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1. Introduction

This paper takes as its starting point the current definition of private sector liquidity (ALP) and discusses which of its components could be excluded from a possible redefinition of aggregate liquidity. To do this, a set of monetary aggregates is constructed which, while remaining within the spectrum of broad definitions of liquidity are narrower than ALP. Then, they are subject to a set of econometric tests in order to provide criteria for a possible redefinition of controlled monetary aggregate.

The strategy for redefining ALP, essentially to reduce its size, is characterized, in the first place, by the need to harmonize monetary policy indicators within the European Economic Community as part of the process towards European Monetary Union. In the first stage of this process, the Committee of Governors of the European Community decided that exercises to coordinate monetary targets would take place followed by evaluation of the level of compliance. An important element in the coordination of monetary policies must be the setting of targets for the aggregates of the countries which play a dominant role in the growth of overall liquidity, and which are already basing an important part of the design of their monetary policy on quantitative targets. In this group of countries, Spain, together with Germany, France and Italy, set their targets in terms of broad definitions of liquidity.

The concerted control of the monetary supply by these four countries, possibly with the United Kingdom, will be the basic instrument for the nominal anchoring of monetary unification. As a result, the harmonization of definitions of monetary aggregates subject to control in these countries is becoming urgent. As ALP used in Spain is broader than definitions of liquidity in the other Community countries, it is useful to analyze the properties of narrower monetary aggregates.

In addition to the objectives of harmonization and coordination, in Spain's case there is a second factor of a domestic nature which favours the use of narrower monetary aggregates namely, the increasing difficulty of determining the limits of the definition of ALP at the margin, with the spread of financial disintermediation, the issue of short-term financial instruments by local and central governments and of highly liquid liabilities by insurance companies and financial entities of limited scope.

These phenomena are producing a shift of financial assets in private sector portfolios which disturbs the behaviour of ALP, hinders its interpretation and involves a general loss of informative content, at least in the short run [1]. This problem cannot be dealt with by broadening the definition of ALP, since, in contrast to what happened in the past with the development of new bank liquidity, the new financial instruments do not meet the minimum statistical requirements for use in a broad definition of liquidity for monetary control purposes.

Consequently, this paper presents evidence of the recent behaviour of a number of narrower measures of aggregate liquidity in the Spanish economy, emphasizing possible short- and long-run shifts in their relationships with nominal expenditure and interest rates during the period under analysis.

To arrive at an appropriate definition of stock of money in the context of harmonization, the first selection criterion has to be an analysis of the behaviour of the demand functions of the monetary aggregates under consideration, since the stability, predictability and robustness of the demand for money take on special importance in the extended process of financial innovation occurring as a result of increased competition between banks in the deregulated European financial services market[2].

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[1] As a result of this increase in financial uncertainty and complexity, the authorities have adopted larger doses of flexibility and discretionality in the conduct of monetary policy, so that the analysis of the behaviour of a wide set of monetary and non-monetary aggregates, such as interest rates, exchange rates and movements in yield curves has become increasingly important (see Escrivá (1990) and Malo de Molina and Pérez (1990)).

[2] In fact, with the prospect of the deregulation of financial services in the European Single Market, the profound changes occurring in the competitive structure of the banking system are causing increased competition between financial intermediaries. The process of delocalization of bank deposits which has accompanied the complete removal of all capital controls in France and Italy at the beginning of 1990 are a good example of these difficulties.

In view of the potential problem that the lack of stability of money demand functions may reflect structural shifts associated with financial deregulation and innovation, it is important to test new econometric procedures for specification, modelling and estimation. These procedures, used to identify genuine phases of instability to aid discrimination between aggregates, are a guide in the search for the most stable characterizations for sampling periods prior to those in which demand genuine shifts might have occurred in the underlying money demand function. They also help to examine the degree to which such shifts are corrected after the set of explanatory variables is appropriately modified[3].

In this respect, the concepts of cointegrated variables and their empirical counterpart of error correction models in levels are used to analyze the short- and long-run behaviour of the demand functions of the monetary aggregates under examination. Currently, this methodology has become a very popular empirical procedure as it allows long-run relationships between non-stationary variables to be estimated and tested. Under the cointegration hypothesis, the deviations from the long-run target path are constrained to be a stationary stochastic process and the previous class of models allows restrictions to be put on the short-run dynamics in such a way that these relationships are maintained over the long-run.

The paper is organized as follows. Section 2 contains a brief discussion of some theoretical models in the area of demand for money. Section 3 comments on the changes in ALP during the sample period as well as the information problems experienced with its components at the margin. Section 4 describes the construction of alternative narrower aggregates. Section 5 describes the statistical concept of cointegrated variables and comments briefly on different approaches to estimating dynamic models involving cointegrated variables. Section 6 offers a preliminary description of the stochastic properties of the relevant data, a

[3] An example relevant to the Spanish case is the introduction of own interest ratesfor specific components of the monetary aggregates whose demand function is being analyzed. In the absence of these rates, the process of financial innovation will tend to reduce artificially the estimated elasticity of the nominal balances with respect to the interest rates of alternative assets, since if a general increase occurs in all interest rates, own and alternative, the response of the monetary aggregate will be diminished compared with the chage in alternative rates due to the exclusion of the own rates.

description of the econometric procedures used to estimate the short- and long-run behaviour of the equations and a discussion on the results. Section 7 contains additional results from the estimation of transfer functions for comparison with those obtained from the cointegration in levels approach. Finally, a summary with the main findings is given in Section 8.

2. Brief Theoretical Considerations

This section reviews some of the principal theoretical results in the literature on money demand functions with a view to their use in the interpretation of empirical results discussed in later sections.

It is convenient to start by considering the following simple equilibrium relationship between monetary balances M_t, income Y_t and price level P_t

$$\ln\,(M_t/P_t\,Y_t) = \gamma_o + \varepsilon_t \tag{1}$$

where ϵ_t is a stationary random disturbance with zero mean.

This relationship is traditionally associated with the quantity theory of money which establishes, that the long-run (inverse) velocity of money, exp (γ_0), is constant. Given a certain level of nominal income, PY, the amount of money necessary to support the corresponding level of transactions is derived from (1). The equilibrium stock of money will vary by the same percentage as the corresponding change in either their level of transactions or the price level; in other words, the long-run demand for money is characterized by unitary price and income elasticitis (see e.g. Friedman and Schwartz (1982)).

However, the responsiveness of the demand for money to changes in scale variables (prices and income) and interest rates has been modelled in the literature in many different ways (see, e.g. Judd and Scadding (1982) and Hendry and Ericsson (1990) for an extensive bibliography).

For example, Baumol (1952) uses an inventory approach to model the transaction demand for money, obtaining as a theoretical prediction an income elasticity of 0.5 (using the so-called "square-root formula" c.f. Mauleón (1989)). In a recent study of the demand of a narrow monetary aggregate (M1) in the United States, Baba, Hendry and Starr (1988) imposed this theoretical value and found that the restriction was coherent with the data.

Another branch of this literature assumes that private-sector money holdings can be used as a buffer stock against different types of shocks, from which it follows that they are continuously affected by the difference between income and expenditure flows in each period. This implies that disturbances originating in other markets have a spill-over effect in the holdings of liquid assets. (see, e.g. Miller and Orr (1966), Akerlof (1979) and Carr, Darby and Thornton (1985)).

Miller and Orr (1966) argue that agents exert continuous monitoring over money holdings but that these only undergo adjustments when they reach certain thresholds due to the existence of transactions costs. In so far as these balances remain within appropriately defined limits, agents' portfolios are not affected. In comparison with equation (1) which predicts unit elasticities for prices and incomes in the demand for money, the buffer-stock or disequilibrium models typically predict lower values for such elasticities, at least in the short run (see, for example, a survey of the literature in Milbourne (1988) and Escrivá (1990)). In the long run, agents revise the limits of intervention as new information is received on changes in income, prices and other relevant factors, which implies different responses in the short and the long-run demand for money.

