kingdom and conclude that "both the Divisia and the modified Divisia indices dominate their corresponding simple-sum aggregates". However, Piyu and Fluri (1991) study the aggregate/inflation and aggregate/instrumental variable relationships. They affirm that "M1 and Divisia M1 were related similarly both to Swiss inflation and to the monetary base".

Beyond academia, certain central banks (particularly the Federal Reserve, the Bank of Canada and the Bank of England) and the Economic

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[3] Barnett (1978, 1980, 1982 and 1991), Rotemberg, Driscoll and Poterba (1991).

[4] Among these are Ford, Peng and Mullineux (1992) for the British case; Piyu and Fluri (1991) for the Swiss case; Horne and Martin (1989) for the Australian case; or the papers in the preceding note for the US case.

Unit of the EC Central Bank Governors' Committee have recently considered this line of research. The former as a result of the deterioration of the money demand estimates for their traditional aggregates. And the latter in the context of the harmonisation of Community countries' monetary aggregates in 1992, although this methodology was not finally adopted.

There are no recent studies in this connection in Spain. This paper conducts an initial evaluation of the weighted monetary aggregates, analysing their long-run properties in comparison with those of two of the monetary aggregates managed in Spain: ALP and M2. Specifically, a test is conducted for the existence of a co-integration relationship between the aggregates considered and the variables that economic theory suggests as arguments of a money demand function. Conversely, the fact that the progressively greater flexibility of the two-level framework and the replacement of a quantity-based variable by an interest-rate-based variable may have diminished the relevance of the problem of controllability explains why the paper does not address the aggregate/instrument relationship.

The paper is set out as follows. Section 2 compares the two types of aggregate at the purely theoretical level. Section 3 addresses the problem of constructing the weighted aggregate. Then, in section 4, and at the empirical level, the weighted aggregate is compared with the traditional aggregates ALP and M2. Section 5 offers possible explanations for the results of the previous section and finally, in section 6, the main conclusions of the paper are drawn together.

2.- SIMPLE-SUM VERSUS WEIGHTED-SUM

Let us assume an economy with a representative consumer whose utility function can be expressed as:

$$U\ (C,M)$$

where C is consumption and M liquidity services, such that:

$$M = f\ (m^1,\ m^2\ \ldots\ m^k)$$

where the different m^i $(i = 1, 2 \ldots k)$ are the amounts of the economy's different financial assets held by the consumer and $f\ (\cdot)$ is the function aggregating the liquidity services provided by the different financial assets.

Here, the simple-sum aggregates can be interpreted as a particular approximation to $f\ (\cdot)$. Thus, focusing on a specific instant, t, and representing this aggregate by S_t gives us:

$$S_t \equiv m_t^1 + m_t^2 + \ldots\ldots + m_t^s\ , \quad s < k$$

where the financial assets are in descending order of liquidity.

Proponents of the weighted aggregates advance a different approximation based on the consideration of the various financial assets as imperfect substitutes. The general rationale behind the construction of these weighted aggregates is fairly simple: if each financial asset provides different liquidity services, rather than merely aggregating the amounts held of each, such amounts must be weighted in terms of the specific liquidity services provided by each of the assets.

This paper will focus on two specific weighted aggregates: the Divisia Index, associated with Barnett, and the Currency Equivalent

Aggregate proposed by Rotemberg, Driscoll and Poterba[5]. The former, in its most commonly used form, is as follows:

$$\Delta \log D_t \equiv \sum_{i=1}^{s} \left(\frac{s_t^i + s_{t-1}^i}{2} \right) \Delta \log m_t^i; \quad s < k \tag{1}$$

with:

$$s_t^i = \frac{(r_t^{s+1} - r_t^i)\, m_t^i}{\sum_{j=1}^{s} (r_t^{s+1} - r_t^j)\, m_t^j} \tag{2}$$

where r^i_t is the interest rate on the i-nth financial asset and D_t is the aggregate.

As to the second approach, where the Currency Equivalent Aggregate is called L_t, this takes the form:

$$L_t \equiv \sum_{i=1}^{s} \frac{r_t^{s+1} - r_t^i}{r_t^{s+1}}\, m_t^i \tag{3}$$

In both cases a weighted sum is proposed, either of the assets or of their rates of change, where the weights depend on the differential between the own interest rate of the asset included and the interest rate on a financial asset that provides no liquidity service (benchmark). The related interpretation is fairly intuitive. Insofar as the financial assets considered are risk-free and mature on the same date, the returns thereon should coincide. Thus, since one asset may differ from another due solely to its degree of liquidity, the difference between the interest rate on any asset that provides liquidity services and that which provides zero liquidity will respond, in fact, to the degree of liquidity of the

[5] We shall confine ourselves to setting out the results and the interpretation thereof. For a wider view of these indices, see the references of Note 3.

former.

Admittedly, in purely theoretical terms, the superiority of the weighted aggregates is evident. But the selection of the monetary aggregate best suited for the role of intermediate target involves a substantial empirical component. Thus, the worth of a specific aggregate must be judged in terms of the stability of its relationship to the final variables targeted by monetary policy, whereby it is essential that the simple and weighted aggregates should be compared from the standpoint of their empirical properties.

Empirically, the superiority of the weighted aggregates is not so patent. Various problems arise when specifying in practice definitions (1) or (3). First, although both types of aggregate entail an a priori decision on what asset s (the asset providing the minimum liquidity service) is, the weighted aggregates require, moreover, selection of asset s+1, i.e. that which will act as benchmark in the construction of the weights. Further, the considerable volatility of interest rates generally translates into highly variable weights. In principle, this should pose no problem insofar as such volatility reflects changes in the degree of liquidity of the different assets. Thus, the amounts of the different assets held would change as their relative liquidity changed, whereby the level of liquidity compatible with agents' spending decisions would remain unchanged. However, underpinning the foregoing argument is the debatable assumption that agents adjust their portfolios continuously when faced with changes in the relative prices of the different assets. Insofar as this assumption is not satisfied (e.g. agents may adjust their portfolios only at relatively lengthy intervals), the variability in the weights will not necessarily be related to changes in the relative services of liquidity provided by the assets. As a result, it will be possible to find changes in the aggregate that do not respond to changes in individuals' demand for liquidity. This reasoning warrants the consideration of filters to smooth the series of interest rates and poses, in turn, the problem of assessing the effect of such filters.

Second, once a specific measurement of the weights of the assets has been obtained, the analysis of the stability of their relationship to the relevant final variables remains to be made. In this respect, the existence of generally accepted theoretical macroeconomic models with specific implications for the relationship between money, real output and prices provides a clear framework for such a comparison.

Although most existing empirical applications have focused on Divisia indices, this paper also addresses the Currency Equivalent Aggregate. The level of this latter aggregate, unlike that of the Divisia index, can be interpreted in terms of the stock of cash that would provide the same liquidity services as the set of assets considered (Rotemberg et al., 1991) or, under the assumptions of risk neutrality and stationary expectations, as the discounted liquidity services flow derived from holding such a set of assets (Barnett, 1991). In this sense, in addition to the comparison with ALP (the aggregate targeted by the Banco de España), the comparison with an aggregate closer to the concept of the transactions demand for money -such as M2- would also be worthwhile.

The following section will address the problem of constructing the weighted aggregates. Their comparison with the simple-sum aggregates will be dealt with in section 4.

3.- CONSTRUCTION OF THE WEIGHTED AGGREGATES

When obtaining measurements of weighted aggregates for the Spanish economy, the first problem is to decide which assets are money ones or, tantamount to this, which range of assets must underpin the aggregation in (1) or (3). Economic theory is very accurate in this respect, and the possibility of aggregating a set of assets depends on the assumption of weak separability of the utility function. Indeed, there is, in the case of monetary aggregates, a wide range of empirical literature parallel to that on the Divisia indices which seeks to test the foregoing assumption in the framework of a system of coherent demands (Serletis, 1987).

Given the aims of the paper, only the aggregation of the assets forming part of the definition of ALP -the intermediate target of Spanish monetary policy in recent years- will be considered. An excellent yardstick for comparing the properties of any alternative aggregate is provided by the many empirical papers on the relationship between ALP and the final goals of monetary policy and, especially, by a relatively stable demand function[6].

Having decided which assets we will aggregate in the construction of the Currency Equivalent Aggregate and the Divisia index, returns must be assigned to each of them. In this connection, the paper will use the time series of interest rates net of taxes (calculated in Cuenca (1992)) for various components of ALP.

The following step in the empirical specification of (1) or (3) is the choice of the financial asset to act as a benchmark, defined by its inter-period wealth transfer function, without it providing liquidity services. In this connection, the literature on Divisia indices has suggested an entire array of assets ranging from the return on human capital (Barnett and Spindt, 1982), through the return on public or private long-term bonds (Yue and Fluri, 1991) or some index of stock market returns (Poterba and Rotemberg, 1987), to the six-month interest rate on Treasury bills (Chou, 1991). That said, it would seem reasonable to confine the scope of the analysis to assets whose differences in terms of returns may respond, at least fundamentally, to the different liquidity services they provide, thereby preventing other differentiating features -risk considerations in particular- from playing a notable role. The idea would thus be to retain some correspondence between the liquidity of, and returns on, the different assets.

In this paper the interest rate on the benchmark asset has been defined as:

$$r_t^b = \text{máx}[r_t^d \ , \ r_t^i] \qquad (i=1,\ldots l) \tag{4}$$

where r_t^d is the internal rate of return on public debt maturing at over

[6] Dolado (1988), Dolado and Escrivá (1991).

two years held outright by the public, and r_t^i the interest rate on the different monetary assets. Indeed, in many of the specifications of the demand for ALP, the first rate plays the role of an interest rate representative of assets not included in the aggregate. It should further be pointed out that, although there is an interest rate for long-term fixed-income private instruments (the so-called return on private bonds), the limited liquidity of the related market in the relevant period has dissuaded us from considering it in our analysis.

Equation (4) precludes the existence of negative weights. As a result, when the assets defined previously as money assets evidence after-tax returns greater than that on debt, their weight is zero. By contrast, public debt at over two years held outright by the public is not aggregated at any time. This solution is merely empirical, albeit standard in this literature, and evidently not the only possibility. The responsiveness of the results to the definition of the benchmark is a controversial subject which is not tackled in this paper.

Chart 1 shows the course of the interest rate on the benchmark asset in the 1978/I-1989/II[7] period, along with the different financial assets that have successively fulfilled this role. Since end-1986, this rate virtually matches the internal rate of return on public debt at over two years held outright by the public. For the previous period, however, the benchmark rate alternates between the interest rate on bonds (industrial-bank bonds, bonds issued by commercial and foreign banks and mortgage bonds) and that on endorsed bills and guarantees on commercial paper. The former instruments enjoyed significant tax benefits to December 1986, and the latter to June 1985.

The fact that assets included in ALP act as the benchmark for most of the sample period is illustrative of the presence in this aggregate of financial instruments whose monetary nature might be debatable and

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[7] The sample used throughout the paper ends in the second quarter of 1989 as a result of the introduction, as from the third quarter that year, of credit ceilings. These obviously pose problems of stability in the relationship between nominal spending and money, however the latter is measured.

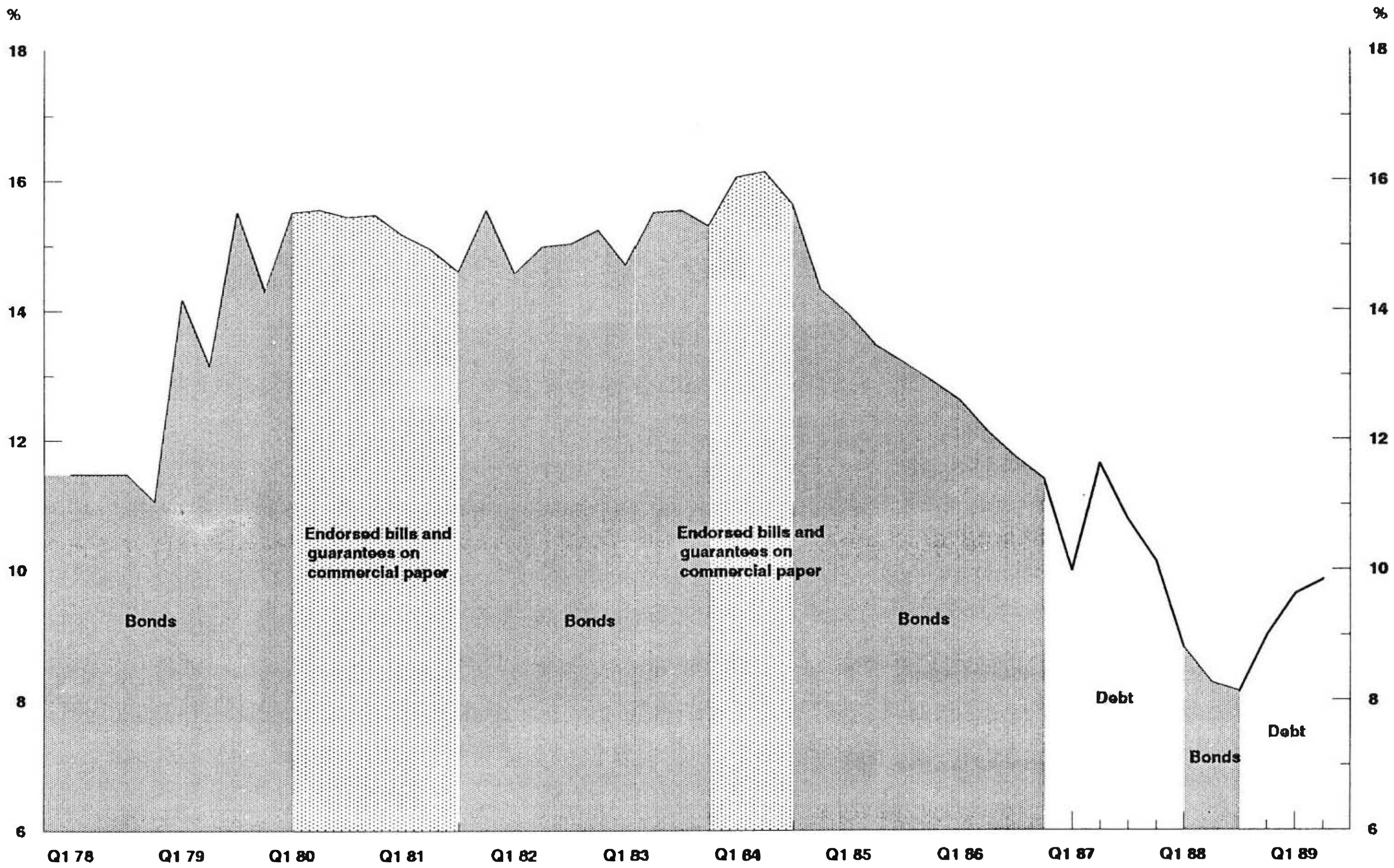
which should be classified as instruments at the edge of ALP. Their inclusion was always the result of a specific intention of the monetary authority: to interiorise in the aggregate selected as the intermediate target of monetary policy the frequently tax-related shifts caused by the spectacular growth at various junctures of these assets.

Chart 2 expands upon this idea of border-line instruments. It depicts the sample average over the 1978/I-1989/II period of the weights $(r_t^b-r_t^i)/r_t^b$ for all the components of ALP, providing a table of monetary assets ranked naturally according to their degree of liquidity. This weights structure is in strong contrast to the implicit structure in ALP (unit weight for all assets), distinguishing three major asset groupings. The first is made up of highly liquid assets, specifically those incorporated into the definition of M2: cash, sight deposits and savings deposits. The second comprises instruments the changes in the balances of which account for a weight, on average, of between 20% and 40% of the aggregate we have called the Currency Equivalent Aggregate: these are insurance transactions, asset participations, time deposits, Treasury and local government (Basque Country and Navarre provinces) notes, and repos on public and private assets. The third group is made up of assets whose weight is less than 20%: asset transfers, endorsed bills and guarantees on commercial paper, outright Treasury bills held by the public and bonds. The chart also includes the (average) relative weight of each of the assets in the total of ALP. Clearly, although the three most liquid assets (for which the weight changes relatively little in relation to that which they have in ALP) have a significant relative weight in ALP, some assets have equally notable relative weights (time deposits for instance) in which the change in weight is substantial. In short, this chart illustrates, with the example of the aggregate L_m, that there are significant quantitative differences between the simple-sum aggregate and the weighted aggregates addressed in the rest of the paper.