Traditional portfolio models à la Tobin-Brainard assume that demand for money depends negatively on the yield of all portfolio assets. Since our definitions of monetary aggregate contain both interest bearing and non-interest bearing assets, there is an argument for including own yields in the money demand equations, together with alternative interest rates representing opportunity costs of holding money. Similarly we should also consider including both the inflation and income growth rates, since, with adjustment costs, real money holdings will be eroded by continuosly increasing nominal income.

In the short run, it is also expected that the behaviour of the demand for money will be influenced by supply-side factors. For example, disturbances caused by unexpected changes in bank loans, in the balance on current account or in short-term capital flows will probably affect short-run fluctuations in the demand for money and it will be important to account for such "supply injections" in future empirical work (see e.g. Dolado et al. (1990)). Note that, in order to construct a model capable of describing short-run fluctuations in the data, it might be necessary to replace the single equation approach used in this paper by a system of equations approach which, given the existing the feedback effects between supply and demand, models the imbalances in the money market jointly with other variables in the system.

In this paper we will focus exclusively on existing relationships between money, income, prices and interest rates (own and alternative) from the interpretative standpoint of a of a demand for money function. While the development of a more complete and sophisticated model may be very helpful for understanding short-term mechanisms for determining the money stock held by agents, this fact need not prevent us from trying to establish stable long run relationships between the preceding variables and examining which monetary aggregates meet these requirements most satisfactorily. In our opinion, cointegration theory is the most appropriate analytical approach for determining to what extent such relationships exist since it seems reasonable to consider the variables involved as integrated stochastic processes. The relevant concepts of this type of theory on the behaviour of time series are developed in Section 6.

As previously remarked, income and price elasticities in a static model such as (1) must be interpreted as the long-term response of demand for money along a steady state path of the economy. Within a more general dynamic specification of the model, it will be then possible to disentangle the short-run characteristics of the relationaship from the long-run properties.

One ad hoc argument frequently used to justify dynamic specification in demand for money equations introduces transaction or adjustments costs into the agents optimization problem. The (linear) decision rule which emerges from minimizing these costs (in general represented by quadratic functions) implies that the agents will have to make partial adjustments (PA) to their current money holdings towards the desired level. It follows from the PA-type models that the amount of money in each period can only be considered "optimal" in the long run, after all the adjustments have been made. A common problem with PA models is that they frequently lead to an unreasonable long period of adjustment, due largely to their uniparametric representation of the dynamic structure of the model. Thus, it seems reasonable to use more flexible forms in the dynamic specification which models fluctuations in the short-run money stock. In so far as the money stock and its determinants are cointegrated, error correction models (ECM) provide the, relevant alternative, whilst if cointegration does not hold a "transfer function" approach in the differenced variables will be more appropiate.

3. Changes in ALP and the Problems of Information at its Margin

ALP is, as is well known, the variable used as an intermediate target in monetary policy. It is a broad definition of liquidity incorporating a large set of financial instruments. A detailed description of the characteristics of these assets and the process of substitution which took place over the last two decades can be found in Sanz (1988). Fig. 1 summarizes the changes in the internal structure of ALP between 1975 and 1990. Though the proportion of cash in ALP has remained relatively stable, the proportion of sight and savings deposits increased at the expense of time deposits until 1978 as yields of the formern deposits were in excess of the maximum legal rates in the context of a strong inflationary situation. From 1978 until 1982, time deposits became more attractive due to the deregulation of their interest rates and lower inflation. Since then, a set of new liquid assets (bonds, insurance operations, endorsed bills, Treasury notes, etc.) began to appear as a result of financial deregulation and the need to finance a growing public deficit.

In recent years, there have been many episodes in which different types of financial disturbance have depleted the informative content of ALP, even though it represents a very broad definition.

Nevertheless, it should be noted it has been frequent that shifts in private portfolios have been internalized in ALP. In fact, it is difficult to find another monetary aggregate which, from the purely statistical standpoint, shows such stable short-term monthly or quarterly growth rates [4]. In some periods, particularly between 1982 and 1986, the aggregate behaviour of ALP was largely unaffected by the enormous financial disturbances taking place; sharp readjustments in portfolios were internalized since all the assets involved fell within the definition. This was so for shifts between deposits and other bank liabilities, shifts between these and privately-held government securities basically implemented by financial institutions using repurchase agreements, and the asset substitutions accompanying the deregulation of interest rates.

Even so, shifts at the margin of ALP have gradually taken on as much importance as substitutions between financial assets within the aggregate. In some cases, the very broad definition of money supply has not served as an antidote to the erosion of informative content stemming from the process of financial innovation, whether "genuine" or, more frequently, spurious to avoid tax and financial regulation. In this context, it is useful to recall the causes of abrupt shifts at the margin of ALP in recent years:

a) Bringing forward subscription to assets in the period before the Law on Taxation of Financial Assets came into force in May 1985.

b) Issue on a massive scale by financial intermediaries of short-term repurchase agreements for medium- and long-term public debt from mid-1986 and of Treasury Bills from summer 1987 as Treasury Note yields lost their alignment with market interest rates.

c) Subscriptions to large volumes of single-premium insurance bonds issued by insurance companies often linked to banking groups, or by savings banks with head offices in Catalonia from 1986 to mid-1988. Since then, and especially since June 1989 when new regulations came into force, the process has been reversed with heavy disinvestment in these bonds. In these operations, the interest of financial

[4] A warning must be given that this stability is partly the result of a posteriori reconstructions of the historical ALP series. The growth rates of the aggregate showed certain irregularities as a consequence of financial disturbances involving assets both included and excluded from its definition. Though the latter were included later, they are not reflected in the ALP series currently used. Even so, these irregularities hindered interpretation of the growth rates, at a time when these were required for monetary policy decisions.

institutions to avoid reserve requirements coincided with the search by some agents in the private sector for financial assets suitable for investing undeclared liquid balances.

d) These two factors also produced large volumes of credit transfers by financial institutions mainly during 1988 and the first half of 1989. These transfers, formally implemented as "off-balance sheet" operations, were in practice mainly methods of capturing liabilities basically in the form of traditional bank deposits. As with single-premium insurance bonds, stricter regulation of these operations in mid-1989 lead to a sharp fall in their amount.

e) In the second half of 1989 and early 1990, high volumes of local government bonds and commercial paper were placed with the public for similar reasons.

The distorting effect on ALP of new financial instruments, close substitutes for the assets included in the aggregate, was corrected in some cases by obtaining information on these instruments and including their balances in the money-supply definition. This was the solution adopted for sales of public debt with repurchase agreements or transfers of private assets. An improvement occurred in the interpretative quality and stability of the broad definitions of liquidity, although relatively prolonged periods of ambiguity in the analysis of signals from the money supply occasionally occurred until the statistical requirements for the new financial instruments were completed and a systematic channel for obtaining the information worked out.

In other cases, however, it was not possible to obtain data of sufficient quality for financial instruments which turned out to be high substitutes in private portfolios of assets included in ALP; consequently the most that could be achieved was some estimates of the size of the financial disturbances affecting the aggregate. These estimates were generally heavily revised and referred exclusively to specific points in time. A paradigmatic case, in this context, were single-premium insurance bonds. It is estimated that their balances could have exceeded 1.5 trillion pesetas towards the end of 1988. However, it was not possible to determine accurately the speed at which this balance grew, nor the rate at which the instruments were redeemed.

The growing problem of obtaining precise information on new financial instruments and of having the statistical data promptly and regularly available has gradually eroded the quality of the broader definitions of liquidity recently developed. This deterioration creates potential errors in the measurement of the data collected and in revising advances until the information becomes final. The strategy of gradually broadening the aggregate has involved increasingly complicated statistical requirements. This is so since financial instruments similar to assets included in ALP are being issued on markets outside traditional banking circuits, either by new financial intermediaries on which little information is available, by the development of markets for commercial paper without bank involvement, or by the spread of short-term debt issues to official sectors on which precise information is not available. Problems recently experienced in obtaining reliable data on the size of the markets for commercial paper and local government bonds are good examples of these difficulties[5].