As indicated in the previous section, there remains a problem to be dealt with: namely, the presence of lags and inertia in portfolio switching by individuals. In these conditions it is not right to interpret changes in $(r_t^b-r_t^i)/r_t^b$ as alterations in the liquidity services provided by the different assets. This phenomenon will be particularly relevant in

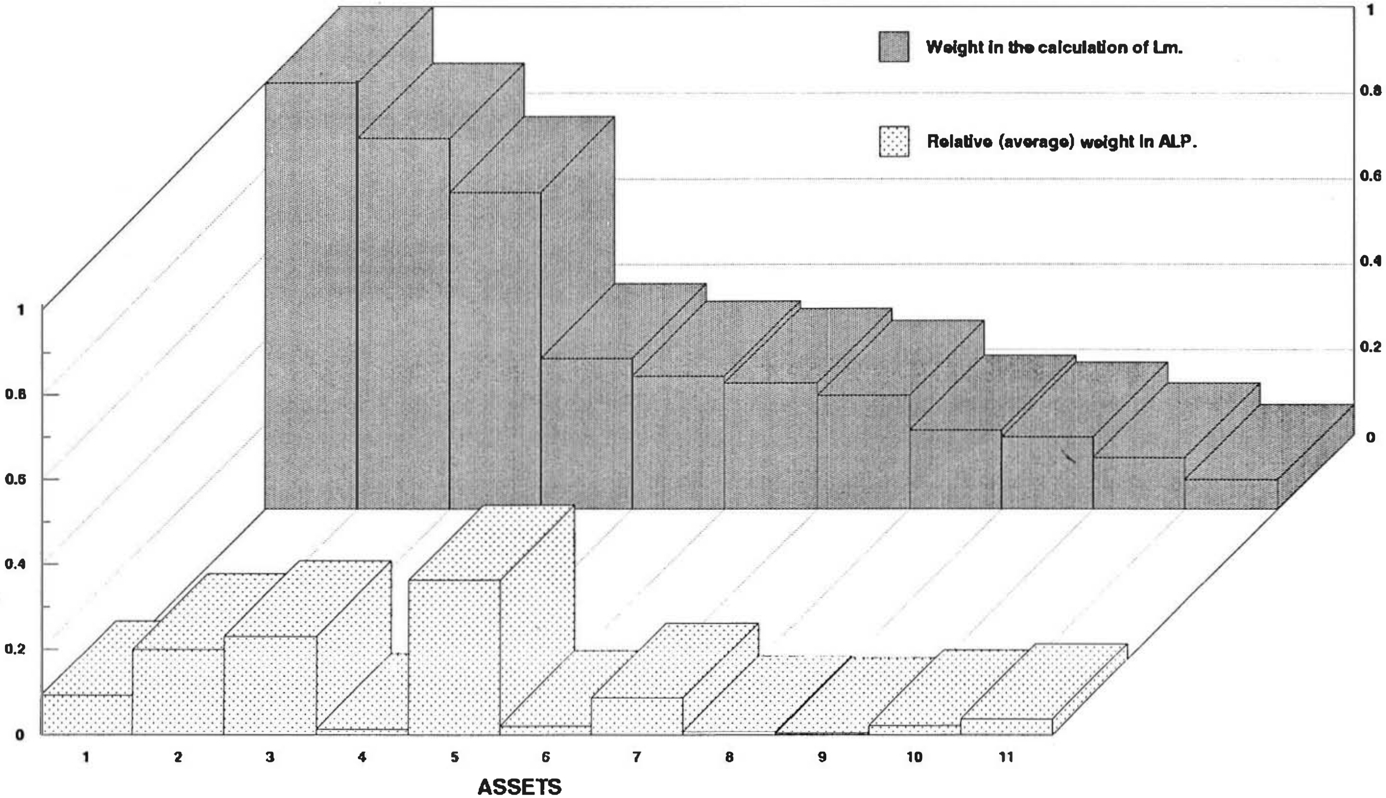
Chart 1

BENCHMARK INTEREST RATE



WEIGHTS OF ALP COMPONENTS

Chart 2



1. Cash and deposits at the Banco de España.
2. Sight and foreign-currency deposits.
3. Savings deposits.
4. Insurance transactions and asset participations.
5. Time deposits.
6. Treasury and local government (Navarre and Basque provinces) notes.
7. Asset repos.
8. Asset transfers.
9. Endorsed bills and guarantees on commercial paper.
10. Treasury bills.
11. Bonds.

a context where r_t^b is much more volatile than the different r_t^i, due -in part- to the existence of regulations, in a large sub-set of the sample, on the deposit rates offered by banks for the shorter-dated instruments.

In this respect Rotemberg et al. (1991) propose the use of centred moving averages of $(r_t^b - r_t^i)/r_t^b$, arguing that if individuals do not continuously adjust their portfolios, their decisions will be based on present and expected values of this variable. Along these same lines, we will use different moving averages (centred and uncentred) for various lengths. In particular, we shall name as L the aggregate defined as such in (1), as Lc(i) and L(i) the aggregates constructed with centred and uncentred moving averages, respectively, of i-months' length, and as L_m the aggregate which uses fixed weights corresponding to the sample average of $(r_t^b - r_t^i)/r_t^b$.

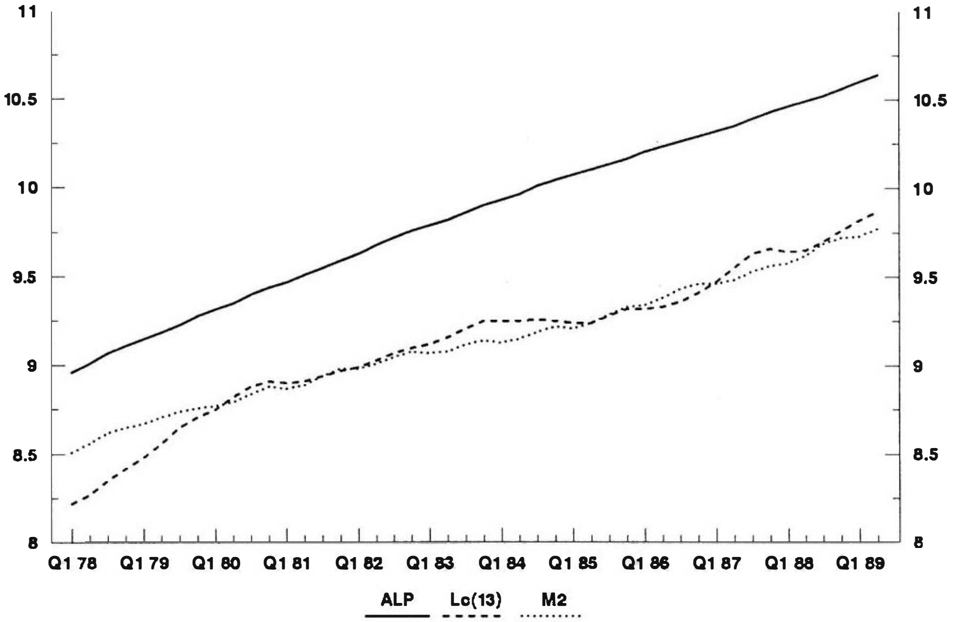
The appendix offers charts of the 12-month growth rates of these aggregates, the graphic presentation in this section being confined to one of them: Lc(13), specifically the empirical definition of the Currency Equivalent Aggregate used as a basis of the results obtained in Rotemberg et al. (1991). Charts 3 and 4 show respectively the levels and 12-month growth rates (T_4^1) of ALP, M2 and Lc(13). This latter aggregate is similar in scale to M2 in the eighties, although there are substantial discrepancies between the two in the previous period. Between 1981 and 1989, Lc(13) was, on average, only 3.4% greater than M2, a proportion that held relatively stable during this period. Nonetheless, the growth rates of both aggregates differed notably for long periods of time, although the sign of this difference is not constant over time. In any event, the growth rates of Lc(13) are more volatile.