This development of disintermediated markets limits the strategy of making successive extensions to the broad definition of liquidity by causing insurmountable problems to the information available. It is therefore useful to explore the possibility of defining narrower monetary aggregates. The construction of a money-supply aggregate which, while remaining within the spectrum of broader definitions of liquidity, covers a smaller number of financial assets than current ALP is also desirable from the standpoint of harmonizing definitions of money supply among EEC member-states to reach coordinated monetary targets.

4. The Construction of Alternative Aggregates

Using the current definition of ALP as a starting point, narrower aggregates were constructed which combining a variety of criteria for financial assets: the degree of tax anonymity, term and type of issuer.

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[5] Data on the total volume of issues and the rate of redemption is necessary, as is a breakdown by holders to ascertain changes in private-sector liquidity. A breakdown of financial holdings by agents has caused problems, in some cases even with instruments issued by banks. In fact, at the time of accurately determining private-sector holdings, small gaps exist in the information on the assets in the ALP definition which it has not been possible to cover in their entirety: bonds, securities issued by official credit institutions and government securities.

It should be noted that, because of problems of availability of the proper data, the eventual treatment of the time deposits has been excluded from this study, and its balance has been entirely incorporated in the constructed aggregates. On the other hand, though some components of ALP with residual quantitative importance (e.g. repurchase agreements for private-sector assets, endorsed bills or guaranteed commercial paper) could be excluded from the definition of some of the aggregates, for reasons of simplicity they were not taken into consideration in the analysis. Considering the negligible magnitude of the balances of these components, the results of the estimations of the demand functions are very insensitive to the exclution, or not, of these assets in the proposed liquidity definitions.

The first set of financial assets considered when reducing the size of ALP was outright private holdings of government securities (Treasury bills and notes). A broad set of private agents, particularly households, keep these assets in their portfolios until maturity and normally purchase them on the primary market or, alternatively, in the secondary markets soon after issue. Therefore, agents maintain these assets in their portfolios for considerable period of time, and this period frequently coincides with the term of the issue: one year for Treasury bills and a year and a half for notes. In so far as this is the general behaviour of these holders, it is probable that these instruments represent savings which will not be used for expenditure. However, if the usual practice among the holders of these bills is characterized by agents, predominantly companies of a certain dimention, which use the liquidity posibilities on the secondary market as part of their short-term cash management, then it would not be appropriate to exclude these outright holders from the definition of the monetary aggregate. The following data gives an indication of the potential significance of these agents within the market. The data refers to the volume of outright operations in billions of pesetas for the first nine months of 1990 for outright operations with Treasury bills on the book-entry secondary market for government securities. These operations only include the negotation between the security companies and the general public during the first nine months of 1990:

	Purchases	Sales
January	227.8	69.2
February	171.7	25.7
March	219.4	35.9
April	298.0	30.9
May	399.2	24.1
June	454.1	87.5
July	195.4	25.6
August	278.7	16.5
September	142.7	18.9

Though these figures cannot be directly related to movements in the balance of Treasury bills purchased outright by the private sector, they are indisputable evidence of significant activity in this segment of the secondary market, even when sales are made by the general public, and they raise questions about the nature of the typical investor who purchases maturing Treasury bills. The matter remains, in any case, open to empirical testing.

In addition to outright holders, the possibility has been raised of excluding from ALP repurchase agreement of government securities made by financial intermediaries to private agents. A high percentage of these repurchase agreements incorporate a term that is very close to the maturity of the security. This fact shows that a strategy of the financial institutions is to use repurchase agreements to satisfy a segment of the demand for government securities which could easily be rechannelled towards the primary market. This strategy is much more profitable for them than simply collecting commission. Thus, substitution between Treasury bills purchased outright and repurchase agreements at longer terms could be very high in private portfolios. To exclude this type of operation from the aggregate, repurchase agreements were divided into terms longer or shorter than six months.

Repurchase agreements were further divided into terms of longer or shorter than three months. This division is based on the fact that a high percentage of repurchase agreements implemented as Treasury bonds with half-yearly coupons are for shorter terms, from a few days to six months, enabling agents to avoid withholding tax on bond yields which can distort the division of repurchase agreements at six months. To counteract this, on the basis of the statistical information available of the structure of the terms in these operations, the three-month threshold was tested to separate repurchase agreements related to transactions and expenditure decisions from those associated with financial investment decisions.

Another method followed in the strategy of "unloading" some of the components of ALP was to use tax anonymity, a factor which has been behind investment in some of the financial assets included in the aggregate (Treasury notes, insurance operations and private asset transfers). Investing in these instruments to avoid taxation control by the Treasury limits their use for expenditure decisions; similarly their substitutability with financial assets not offering tax anonymity - the great majority - is severely restricted. The construction of a series for "anonymous securities" was a problem due to the sharp break in the tax treatment for financial instruments that ocurred in 1985. The solutions adopted and details of the construction of this series can be found in Cuenca (1990) [6].

Specific definitions of the seven monetary aggregates for which demand functions were finally estimated are given below:

ALP		
ALPC	=	ALP - government securities purchased outright
ALPC6	=	ALPC - "repos" government securities over 6 months
ALPC3	=	ALPC6 - "repos" government securities between 3 and 6 months
ALPOC	=	ALPC - "Anonymous securities"
ALPOC6	=	ALPOC - "repos" government securities over 6 months
ALPOC3	=	ALPC - "repos" government securities between 3 and 6 months

A series of average quarterly end-of-month balances for the period 1974.1-1990.2 was constructed for these aggregates. Table 1 shows

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[6] A dummy variable has been used in the equations where the monetary aggregate is corrected by "anonymous securities". This takes the values 1,2,3,4 in 1985(3) - 1986(2) and zero in the rest of the sample. If the equation is in differences, then the dummy variable has ben differenced too.

the percentages of ALP for each aggregate in different sampling periods, demonstrating the increasing importance of the eliminated components which vary between 4% and 17% of ALP in 1990(2). The absence of a breakdown by term of daily frequency for repurchase agreements prevented the use of normal criteria for defining the monetary aggregate as average daily data. In the case of ALP, which is the only one of the preceding aggregates for which a comparison between the results obtained with both types of data can be made, greater variance was observed in the residuals in the model with average end-of-month balances, though the worsening of the adjustment is small (0.32% against 0.35% with data up to 1989 (2)) and the estimated coefficients show little variation.

For each aggregate series of a own interest rate (r^p) and an alternative interest rate (r^a) were designed: the former defined as the weighted after-tax rate of the components included in the aggregate; the latter as the weighted after-tax interest rate for public debt over two years and of the components excluded from ALP.

Variables of scale were the consumer price index (P) with base 100 = 1983 and gross domestic product in real terms (Y) with base 100 = 1980, on a quarterly basis using the Denton procedure with indicator (see Denton (1977)).

In the notation, small letters have been used to denote the logarithmic transformation of the variables, for example, m = ln M, p = log P, etc. Unlike the other variables, interest rates appear without logarithmic transformation, consequently their coefficients in the equations have to be interpreted as semi-elasticities.

5. The concept of cointegrated variables

Before discussing the stochastic properties of the series introduced in the last section and the models derived from them, it is useful to examine some of the statistical concepts underlying the discussion.

The problem of estimating long-run relationships between economic variables has been recently discussed in a long number of articles on error correction models and cointegration. The concept of cointegration has aroused great interest among applied economists as it provides a suitable framework for testing long-run relationships between non-stationary time series, in particular series which are integrated of order one, I(1) [7].

Consider a linear combination of n non-stationary series x_{it} (1 = 1,...,n) given by:

$$z_t = \sum_{i=1}^{n} \beta_i x_{it}$$

Each of the individual series is assumed to follow a non-stationary process I(1). These time series are cointegrated, CI(1,1) if z_t is a stationary process I(0) [8].

If a model is made of a set of non-cointegrated series, the danger exists of making incorrect inferences on their econometric relationships (c.f. the so-called "spurious regression" problem (Granger and Newbold (1974)). Thus the possible existence of (multiple) long-term relationships between a set of non-stationary series should be associated with their number of cointegration relationships which exists between them.

The representation theorem in Engle and Granger (1987) established the link between the concepts of cointegration and error correction models (ECM), demonstrating that cointegrated variables can always be represented in terms of ECM and vice versa.

Engle and Granger (1987) also proposed a two-stage estimation procedure to determine the parameters in the (ECM). In the first stage, the static long-run equation between the levels of the (non-stationary) variables is estimated using OLS, and the residuals of the regression tested to be I(1). Provided that the null hypothesis that they are I (1)

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[7] A time series x_t is I(d) if $(1-L)^d x_t$ has a Wold representation in terms of an invertible moving average.

[8] In general, a set of n time series, each one I(d), will be cointegrated CI(d,b) if there is at least one combination of them of order d-b, where $0 < b \leq d$.

can be rejected, the short-term dynamics is then estimated in the second stage. Stock (1987) has proved that the estimators of the cointegration relationship in step one converge to their true values at a faster rate than usual when dealing with stationay series. The importance of this property of "super consistency" in finite samples has been questioned by Banerjee et. al. (1986) who demostrate, using simulation procedures, the existence of substantial bias in the two-stage procedure [9].

Another possible difficulty with the two-stage procedure is that it implicitly assumes the cointegration relationship is unique. When the number of variables exceeds 2, the possible existence of multiple cointegration equation has to be considered, since there in general could exist up to (n-1) cointegration relationships. In this case, the long-run model would consist of the complete system of cointegration equations. The more or less arbitrary choice of one of these equations and, for example, its normalization with respect to the coefficient of the nominal balances, under the erroneous assumption that such relationship is unique, would lead in practice to estimating parameters which would be a convolution of the parameters of the complete system. Thus, interpretation of parameters obtained from single equation estimates would be unreliable.

Recently, a solution to this problem has been proposed by Johansen (1988, 1989) in which the entire cointegration space is estimated simultaneously using a maximum likelihood procedure. He has also proposed methods for making inferences on the number of cointegration vectors and the validity of different types of parameter restrictions, using a formal likelihood based statistical framework.

6. Changes in the variables, models and empirical evidence

6.1. Velocity of circulation and its explanatory factors

Figs. 2 and 3 show that velocity of circulation (p+y-m) has an irregular seasonal structure, product of the interaction of the seasonal pattern in the series M, P and Y. In the absence of a more detailed study on the subject, the deterministic part of this seasonal pattern was treated

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[9] Note that generally the estimators in the first stage of the elements of the cointegration vector do not have standard distributions and classic inferences cannot be made from them (see, for example, Dolado (1990)).

with seasonal dummy variables and their intersection with a linear trend to capture the trend of the seasonal pattern. In spite of the imperfections evident in this procedure, it has been shown to be a very robust method with hardly any serial correlation in the seasonal frequencies. Table 2 shows that between 1976 and 1978, the velocity of circulation of ALP grew continuously, indicating that the growth rate of nominal income was lower, ceteris paribus, than the ALP growth rate. Since 1978 until the end of the sample, velocity of circulation fell continuously. This downward trend did not occur with smaller monetary aggregates, such as ALPC3, ALPC6, ALPOC, ALPOC3, and ALPOC6 though, obviously, what occurred between 1974 and 1978 is shared by all the series, as the corrections made start from the beginning of financial deregulation in 1982. Table 2 contains information on these phenomena in terms of the rates of change of the velocities of the aggregates as well as their variability in different sub-periods. Except in the cases of ALPC3 and ALPC6, much lower variability was detected from 1982.

The charts of the velocity of circulation and its determinants (Figs. 4-9) reveal that the majority of these variables show non-stationary symptoms reflecting generation processes with deterministic and/or stochastic trends.

Before considering whether these variables are cointegrated, it is useful to make an initial judgement on their stochastic properties by testing if the stochastic components governing them are integrated processes. Recall that for these variables to be C(1,1), each variable should be I(1).

As a pre-test of the econometric analysis of the long-term relationship explaining demand for money, we will begin by commenting on the results of the tests on the degree of integration of the series studied for the 1974-1989 sample period.

A multitude of tests have been proposed recently in the literature to test if a time series is integrated or not (see e.g. Dolado, Jenkinson and Sosvilla-Rivera (1990)). However, many of these tests have little power, compared with alternative hypotheses, when the process generating the data deviates from the assumptions used in the test. A broad range of such tests were applied in this study and, given the high number of series analyzed, not all point in the same direction. Even so, summarizing the results, the sample evidence is not incoherent with M, P and Y being I(2) and with r^a and r^p being I(1), from which it can be deduced that p and y are I(1) (income is less clear). Velocity of circulation appears to be I(1), though as will be remarked later, in the joint analysis of the series its differentiated behaviour must be controlled in the 1974-1978 period [10].

6.2. Empirical models of long-run demand for money

To analyze long-run stability of the relationship between the monetary aggregates described above and their determinants we considered the following standard long-run desired demand for money function:

$$m = \lambda_1 \, p + \lambda_2 \, y + \lambda_3 \, r^a + \lambda_4 \, r^p + \lambda_5 \, \Delta p + \lambda_6 \, \Delta y \qquad (2)$$

To analyze the existence of cointegration between the variables appearing in (1), the procedure popularized by Johansen (1989) was used to select cointegration relationships from the elements of the vector of the variables

$$x = [(m - \lambda_1 \, p - \lambda_2 \, y), \; r^a, \; r^p, \; \Delta y, \; \Delta p] \qquad (3)$$

where each vector element (3) has to be an integrated variable I(1) in deviation from its deterministic components. This implies that a just difference filter (Δ) makes such variables stationary (I(0)). As mentioned previously, a preliminary analysis of the properties of the individual series revealed the existence of 2 unit roots (I(2)) in m, p, and y, the remainder of the components being I(1) (see Figs. 4-9). Given the presence of I (2) variables, a combination was chosen from the first subset of variables which was I(1), on the basis of the substitution of different values of λ_1 and λ_2 suggested by the conventional economic theory of the demand for money function, for example, $\lambda_1 = \lambda_2 = 1$. As remarked above, this was the set of values selected. It was demonstrated that the use of this procedure did not reject the null hypothesis of no-cointegration for

[10] An appendix is available on request containing the tests of unit roots in both regular (ADF) and seasonal (HEGY) frequencies.

any aggregate in the 1974–1989 period, although rejection was obtained in the 1978–89 period. Examination of the residuals suggested, as in previous studies (Dolado, 1988), the use of a combination of quadratic linear trend up to 1978 (D_t), which includes the fall in velocity of ALP and its redefinitions up to that date which cannot be explained by the remaining variables. This variable attempts to capture, in a rough way, possible changes in the extra-rates paid to depositors, as well as measurement of the series errors which are more likely to have occurred in the early subsample period.

Assuming that the variables in x_t are 1(1), under cointegration there will exist different cointegration vectors $\beta_i (i=1...r)$ such that each linear combination $\beta'_i x_t$ is I(0). The vectors β_i are determined by calculating the r quadratic canonical correlations between x_t and $\beta' x_{t-k}$, correcting by the lagged differences and the deterministic trends existing in the non-stationary part of the model. Denominating $\xi_1 ... \xi_r$ to the canonical correlations, the estimation procedure yields results for n>r where n denotes the number of variables in x_t (five in our case). Intuitively, the ξ_i values measure the total correlation between x_t (which is I(0)) and $\beta'_i x_{t-k}$, so that this correlation will be "high" only in the case when the linear combinations $\beta'_i x_{t-k}$, are also I(0), while ξ_i's near zero will indicate that $\beta'_i x_{t-k}$, is not stationary.

Following Johansen's procedure, in this case, if the variables are cointegrated, a model VAR(k) for the variables in the information set can be parametrized in the following way:

$$\Delta x_t = \sum_{i=1}^{k-1} \pi_i \, \Delta x_{t-i} - \alpha \, (\beta' x_{t-k}) + \mu' c_t + \gamma D_t + \Phi_1 \, (S_t + \Phi_2 S_t \, t) + \varepsilon_t \quad (4)$$

where $c_t = (1,t)$, i.e. constant and linear trend, D_t is a combination of linear and quadratic trends up to 1977(4) [11] and S_t ($S_t t$) are seasonal dummy variables (intersected with a linear trend) with a zero mean. In the

[11] The variable D_t is defined as the linear combination $t+bt^2$ until 1977(4) and thereafter zero, where t is a linear trend. The parameter b is estimated for each aggregate in the preliminary estimation phase of the VAR and is restricted to that value in later stages.

present case k=2 was generally sufficient to achieve relatively clean correlograms of e_t [12].