But the same is not the case for ALP. Thus, between 1981 and end-1986, ALP systematically had appreciably higher growth rates than Lc(13), leading to an ever-greater difference in the course of both aggregates which was only interrupted in recent years. This behaviour of Lc(13) in relation to ALP parallels that of M2 in relation to ALP. It also reflects the shifts seen in those years to less liquid instruments as a result of financial innovation.

BALANCES OF MONETARY AGGREGATES

Chart 3

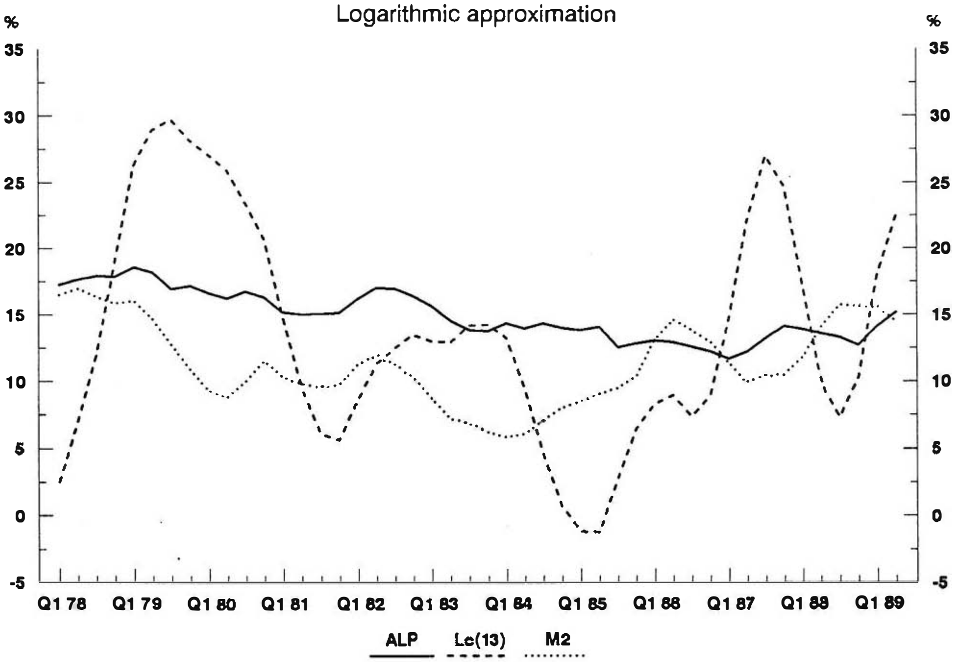
Logarithms



RATES T1,4

Chart 4

Logarithmic approximation



4.- THE WEIGHTED AGGREGATES VIS-A-VIS ALP AND M2

4.1.- Statistical properties

Table 1 draws together some of the statistical properties marking the course of the constructed weighted aggregates in the 1978/1-1989/2 period. Results for ALP and M2 are also included. The table is set out in seven columns. The first depicts the name of the aggregate to which the remaining columns refer. Columns 2 to 4 contain various tests on the order of integration of the series. Columns 5 to 6 include measures of the volatility of the various aggregates. Lastly, column 7 details a Lagrange test on the absence of serial correlation up to the eighth order[8].

With regard to the tests on the order of integration of the aggregates, the statistics defined as $\Phi_3(2)$ and $\Phi_3(4)$ (columns 2 and 3) respectively test the hypotheses $H_1:(\alpha_3, \beta_3)=(1,1)$ y $H_2:(\mu_3, \Theta_3, \alpha_3, \beta_3)=(0,0,1,1)$ in the regression:

$$m_t = \mu_3 + \Theta_3 t + \alpha_3 m_{t-1} + \beta_3 \Delta m_{t-1} + \sum_{j=1}^{p-2} \delta_{3j} \Delta^2 m_{t-j} + \sum_{i=1}^{3} \phi_i D_{it} + e_t \qquad (5)$$

where D_{it} are centred seasonal dummy variables.

These statistics are analogous to the standard F-tests on the significance of a set of regressors. Their distribution is tabulated in Hasza and Fuller (1979), and the critical values for a significance level of 5% and a sample size such as that at issue are about 10.17 and 5.77.

The statistic called $t(\hat{\beta})$ (column 4) is the t-ratio of the hypothesis $H_3:\beta=1$ in the regression:

[8] This test is distributed as F, and its critical value at 5% is approximately 2.25.

Table 1

AGGREG	$\Phi_3(2)$	$\Phi_3(4)$	$t(\hat{\beta})$	$\sigma(m)\%$	$\frac{\sigma(m)}{\sigma(ALP)}$	LM_8
ALP	7.16	3.80	-1.63	0.56	1.00	0.68
M2	3.25	2.10	-2.00	0.82	1.46	1.49
D	3.73	2.28	-2.7	0.79	1.41	0.58
L	9.14	4.30	-1.81	6.91	12.3	1.63
Lc_{13}	7.08	3.57	-1.92	1.39	2.48	0.31
Lc_{25}	7.85	3.99	-1.18	1.04	1.86	0.62
Lc_{37}	4.47	2.54	-1.36	0.77	1.38	0.87
L_m	2.67	1.70	-1.69	0.63	1.13	0.92
L_{12}	5.32	2.97	-2.53	1.68	3.00	0.96
L_{24}	5.42	2.82	-2.44	1.17	2.09	0.81
L_{36}	4.21	2.13	-2.03	0.97	1.73	0.43

$$\Delta m_t = \mu + \beta \Delta m_{t-1} + \sum_{j=1}^{p-2} \gamma_j \Delta^2 m_{t-j} + \sum_{i=1}^{3} \phi_i D_{it} + u_t \tag{6}$$

Its distribution is tabulated in Dickey and Fuller (1979) and, more recently, in MacKinnon (1990). For a significance level of 5% and the sample size used, the critical value is -2.93.

Neither test allows the rejection at the usual confidence levels of the hypothesis that all the aggregates are second-order integrated [I(2)], i.e. they need to be differentiated twice to be stationary. Following on from this, column 5 details the standard error of the residuals in the regression as a measure of the volatility of the series considered:

$$\Delta^2 m_t = \sum_{j=1}^{p-2} \gamma_j \Delta^2 m_{t-j} + \sum_{i=1}^{3} \phi_i D_{it} + \eta_t \tag{7}$$

The monetary aggregate evidencing least volatility is ALP, with a standard error of 0.56%, while the most volatile is the Currency Equivalent Aggregate constructed directly on the basis of its theoretical definition in (3), with a standard error of 6.91%, twice as great as ALP.

In this ordering of aggregates according to volatility, the Currency Equivalent Aggregate L_m, which uses as weights the sample average of $(1-r_t^i/r_t^b)$, the Divisia index and Lc_{37}, presents lower standard errors than those of M2: 0.63%, 0.79% and 0.77%, respectively, compared with 0.82% for M2. The remaining Currency Equivalent Aggregates constructed from moving averages of $(1-r_t^i/r_t^b)$, are at an intermediate position in this ordering, and continuous reductions arise in their volatility with the use of centred moving averages and with the extension of their length.

The greater volatility of the weighted aggregates in relation to ALP is a disadvantage as regards the informativeness of their short-term path. Nonetheless, there remains the possibility that their long-term course is closely connected with nominal spending in the economy. This possibility is explored in the following sub-section and assumes much greater significance when judging the capacity of these aggregates as intermediate targets of monetary policy.

4.2.- Cointegration relationships

This section investigates the existence of cointegration between a set of variables -which economic theory suggests are arguments of a money demand function (prices, income, inflation and interest rates) - and various definitions of liquidity: ALP, M2 and the weighted aggregates constructed.