The matrices α and β in (4) have dimensions (nxr) where the r columns in β contain the cointegration vectors and the columns in α contain the "coefficients of adjustment" which represent the way in which the error correction terms affect Δx_t.

Obviously, n-1 is the maximum number of cointegration vectors which can exist between n variables in x_t. Therefore, the maximum value of r is n-1. To test the value of r, we used the trace test to test the null hypothesis r = r<n against the general alternative hypothesis r = n.

Johansen (1988) has shown that these hypotheses can be tested by simple maximum likelihood ratio tests. In first place, the e_i eigenvalues are calculated in decreasing order. When r cointegration vectors exist, it is expected that the first r eigenvalues will be significantly different from zero, while the last (n-r) eigenvalues will be zero under the null hypothesis. The trace test is as follows:

$$\xi_{Tr} = -2 \ln Q = -T\sum_{r+1}^{n} ln(1 - \xi_i) \qquad (5)$$

The statistical distribution followed by this test statistic is not standard and depends on the parameter n-r and on the deterministic components included in model (4). Critical values exist in Johansen and Juselius (1990) (denoted as E (0.95)), though they only include seasonal constants and variables which cannot be strictly applied in our case [13].

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[12] The following programs were used to obtain these results: REG-X (copyright S.G. Hall), RATS (from the program written by I. Lobato of the Centre for Monetary and Financial Studies) and SCA.

[13] The critical values used in Table 3 also take into account the possible existence of a linear trend between the regressors and come from simulations recently made by Soren Johansen. However, these simulations do not take into account the presence of D_t in the equations.

Some comments on the deterministic variables in (4) are necessary. Under the null hypothesis of cointegration it can be demonstrated (see Appendix) that the process x_t can be expressed as follows:

$$x_t = x_0 + C(1) \sum_{0}^{t} \ln(1 - \Sigma_i + C\mu' \, c_t \, (1 - L)^{-1} + C\gamma D_t \, (1-L)^{-1} + \\ + C(L)\phi_1 \, (\sum_{0}^{t} S_i + \phi_2 \sum_{0}^{t} S_i) + C^*(L)\varepsilon_t \qquad (6)$$

where C is the matrix (nxn) of long-term multipliers C(L=1), $(1-L)^{-1}c_t$ represents a linear and quadratic trend, while $(1-L)^{-1}D_t$ represents the cumulative process of D_t and $C^*(L)$ is an invertible lag polynomial.

As shown in (6), the constant, the linear trend and D_t can represent the effect of a quadratic linear trend and $(1-L)^{-1}D_t$ in the non-stationary part of the model. In the absence of the last three trends ($C\mu=C\gamma=o$), it can still occur that $\mu\neq 0$ and $\gamma\neq 0$, representing the presence of a constant, a linear trend and D_t in the cointegration vector. In this case (see Appendix) $\mu=\alpha\beta'_0$ and $\gamma=\alpha\gamma_0$ and the model (4) can be rewritten as follows

$$\Delta x_t = \sum_{i=1}^{k-1} \pi_i \, \Delta x_{t-1} - \alpha(\beta^{*\prime} \, x^*_{t-k}) + \phi_1(S_t + \phi_2 \, S_t \, t) + \varepsilon_t \qquad (7)$$

where:

$$\beta^* = (\beta'_{1'} - \beta'_{0'} - \gamma_0)'$$

and:

$$x^*_t = (x', \, C_t, \, D_t)'$$

A variety of tests were applied to determine cointegration rank depending on how the deterministic terms appear in the model. Generally, but with some exceptions, a single cointegration vector seems to exist when constant, the linear trend and D_t appearing in the cointegration vector (see Table 3). The exceptions are ALPC6 where clearly no cointegration vector exists and to some extent ALPC3. Although, in some cases, a second cointegration vector may exist, given that the critical values used are not totally correct and may be downward biased and that , the first cointegration vector can generally be interpreted in agreement with its signs as a demand for money function, thence we proceeded in those cases as if there was only one cointegrating vector. Under this assumption, we proceeded on to determine the short-run dynamics in a uniequational framework, estimating unrestricted equations of the type.

$$\gamma_0(L)m_t = \gamma_1(L)p_t + \gamma_2(L)y_t + \gamma_3(L)r_t^a + \gamma_4(L)r_t^p + \\ + \mu' c_t + \phi_1 \; (S_t + \phi_2 \; S_t \; t) \; + \gamma \; D_t + \varepsilon_t \tag{8}$$

where $y_i(L)$ are polynomials in the lag operator L.

It is important to note that the application of OLS to (8) is only efficient if the explanatory variables are weakly exogenous (see Eagle, Hendry and Richard (1983)) which, for example, implies that the cointegration vector can only appear in the equation which determines m_t. Otherwise non-linear restrictions would exist between the parameters of the conditional model given by (8) and the marginal models for each explanatory variable (see Dolado, Andrés and Domenech (1990)). When this hypothesis was tested, examining the elements corresponding to the first column of the matrix of "weightings" α, the evidence did not appear to reject it. Moreover, when the equations were estimated by instrumental variables, the results were always very similar to those of OLS. Based on these considerations, together with others given in Dolado (1988), it can be inferred that the application of OLS to (8) does not appear to be too inappropriate.

6.3. Results

Tables 5-9 show the recursive estimates the parameters of the different demand for money function from 1982 (4) until 1989 (2) with the initial period in 1974 (3). ALPC6 is excluded since, as explained previously, cointegration does not exist in its equation in levels. The specification of each equation was selected on the basis of the 1974 (3) - 1987 (4) sample, so that the 1988 (1) - 1989 (4) period is independent of the period chosen for selection of the equation; this is done to test the stability of the parameters. Below, we comment on the long-run properties of the solutions for each aggregate on the basis of the columns headed 89(2) in Charts 4-9.

i) ALP: unit income and price elasticities. For the purpose of testing the hypothesis in this case and in the cases described later, the tables show the t statistics for testing the joint hypothesis separately as ($t(\lambda_1)$ and $t(\lambda_2)$ for unit income and price elasticities, respectively). In the short -run, however, income elasticity is 0.0 and price elasticity is 0.4, so that in a quarter a 1% increase in income and price increases real balances by 0 and -0.6%, respectively. Mean lags for income and prices are 3 and 4 quarters respectively. The semi-elasticities for specific and alternative rates are 1.9 and -0.8 respectively, and when converted into elasticities (evaluated at maximum values) become 0.12 and -0.11 respectively. The standard deviation of the residuals is 0.35%, with a reduction in the ARIMA (with deterministic components) of 48%. The Chow test for stability of the parameters for the 1988(1) - 1989(2) period takes a value of 0.25 (5% = 2.45).

ii) ALPC: unit income and price elasticities. In the short run, income elasticity is 0.0 and price elasticity is 0.3, so that in a quarter an increase in income and prices by 1% increases real balances by 0 and -0.7%, respectively. Mean lags for income and prices are 4 and 6 quarters respectively, therefore the adjustment is somewhat slower than in ALP. Semi-elasticities for specific and alternative rates are 2.4 and -0.9, respectively, and when converted into elasticities become 0.15 and -0.14, respectively. Standard deviation for the residuals is somewhat above the last case, at 0.40%, with a reduction of 40%. The Chow test takes the value 0.95 (5% = 2.45).

iii) ALPC3: unit income and price elasticities. In the short run, income elasticity is 0.0 and price elasticity is 0.2, so that in a quarter an increase in income and prices by 1% increases real balances by 0 and -0.8%, respectively. Mean lags for income and prices are 2 quarters respectively, therefore the adjustment is somewhat faster than in ALP. Semi-elasticities for specific and alternative rates are 2.7 and -0.0 respectively, and when converted into elasticities (evaluated in their maximum values) are 0.15

and 0 respectively. Standard deviation for the residuals is 0.52% with a reduction over ARIMA (with deterministic components) of 44%. The Chow test takes the value 1.43 (5% = 2.34).

iv) ALPOC: unit income and price elasticities. In the short run, income elasticity is 0.0 and price elasticity is 0.2, so that in a quarter an increase in income and prices by 1% increases real balances by 0 and -0.8% respectively. Mean lags for income and prices are 5 and 4 quarters respectively, therefore the adjustment is slower than in ALP. Semi-elasticities for specific and alternative rates are 5.2 and -0.8 respectively, when converted into elasticities (evaluated in their maximum values) are 0.32 and -0.11 respectively. Standard deviation for the residuals is 0.39%, with a reduction in relation to ARIMA (with deterministic components) of 30%. The Chow test takes the value 1.79 (5% = 2.34).

v) ALPOC6: unit income and price elasticities. In the short run, income elasticity is 0.0 and price elasticity is 0.2, so that in a quarter an increase in income and prices by 1% increases real balances by 0 and -0.8%, respectively. Mean lags for income and prices are 4 quarters, similar to ALP. Semi-elasticities for specific and alternative rates are 5.1 and -0.5 respectively, which converted into elasticities are 0.32 and -0.07 respectively. Standard deviation for the residuals is 0.40% with a reduction in relation to ARIMA (with deterministic components) of 31%. The Chow test takes the value 1.83 (5% = 2.34).

vi) ALPOC3: unit income and price elasticities. In the short run, income elasticity is 0.2 and price elasticity is 0.2, so that in a quarter an increase in income and prices by 1% increases, in both cases, real balances by -0.8%. Mean lags for income and prices are 3 and 4 quarters respectively, similar to ALP. Semi-elasticities for specific and alternative rates are 4.7 and -0.4 respectively, which converted into elasticities (evaluated in maximum values) are 0.30 and -0.05 respectively. Standard deviation for the residuals is 0.38% with a reduction in relation to ARIMA (with deterministic components) of 30%. The Chow test takes the value 1.27 (5% = 2.34).

Summarizing, income and price elasticities in all cases are unity, although there is a very important inertial element in the short-run multipliers (a quarter), especially in relation to income. However, the adjustments occur relatively quickly, with mean lags between 1 and 1.5 years. Interest-rate elasticities are small in all cases and is it interesting to note that the elasticity of the alternative rate is cancelled out when the 3- or 6-month repurchase agreements are subtracted from their aggregate, which makes it likely that high substitutability exists between repurchase agreements and public debt at more than two years.

With regards to short-run stability, Figs. 10-15 give the Chow recursive tests for stability of parameters 1, 4 and 8 periods ahead during the 1982(1) - 1989(4) period. In all cases, except ALPC3, marked features of lack of stability were detected at the end of 1989, from which it can be deduced that the financial disintermediation following the restrictions on bank credit had a uniform effect on the aggregates, irrespective of the scope of their definition. In the case of ALPC3, despite the fact that its behaviour was better at the end of the sample, there was great instability in preceding periods and the residuals standard deviation was much higher than for other aggregates. Some within-sample transitory instability has also been observed in all cases with the exception of ALP. Finally, on the basis of two new observations for the first two quarters of 1990 which appeared after the preparation of this paper, there is continuing evidence of instability. Thus, the present loss of information content of the monetary aggregates is likely to persist for some time.

7. Other Alternative Econometric Approaches: Transfer Functions

As mentioned in Section 6, the existence of cointegration for the sample as a whole depends decisively on the use of a linear trend and the D_t variable in the cointegration vector between the variables analyzed. Though it has been argued that good reasons exist for treating the 1974-1977 period in a different way to the later period, and it has been noted that the linear trend must appear in the long-term relationship, both deterministic variables may well indicate mis-specifications in the equation, even though the error specification statistics do not appear to have captured it. Based on this evidence, the alternative is to abandon the estimation of the equations in levels and estimate them in differences, using a transfer-function approach (see Box and Jenkins (1976)): for example, this method was chosen by Mauleón in 1987. Note, however, with this method it is impossible to recover a possible relationship of equilibrium in levels, which does seem to exist from 1978. We believed its use was helpful for comparing results with those derived from the estimation of ECM models with the "suspicious" variables. It is important to note that despite losing the relationship in levels, given the indications that m, p, e and y are I(2), the estimate of the transfer functions in ordinary regular differences (Δ) also results in cointegration relationships, though of a lower order, i.e. C(2,1) instead of C(1,1).

Tables 10-16 show the results of estimating transfer functions of the type:

$$\Delta m_t = \frac{\lambda_1 (L)}{\Phi_1 (L)} \Delta s_t + \frac{\lambda_2 (L)}{\Phi_2 (L)} a_t \qquad (9)$$

where $y_i(L)$, $\Phi_i(L)$ (i=1,2) are lag polynomials, s_t is interpreted as the set of determinants of m_t, including the firts differenced price level to test homogeneity between nominal balances and prices; and a_t is an innovation. In cases where "anonymous" securities were not excluded, an atypical value in 1985(3) (AD853) was necessary, while in the remaining cases the artificial trend variable 85(3)-86(2) (TEN) was used described in note 6.

In general, results are relatively similar to those for the ECM models. The ALP aggregates, ALPC, ALPOC, ALPOC6 and ALPOC3 show acceptable results with preference towards ALP. Their long-run price elasticities are always unity, while income elasticity is also close to that value. As in the evaluation of the ECM models, ALPC6, and now to a much greater extent ALPC3, show sample fits much worse than those of the preceding aggregates. Moreover, the estimated values for income and price elasticities are difficult to interpret, particularly for the first elasticity, whose values of 0.3 are too low. The semi-elasticities of specific and alternative rates show the correct signs, although with absolute values lower than those previously obtained. Given that the latter variables, like the (differentiated) rates for inflation and growth of GDP are now stationary variables in the context of an equation with variables I(1) (m, p and y), their coefficients tend to their true values more slowly than the coefficients of the variables I(1), which can cause some bias with finite samples. Changes in prices have a strong inertial effect (2 quarters) while a change in income is transmitted with greater speed than in the ECM models, this being the most substantial difference between these two estimation procedures. It was shown, however, that by using the (inverse) of the lagged velocity of circulation, as in the ECM models, the estimated coefficient of the variable was very small, but the contemporaneous income effect disappeared, as occurred in most of these models. This makes us think that the contemporaneous effect of this variable, whose interpolation procedure is open to errors may be somewhat higher than that estimated in the ECM models but lower than the estimate for the transfer functions.

Figs. 16-22 show the recursive Chow tests 1,4 and 8 periods ahead. The conclusions reached from them are similar to those obtained from the ECM models, especially in relation to the unsatisfactory behaviour of ALPC3 and ALPC6. With respect to possible differences, the relatively better results of ALPOC6 compared with ALPOC3 should be noted, though the divergences are small.

8. Conclusions

This paper attempts to answer the question to what extent a reduction in the size of the ALP monetary aggregate affects its relationship with its explanatory arguments from the standpoint of its demand function.

A summary of the principal results may be found in Table 17 where the characteristics of cointegration, adjustment and stability for each equation, and the mean quadratic error in the prediction errors for the periods 1988(1) - 1989(2) and 1989(3) - 1990(2), are reported. It can be seen how, in general, both of the methods used to estimate the money demand functions produce very similar conclusions.

Firstly, the demand functions of all the aggregates show marked features of instability from the third or fourth quarter of 1989. The process of financial disintermediation which followed the restriction on bank credit appears to have had almost the same effect on the aggregates, irrespective of the breadth of their definition. The present loss of information content in the money supply aggregates is likely to last some time and will probably not be affected by removal of credit controls, as such a decision would tend to produce new distortions in the monetary series by abruptly sending borrowing flows back to banking circuits. Thus, the choice of aggregates will have to be made on the basis of the results of the estimates and tests made with information up to the second quarter of 1989.