For ALP and M2, the cointegration relationships postulated are of the general form:

$$m_t - p_t = ß_0 + ß_1 y_t + ß_2 r_t^m + ß_3 r_t^a + ß_4 \Delta p_t + u_t \qquad (8)$$

where m_t is the corresponding monetary aggregate; p_t the consumer price index (CPI); y_t gross domestic product (GDP) at constant prices; r_t^m the average weighted after-tax interest rate on the assets making up the aggregate considered; and r_t^a the after-tax interest rate on the alternative assets not included in the definition of the aggregate. Specifically, for ALP, this is the internal rate of return on public debt at over two years held outright by the public; and for M2, a weighted average rate between the former rate and the interest rate on the assets included in ALP but not in M2.

In the case of the Currency Equivalent Aggregates and the Divisia index, the specification tested is:

$$l_t - p_t = ß_o + ß_1 y_t + ß_3 OC_t + ß_4 \Delta p_t + u_t \qquad (9)$$

where l_t is the weighted aggregate and OC_t represents its unit opportunity cost, defined as:

$$OC_t = \sum_{i=1}^{m} \left(\frac{r_t^b - r_t^i}{1+r_t^b}\right)\frac{m_t^i}{L_t} \tag{10}$$

Note that in (9), unlike in (8), no own interest rate appears as the weighted aggregates are measures of liquidity in the strictest sense. As a result, the interest rates must be considered as alternative rates. In this respect, (10) is interpreted as a weighted sum of the different opportunity costs associated with the liquidity services provided by the different assets. Thus, each of the addenda $(r_t^b - r_t^i)$, represents the interest forgone by maintaining the asset m_t^i, this being therefore the price paid in exchange for liquidity services paid by each asset, and the discount factor $(1+r_t^b)$ arises, because the interest is paid in period t+1.

Since Granger introduced the concept of cointegration (Granger, 1981), several tests have been suggested for testing this property, interpreted as a long-term equilibrium relationship. One important group is made up of those who apply standard unit root tests to the residuals of a static regression estimated by ordinary least squares (OLS). In our case, it would involve testing the hypothesis $\rho=1$ in the regression:

$$\hat{u}_t = \hat{\rho}\hat{u}_{t-1} + \hat{\epsilon}_t \tag{11}$$

where $\hat{u}_t$ would be obtained as the residual of the OLS estimate of (8) or (9). However, the distribution of $\hat{\rho}$ is not the same as in the univariate case. Specifically, the distribution of the unit root tests constructed on the basis of $\hat{u}_t$ depends significantly on the number of variables in the cointegration regression. As a result, as we increase the number of variables, greater values of the statistics are required (smaller values of $\hat{\rho}$) to reject the null hypothesis, lessening the power of the tests.

Hansen (1990) called this problem "the curse of dimensionality" in cointegration tests. This paper adheres to the solution proposed by Hansen. Basically, a two-stage procedure is also involved. In the first stage, (8) or (9) is estimated by the Cochrane-Orcutt method, obtaining $\tilde{\beta}_i$ ($i=0,1,..,4$) and $\tilde{u}_t$ estimators. In the second stage, one of the standard tests is used to ascertain the presence of a unit root in the residuals thus constructed. Thus, the hypothesis $\alpha=1$ would be tested in the regression:

$$\tilde{u}_t = \hat{\alpha}\tilde{u}_{t-1} + \hat{v}_t \tag{12}$$

The resulting statistic does not depend on dimension, this being understood as the number of regressors in the regression model. Recently, however, Banerjee, Dolado and Mestre (1992) demonstrated that, despite the foregoing advantage, Hansen's test poses a second problem called "cost of simplicity". This arises from the fact that a common factor constraint is imposed, possibly not backed by data; that may give rise to a lessening of the power of the test in relation to other tests which, although not invariant with dimension, do not impose this common factor constraint. Nonetheless, the Monte Carlo exercises conducted by these authors show how this cost is higher the bigger the parameter they define as the signal-to-noise ratio is. In the case at hand, with the exception perhaps of the analysis of ALP, this ratio will tend to be small in view of the enormous variance of the weighted aggregates in relation to that of the regressors and the poor fit of the ECM model. Thus, the cost of simplicity will foreseeably be small in this case.

Table 2 details the results of the exercise for the eleven aggregates defined. The left-hand columns summarise the first stage of the Hansen method, i.e. the estimates of the cointegrating vectors. These always give the correct signs, except in the case of the opportunity cost parameter for the Currency Equivalent Aggregates L_m and Lc_{13}.

The right-hand section of the table details the tests performed for the existence of a unit root in the residuals of each of the regressions. Specifically, the test included is the $Z(t_\alpha)$ proposed by Phillips (1987), based on a non-parametrical adjustment of the t-ratio of the hypothesis $\alpha=1$ in (12), which allows v_t to follow a fairly general process and, in particular, any ARMA (p,q) model. The asymptotic distribution of this statistic is identical to that tabulated by Fuller (1979) for the univariate

Table 2

AGGREG.	ESTIMATED PARAMETERS					TESTS	
	$\tilde{\beta}_0$	$\tilde{\beta}_1$	$\tilde{\beta}_2$	$\tilde{\beta}_3$	$\tilde{\beta}_4$	$Z(t_\alpha)$	Valor p
ALP	-8.94	1.70	2.35	-0.17	-0.41	-3.88	0.005
M2	-4.38	1.06	6.33	-0.73	-0.17	-2.60	0.100
D	-8.18	1.06	-	-0.04	-0.36	-1.80	0.411
L	-0.85	0.67	-	-0.82	-0.25	-2.34	0.168
L_m	-5.34	1.19	-	0.04	-0.26	-1.87	0.373
Lc_{13}	-4.81	1.14	-	0.23	-0.27	-2.15	0.238
Lc_{25}	-2.30	0.92	-	-0.05	-0.52	-2.04	0.287
Lc_{37}	-3.38	0.97	-	-0.03	-0.15	-1.80	0.411
L_{12}	-3.06	0.93	-	-0.29	-0.56	-1.85	0.384
L_{24}	-3.65	1.00	-	-0.22	-0.39	-1.80	0.411
L_{36}	-3.72	1.00	-	-0.17	-0.26	-1.79	0.417

case. $Z(t_{\alpha})$ is defined as:

$$Z(t_{\hat{\alpha}}) = \frac{\hat{\sigma}_v}{\hat{\sigma}} t_{\hat{\alpha}} - \frac{\sqrt{T}}{2\hat{\sigma}\hat{\sigma}_{\hat{u}_{t-1}}} (\hat{\sigma}^2 - \hat{\sigma}_v^2) \tag{13}$$

where $\hat{\sigma}_v$ and $t_{\hat{\alpha}}$ are, respectively, the standard error of the residuals and the t-ratio of the hypothesis $\alpha=1$ in regression (12). $\hat{\sigma}^2$ is the long-term variance of v_t, estimated on the basis of $\hat{\sigma}_v$ and the s-order autocorrelation coefficients, $\hat{\rho}_s$, via a triangular spectral window:

$$\hat{\sigma}^2 = \hat{\sigma}_v^2 \, [1 + 2\sum_{s=1}^{l} w_{sl}\hat{\rho}_s], \quad \text{where } w_{sl} = 1 - \frac{s}{l+1} \tag{14}$$

The statistic detailed in Table 2 is constructed for l=6 . Alongside the test values, their significance levels are included. Only for the traditional aggregates -ALP and M2- is it possible to reject, at the usual confidence levels, the existence of a unit root in the residuals constructed. For the Currency Equivalent Aggregates the tests take values that are lower than their critical values at 90% confidence. As a result, it is not possible in these cases to reject, at the usual confidence levels, the existence of a unit root in the residuals of the regression. Lowering the level of confidence to 80%, only the aggregate L would satisfy the test requirements.

It is worthwhile testing how increases in the order of the moving average for interest rates are accompanied by increases in the p-value of the cointegration test, irrespective of whether the moving average is centred or not. It should be remembered that the introduction of such moving averages was warranted by the possibility that agents might alter their portfolios at a lesser frequency than that governing changes in returns. That made it necessary to smooth the series of the latter item (see, in this connection, Table 1 for the results such smoothing had on the volatility of the aggregates). In keeping with this, the data of the last column in Table 2 may be interpreted as providing evidence in favour of the limited effect this problem of discontinuous portfolio adjustment apparently has on the long-term relationship between money and nominal spending. Or rather, it may be construed as evidence of a high degree of flexibility in the relevant financial markets, enabling reasonably rapid portfolio adjustments to be made.

In any event, it should be stressed that no stable empirical long-term relationship between the weighted aggregate and income, prices and interest rates has been found. And this despite the fact that in the first stage of the Hansen method the results undoubtedly seemed promising: correct signs, income elasticity close to unity (in line with that obtained for M2 and appreciably lower than that corresponding to ALP), greater sensitivity to interest-rate movements than ALP (especially in the case of L, where the rejection of the existence of cointegration is least evident) and sensitivity to the inflation rate somewhat less than that of ALP and greater than that of M2. Thus, we may conclude that ALP (and even M2), for which there is a stable relationship to the relevant variables, are the soundest candidates empirically speaking to act as intermediate targets of monetary policy.

5.- POSSIBLE REASONS FOR THE INSTABILITY IN THE RELATIONSHIP BETWEEN THE WEIGHTED AGGREGATE AND NOMINAL SPENDING

Although there are various possible explanations for this, one is perhaps the clearest: that the differences among the interest rates on the financial assets included in the aggregates do not respond exclusively to differences in the degree of liquidity thereof. Thus, significantly, all of the aggregates considered include assets with widely differing maturities. There are various well-known theories about the term structure of interest rates. Such theories help highlight differences between interest rates on assets with different maturities that are unrelated to their degree of liquidity. In this respect, there is a need to incorporate some type of adjustment that takes this effect into consideration. As an example, Barnett (1982) proposes adjusting the different returns to a base maturity (1 month) using the term structure of the interest rates that is implicit in the yield curve for Treasury bills. Unquestionably, this is a line of progress that should be considered in future research.

Another possible source of interest-rate discrepancies which is unrelated to liquidity is the tax treatment of the different returns or, more generally, the existence of legal costs associated with the issue or purchase of different assets. Thus, certain authors have argued that profitability arising by virtue of the asset-holder's anonymity for tax purposes is one of the factors explaining changes in cash held by the public (Quiros, 1990, or Jareño and Delrieu, 1991). Indeed, this type of phenomenon can explain why assets such as insurance transactions and asset participations, with a very small relative weight in the structure of ALP and with much of the demand therefor relating to the search for tax anonymity, should appear with a high degree of liquidity (see Chart 2) that is difficult to justify in the light of their specific nature. Moreover, the regulation of certain bank rates or the eligibility or not of specific assets for the purposes of banking reserve requirements in the period under study may give rise to differences in returns unrelated to each asset's relative degree of liquidity.

No regard has been paid either to the effects of transactions-related technological progress (credit cards, ATMs) on the liquidity services provided by the different assets (Ford et al., 1992). Note that these examples suggest the possibility of differences arising in the relative degree of liquidity of an asset which are not accompanied by changes in the relative profitability of such asset.

Lastly, it should be remembered that the assets included in the aggregates have been assumed to be safe assets. However, the coexistence of assets with different maturities raises the possibility that risks relating to the potential early redemption of assets may arise. Admittedly, this maturity risk underlies the premises governing the term structure of interest rates discussed at the beginning of this section. In any event, there are potential risks other than those derived from consideration of the maturity. Such risks would justify, once more, interest-rate discrepancies independent of the degree of liquidity of the financial assets. Perhaps the clearest example in this connection is the existence of differential default risks associated with assets issued by the State (Treasury bills, for instance) or by private companies (private asset transfers).

6.- CONCLUSIONS

The starting point for this paper was the realisation of the theoretical attractiveness of weighted monetary aggregates compared with the traditional aggregates constructed as a simple sum of financial assets. However, on analysing their virtuality as an intermediate target for monetary policy, a patent need to compare both types of aggregate at the purely empirical level arose. In this connection, a traditional Divisia Index along the lines proposed by Barnett (1980) and several Currency Equivalent Aggregates recently proposed in Rotemberg (1991) were constructed for the Spanish economy and for assets included in ALP. The advantage with Currency Equivalent Aggregates compared with the Divisia Index is that they have a direct interpretation in the form of the balance of cash which provides the same liquidity services as the set of assets considered. This paper makes an initial assessment of the weighted monetary aggregates in relation to ALP and M2, analysing first, their statistical properties; and second, the existence of a cointegration relationship between the aggregates considered and the variables that economic theory suggests as arguments of a money demand function.

The level of the so-called Currency Equivalent Aggregates followed a similar pattern to that of M2 in the eighties. However, analysis of the growth rates of the former shows major discrepancies for lengthy periods with a greater degree of volatility -except in cases where very long filters are used for the weights. The Divisia Index evidences, however, less volatility in relation to M2.

In relation to ALP -the least volatile of the aggregates considered- the Currency Equivalent Aggregates had systematically lower growth rates well into the eighties, leading to a progressively greater discrepancy between the two aggregates that was only interrupted in recent years. This behaviour is similar to that of M2 in relation to ALP, reflecting the shift to less liquid instruments which took place those years owing to financial innovation. In the case of the Divisia Index, this behaviour runs virtually to the end of the sample.

Despite there being sound theoretical grounds for weighting the balances of the financial assets on the basis of their different degrees of liquidity, the empirical evidence furnished by the paper proves contrary to the weighted aggregates. Despite having tried different structures of alternative weights, no cointegration equation -for reasonable levels of confidence- has been found between weighted aggregates, real income, prices and interest rates that may be interpreted as a money demand function.

The explanation for this finding is, probably, that the differences between the interest rates on the various assets -the basis for constructing the different weights- do not respond exclusively to the degree of liquidity of each of them. Possible additional variables of relevance which are suggested are differences in maturities; the existence of fiscal or para-fiscal costs associated with the issue or acquisition of certain financial assets; and the existence of risks associated with the return on these assets. The possibility of improving the structure of weights taking these variables into consideration is an obvious extension which future papers could address. Further, such an extension should be made in view of the promising nature of some of the results obtained here, in particular the sign and scale of the coefficients in the first stage of the co-integration analysis.

One interesting result which emerges as a sub-product of the paper is that the smoothing of the interest-rate series worsens the relationship between nominal spending and prices. That may be interpreted as evidence that there is a sufficient degree of flexibility in the financial markets considered to enable reasonably rapid adjustments to be made to the make-up of agents' portfolios.

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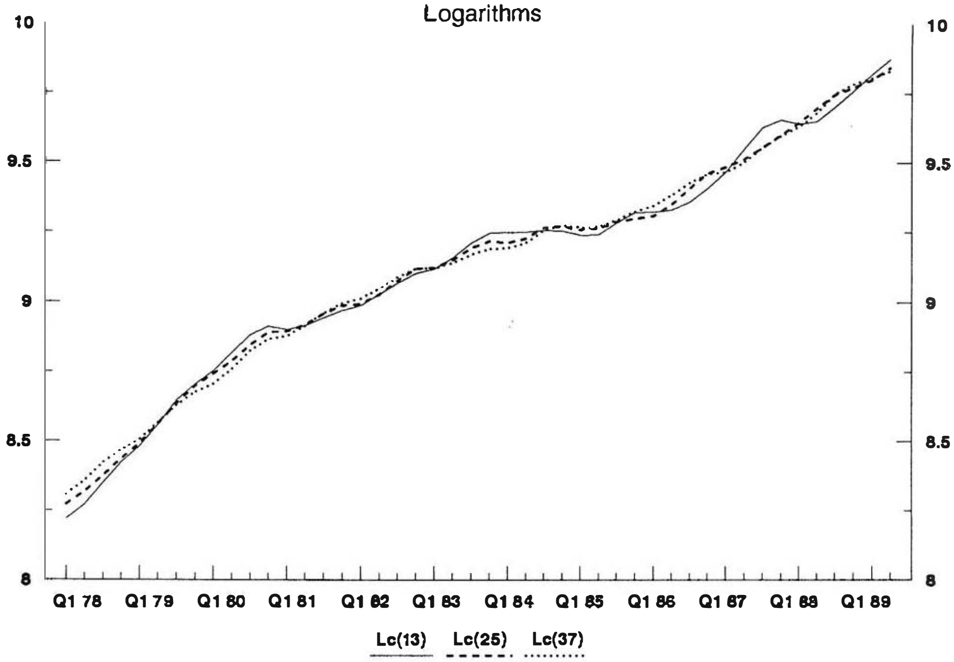
BALANCES OF MONETARY AGGREGATES