Overall, taking into account sample adjustment criteria, stability of parameters and prediction errors in the demand functions, ALP as presently defined is the aggregate with the best behaviour. The exclusion of outright holdings of public debt from the aggregate (ALPC) reduces the goodness of the adjustment, causes some specific instability as well as larger prediction errors. Though the comparison with ALP will not stand up, the ALPC demand function does have some acceptable properties. Results become worse if repurchase agreements, over six months (ALPC6) or over three months (ALPC3), are excluded: cointegration with nominal expenditure in the ECM equations is lost; problems of interpretation arise in the values of some parameters; and both sample and post-sample errors increase considerably. In other words the demand function for these two aggregates never becomes clearly defined.

More promising results are obtained when the set of financial assets known as "anonymous securities" is excluded from ALP. The aggregate which excludes both outright holdings of Treasury bills and "anonymous securities" (ALPOC) shows acceptable results, similar to those obtained for ALPC, although still inferior to ALP. The properties of the estimates improve if repurchase agreement up to six months (ALPOC6) or up to three months (ALPOC3) are also excluded; then the demand function behaves in a similar way to ALP. On this point, the two alternative estimation procedures used produce results which do not completely coincide. In the case of the ECM equations, ALPOC3 is clearly better than ALPOC6 and its demand function shows some results practically comparable with those of ALP in terms of adjustment and for sampling and post-sampling stability; in contrast, with respect to transfer functions, ALPOC6 is better than ALPOC3, though in this case at some distance from ALP.

In short, the results obtained show that it is worthwhile continuing the search for a narrower definition of monetary aggregate than ALP to overcome the difficulties created by the non-availability of information experienced recently with financial assets at the margin of ALP, and to conform with definitions of liquidity used in the larger EEC member states. This reduction in the size of the aggregate would involve excluding instruments providing tax anonymity which have reduced use as liquid assets for supporting expenditure decisions, as well as some public debt held by the private sector, that is, outright acquisitions and repurchase agreements at longer terms which have absorbed part of private savings.

These findings should be supplemented by quantitative studies dealing with the problem of the information content of monetary aggregates from the standpoint of their impact on expenditure variables in the economy and the level of prices.

APENDIX

Granger Representation Theorem and the role of deterministic terms.

Consider the following reparameterisation of (4) in the text.

$$\pi(L)x_t = \mu' c_t + \gamma D_t + \phi_1 (S_t + \phi_2 S_t t) + \varepsilon_t = \eta_t \qquad (A.1)$$

or

$$\pi(1)\ x_t + \pi^*(L)\ \Delta x_t = \eta_t \qquad (A.2)$$

where $\pi(1) = \pi(L=1)$, π^* (L) is a lag polynomial $(=(\pi(L) - \pi(1)\ (1-L)^{-1}$ with all its roots outside the unit circle. Under the null hypothesis of cointegration (A.2) can be written as:

$$\alpha\beta' x_t + \pi^*(L)\Delta x_t = \eta_t \qquad (A.3)$$

Granger Representation Theorem says that (A.3) can be expressed in such a way that Δx_t has an invertible MA representation. In order to prove this property, let us define tuvo (nxn) matrices:
$\alpha_F = (\alpha, \alpha_\perp)$ and $\beta_F = (\beta, \beta_\perp)$ with full rank where $\alpha_\perp$ and $\beta_\perp$ are the respective orthogonal complements of α and β, i. e., $\alpha'_\perp \alpha = \beta'_\perp \beta = 0$

Premultiplying (A.3) by α'_F yields:

$$\alpha'\alpha\beta' x_t + \alpha'\pi^*(L)\Delta x_t = \alpha'\eta_t \qquad (A.4)$$

$$\alpha'_\perp\pi^*(L)\Delta x_t = \alpha'_\perp\eta_t \qquad (A.4')$$

Next, let us define the auxiliary variables :

$$z_t = (\beta'\beta)^{-1}\beta' x_t$$

$$y_t = (\beta_\perp' \beta_\perp)^{-1}\beta_\perp' \Delta x_t$$

Since β_F has full rank it follows that:

$$\Delta x_t = \beta_F(\beta_F' \beta_F)^{-1} \beta_F' \Delta x_t =$$

$$= \beta \; \Delta \; z_t + \beta_\perp y_t \tag{A.5}$$

Substituting (A5) into (A.4) and (A.4') we obtain the following system:

$$A(L)\begin{pmatrix} z_t \\ y_t \end{pmatrix} = \begin{pmatrix} \alpha'\alpha\beta'\beta + \alpha'\pi^*(L)\beta(1-L) & \alpha'\pi^*(L)\beta_\perp \\ \alpha_\perp'\pi^*(L)\beta(1-L) & \alpha_\perp'\pi^*(L)\beta \end{pmatrix}\begin{pmatrix} z_t \\ y_t \end{pmatrix} = \begin{pmatrix} \alpha' \\ \alpha_\perp' \end{pmatrix} \eta_t$$

or

$$\begin{pmatrix} z_t \\ y_t \end{pmatrix} = A(L)^{-1} \alpha_F' \eta_t \tag{A.6}$$

where it is easy to show that A(L) has all its root on outside the unit circle and, thus, A(L) is invertible.

From (A.5) it follows that:

$$\Delta x_t = (\beta \; (1-L)), \beta_\perp) \begin{pmatrix} z_t \\ y_t \end{pmatrix} \tag{A.7}$$

and therefore:

$$\Delta x_t = (\beta \; (1-L), \; \beta_\perp) \; A(L)^{-1} \alpha_F' \eta_t$$

$$= C(L)\ (\mu \cdot c_t + \gamma D_t + \phi_1\ (S_t + \phi_2\ S_t\ t)) + \varepsilon_t \qquad (A.8)$$

where C(L) is invertible, and integrating (A.8) we obtain (6) in the text. Note that

$$C = \beta_{\perp}\ (\alpha'_{\perp}\pi^{*}\ (1)\ \beta_{\perp})^{-1}\ \alpha'_{\perp} \qquad (A.8)$$

thus if: $\alpha'_{\perp}\mu = \alpha'_{\perp}\gamma = 0$, $(1-L)^{-1}\ c_t$ and $(1-L)^{-1}\ D_t$ vanish from the non stationary part of the model whilst if $\alpha'_{\perp}\mu$ and: $\alpha'_{\perp}\gamma$ differ from 0, it follows that both deterministic variables should appear the process generating the x_t's. In this last case, a hypothesis of interest is whether: $\mu = \alpha\ \beta'_0$ and: $\gamma = \alpha\ \gamma'_o$, i.e., both terms should appear in the cointegrating vectors.

As an illustration of the implications of the previous set of restrictions it is convenient to use the Stock and Watson's (1988) common factor representation of a cointegrated system. Consider the following DGP which could be obtained from the integrated representation de A(8) when n = 2.

$$X_t = c_1 + \mu_1 t + \beta f_t + I(0)$$

$$x_{2t} = c_2 + \mu_2\ t + f_t + I(0) \qquad (A.9)$$

$$\Delta\ f_t = c_3 + I(0)$$

where (1, – ß) is an cointegration relationship which eliminates the common factor $f_t \sim I(1)$, in the linear combination

$$x_{1t} - \beta\ x_{2t} = (c_1 - \beta c_2) + (\mu_1 - \beta\mu_2)\ t + I(O) \qquad (A.10)$$

The asymptotic distribution of the estimator of ß depends on whether is zero or different from zero, on $(\mu_1 - \beta\mu_2) = 0$, on $(\mu_2 + \mu_3) = 0$, and on $(c_1 - \beta c_2) = 0$. Hence the test of such a set of restriction is very relevant to obtain the correct asymtotic distribucion.

Johansen (1989) has proved that such a set of restriction can be tested with aχ^2 (n - r) test,

$$T \sum_{i=R+1}^{n} \ln [(1 - \varepsilon_r)/(1 - \varepsilon_u] \qquad (A.11)$$

where ξ_R, ξ_μ are the restricted (under the previous restrictions) and unrestricted eigenvalues obtained from the equation:

$$| S_{kk} - S_{ko} S_{kk}^{-1} S_{ok} | = 0 \qquad (A.12)$$

with:

$$S_{ij} = T^{-1} \Sigma R_{it} R_{jt} \quad (i, J = o, k)$$

and: R_{ot} (R_{kt}) is the matrix of the residuals from the regression of Δx_t on Δx_{t-i} (x_{t-k} on Δx_{t-i}).