Chart 5

Logarithms



RATES T1,4

Chart 6

Logarithmic approximation

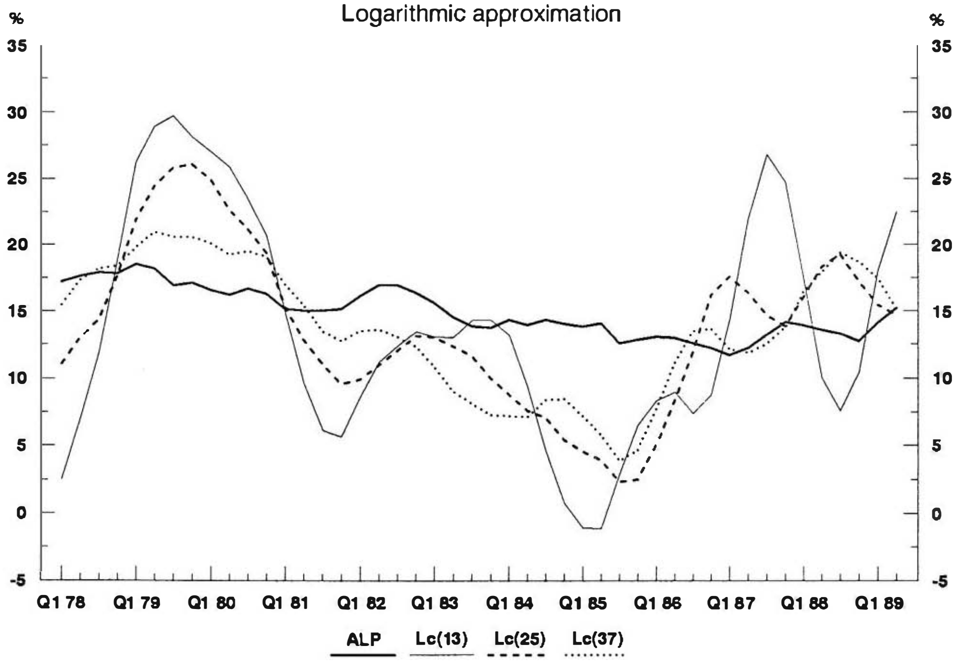


Chart 7

BALANCES OF MONETARY AGGREGATES

Logarithms

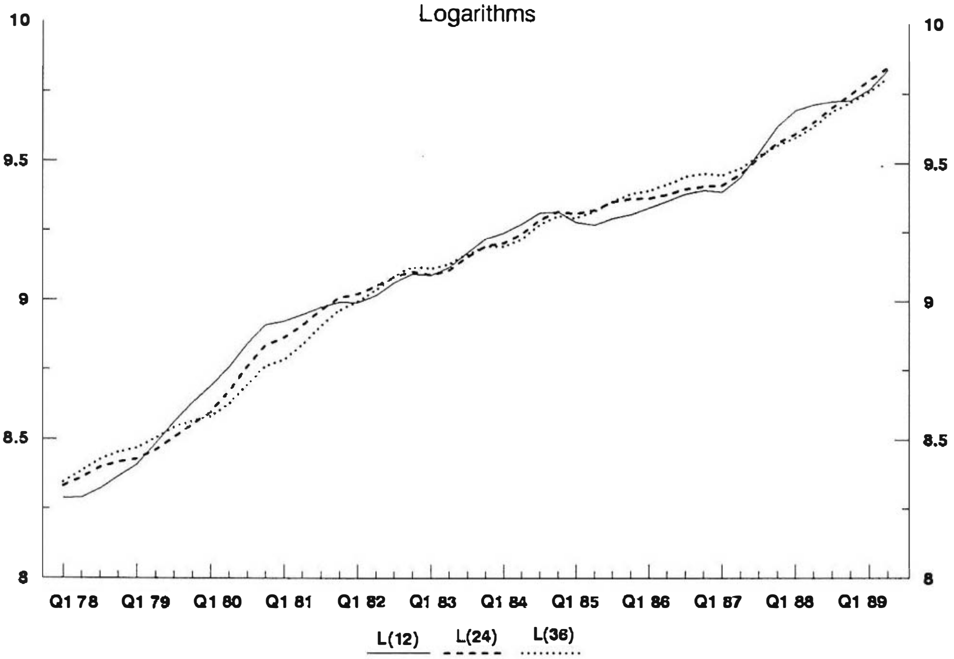
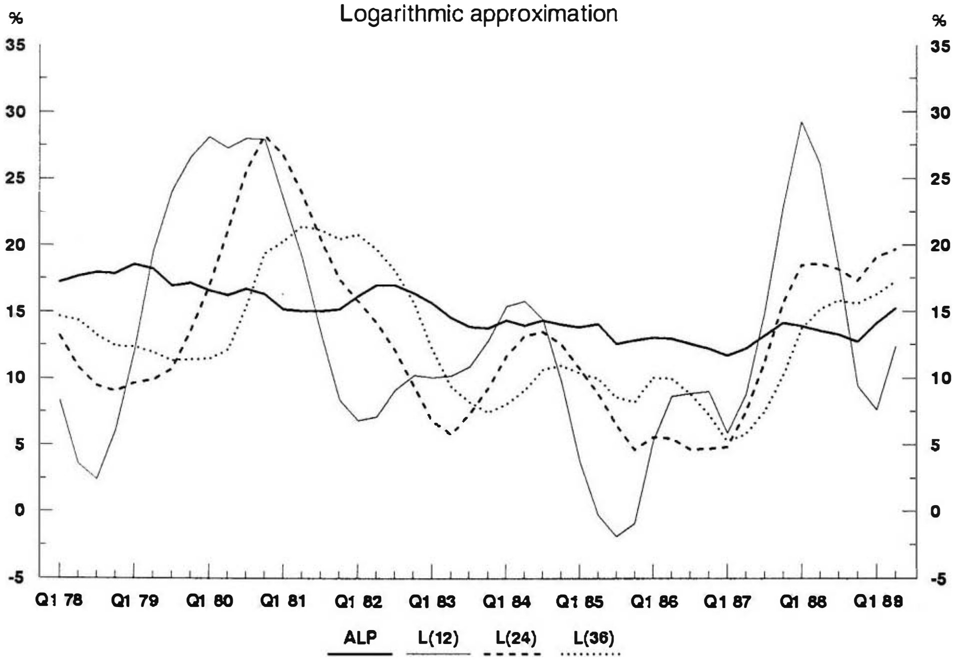


Chart 8

RATES T1,4

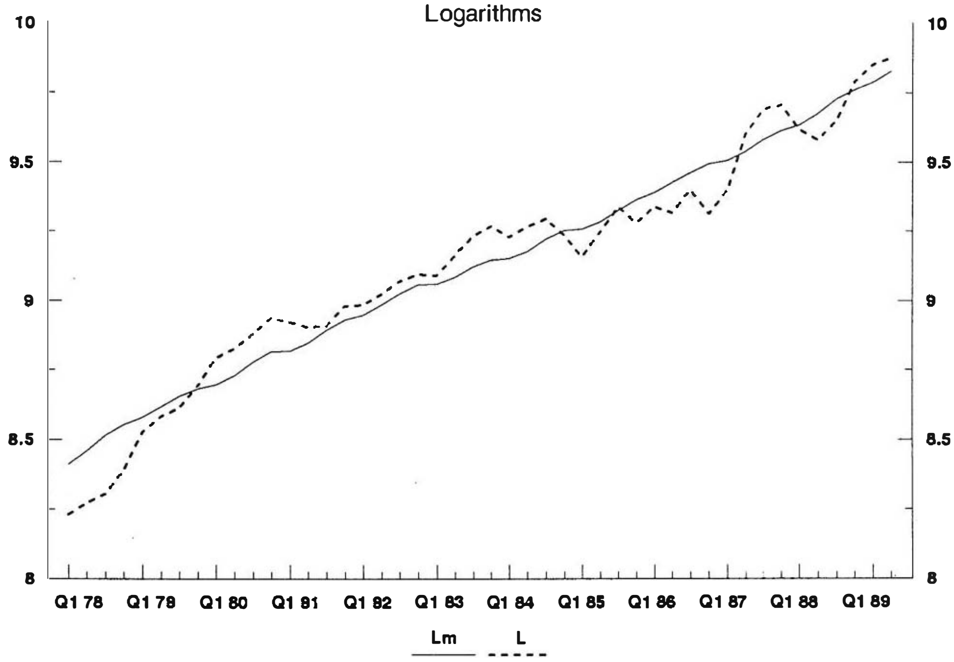
Logarithmic approximation



BALANCES OF MONETARY AGGREGATES

Chart 9

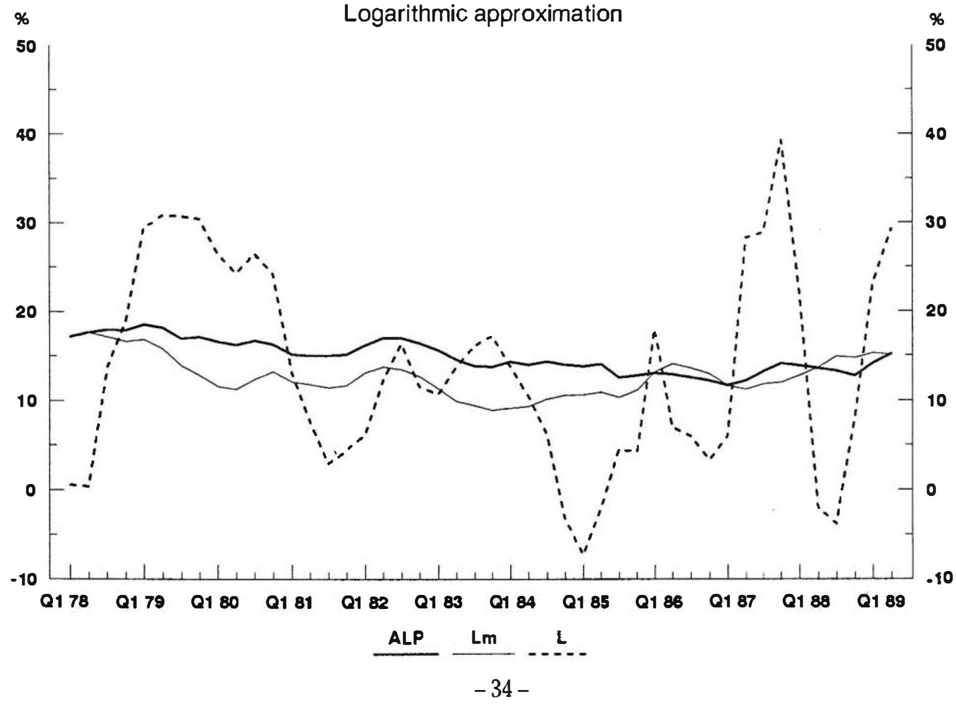
Logarithms



RATES T1,4

Chart 10

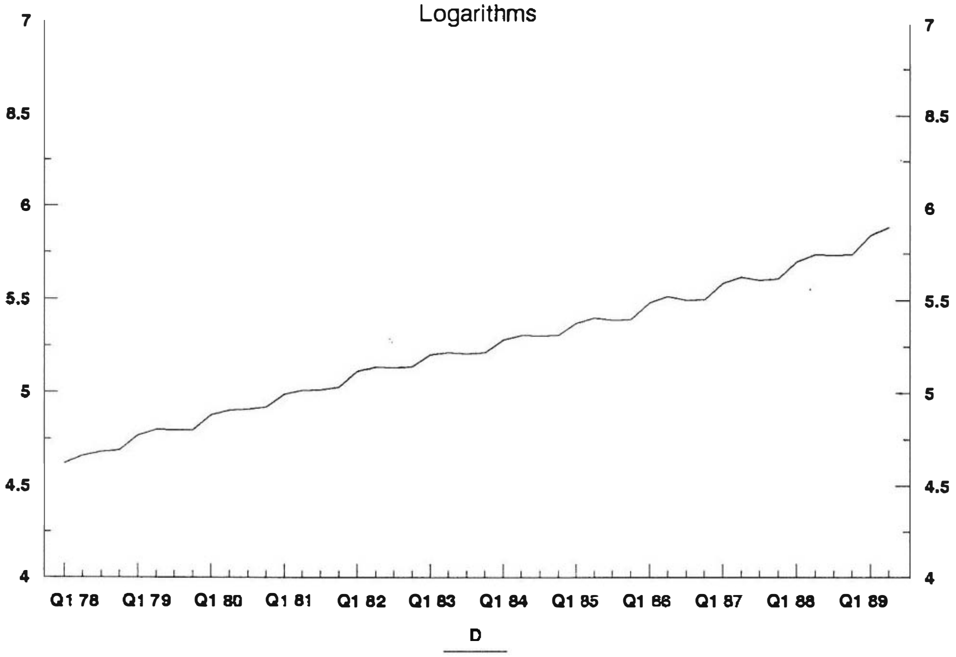
Logarithmic approximation



BALANCES OF MONETARY AGGREGATES

Chart 11

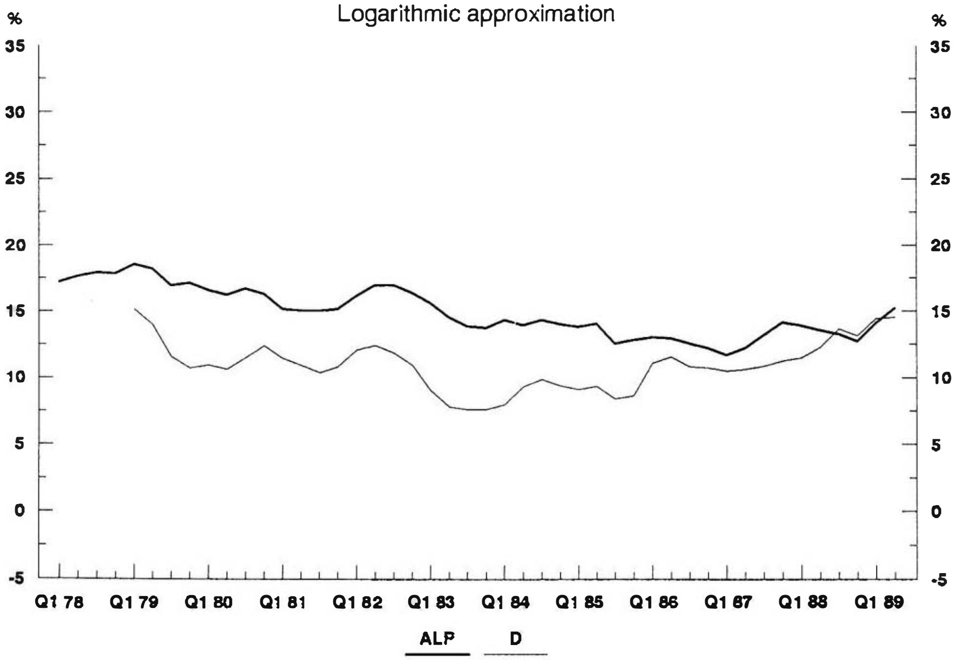
Logarithms



RATES T1,4

Chart 12

Logarithmic approximation



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