Table 3 offers the values of the test statistics (A.11). In this case n = 5 and r = 1. The cointegrating vectors associated to the largest eigenvalues, with the exception of ALPC6, are shown in Figure 23.

PROPORTION OF ALP

Table 1

	ALPC	ALPC6	ALPC3	ALPOC (*)	ALPOC6 (*)	ALPOC3 (*)
1982 IV	0.997	0.996	0.996	0.990	0.990	0.990
1983 IV	0.982	0.977	0.977	0.975	0.970	0.970
1984 IV	0.981	0.969	0.969	0.973	0.962	0.961
1985 IV	0.976	0.930	0.926	0.918	0.911	0.911
1986 IV	0.967	0.897	0.889	0.854	0.854	0.853
1987 IV	0.964	0.899	0.885	0.851	0.839	0.832
1988 IV	0.974	0.909	0.884	0.862	0.839	0.821
1989 IV	0.958	0.887	0.858	0.881	0.842	0.819
1990 II	0.960	0.890	0.860	0.899	0.857	0.833

VELOCITY GROWTH RATES

Table 2

	ALP	ALPC	ALPC6	ALPC3	ALPOC (*)	ALPOC6 (*)	ALPOC3 (*)
1975	-0,440	-0,440	-0,440	-0,440	-0,440	-0,440	-0.440
1976	0,749	0,749	0,749	0,749	0,749	0,749	0.749
1977	2,340	2,340	2,340	2,340	2,340	2,340	2.340
1978	0,600	0,600	0,600	0,600	0,603	0,603	0.603
1979	-1,042	-1,042	-1,042	-1,042	-0,985	-0,985	-0.985
1980	-0,229	-0,229	-0,229	-0,229	-0,181	-0,181	-0.181
1981	-0,546	-0,546	-0,546	-0,546	-0,513	-0,513	-0.513
1982	-0,702	-0,664	-0,654	-0,653	-0,601	-0,591	-0.590
1983	-0,487	-0,093	-0,009	-0,001	-0,065	0,020	0.028
1984	-0,304	-0,090	0,149	0,169	-0,054	0,187	0.206
1985	-0,776	-0,780	-0,060	0,012	-0,997	-0,710	-0.697
1986	-0,027	0,544	1,990	2,154	-0,614	-0,353	-0.380
1987	-0,646	-0,871	-0,973	-0,768	-0,085	-0,005	0.141
1988	-0,795	-0,674	-0,760	-0,485	-0,524	-0,054	0.278
1989	-0,250	-0,117	0,122	0,387	-0,172	0,196	0.461

STANDARD DEVIATIONS OF VELOCITY GROWTH RATES

	ALP	ALPC	ALPC6	ALPC3	ALPOC (*)	ALPOC6 (*)	ALPOC3 (*)
1975-89	0,822	0,837	0,962	0,958	0,780	0,771	-0.440
1982-89	0,262	0,454	0,862	0,865	0,402	0,324	0.749
1986-89	0,306	0,550	1,169	1,140	0,313	0,196	2.340

(*) ALPOC,ALPOC6 Y ALPOC3 are adjusted by value
estimated trend in demand equations

TESTING THE NUMBER OF COINTEGRATING VECTORS Table 3

(1974(3) - 1989(2) T = 60

VAR(2) (System (4))

ALP $\chi^2(4) = 6.7$

	ξ	ξ_{Tr}	$\xi(0.95)$	λ_i
r≤5	-	-	-	(1) 1.0
r≤4	0.010	0.60	10.2	(2) 1.0
r≤3	0.086	6.00	22.1	(3) -0.9
r≤2	0.184	18.20	37.3	(4) 1.6
r≤1	0.302	39.77	57.5	(5) -1.2
r=0	0.564	89.57*	79.3	(6) -1.0

ALPC $\chi^2(4) = 7.2$

	ξ	ξ_{Tr}	$\xi(0.95)$	λ_i
r≤5	-	-		(1) 1.0
r≤4	0.023	2.01	10.2	(2) 1.0
r≤3	0.112	9.13	22.1	(3) -1.0
r≤2	0.202	22.67	37.3	(4) 2.6
r≤1	0.292	43.39	57.5	(5) -1.2
r=0	0.531	88.82*	79.3	(6) -0.8

ALPC6 $\chi^2(4) = 8.1$

	ξ	ξ_{Tr}	$\xi(0.95)$	λ_i
r≤5	-	-	-	(1)
r≤4	0.009	0.54	10.2	(2)
r≤3	0.082	5.67	22.1	(3)
r≤2	0.153	15.63	37.3	(4)
r≤1	0.263	33.94	57.5	(5)
r=0	0.393	63.89	79.3	(6)

ALPC3 $\chi^2(4) = 7.9$

	ξ	ξ_{Tr}	$\xi(0.95)$	λ_i
r≤5	-	-		(1) 1.0
r≤4	0.006	0.36	10.2	(2) 1.0
r≤3	0.107	7.15	22.1	(3) -0.2
r≤2	0.171	18.40	37.3	(4) 2.5
r≤1	0.322	41.72	57.5	(5) -0.8
r=0	0.452	77.81	79.3	(6) -0.5

ALPOC $\chi^2(4) = 6.3$

	ξ	ξ_{Tr}	$\xi(0.95)$	λ_i
r≤5	-	-	-	(1) 1.0
r≤4	0.012	0.72	10.2	(2) 1.0
r≤3	0.112	7.85	22.1	(3) -0.5
r≤2	0.212	22.15	37.3	(4) 5.6
r≤1	0.362	49.12	57.5	(5) -1.1
r=0	0.511	97.17*	79.3	(6) -1.2

ALPOC6 $\chi^2(4) = 8.1$

	ξ	ξ_{Tr}	$\xi(0.95)$	λ_i
r≤5	-	-		(1) 1.0
r≤4	0.041	2.51	10.2	(2) 1.0
r≤3	0.151	12.33	22.1	(3) -0.3
r≤2	0.232	28.16	37.3	(4) 6.0
r≤1	0.403	59.11*	57.5	(5) -0.8
r=0	0.502	100.90*	79.3	(6) -0.1

ALPOC3 $\chi^2(4) = 8.6$

	ξ	ξ_{Tr}	$\xi(0.95)$	λ_i
r≤5	-	-	-	(1) 1.0
r≤4	0.036	2.20	10.2	(2) 1.0
r≤3	0.132	10.69	22.1	(3) -0.2
r≤2	0.216	25.29	37.3	(4) 4.6
r≤1	0.314	47.90	57.5	(5) -1.1
r=0	0.508	90.46*	79.7	(6) -1.1

Note: ξ denotes the eigenvalues obtained from (A.10) in the Appendix, ξ_{Tr} denotes the trace statistic as explained in (5); ξ(0.95) denotes the critical value when an intercept, a linear trend and a set of seasonal dummies are included in the VAR; λ_i denotes the normalized coefficients with respect to (m-p-y-) in equation (2); x^2 (4) denotes the test explained in the Appendix.

RECURSIVE ESTIMATION OF DEMAND FOR ALP
(Dependent Variable: Δ m)

Table 4

	82 (4)	83 (4)	84 (4)	85 (4)	86 (4)	87 (4)	88 (4)	89 (2)
cte	-0,61	-0,65	-0,65	-0,64	-0,70	-0,71	-0,69	-0,69
	(6,2)	(7,9)	(7,4)	(7,1)	(7,0)	(7,1)	(8,2)	(8,6)
$\Delta(m-p)_{-1}$	0,05	0,09	0,12	0,12	0,16	0,16	0,15	0,15
	(0,9)	(1,3)	(1,8)	(2,0)	(2,6)	(2,9)	(2,9)	(3,0)
Δp	0,38	0,40	0,41	0,41	0,41	0,38	0,38	0,38
	(8,4)	(9,1)	(7,8)	(8,5)	(8,7)	(8,5)	(8,9)	(9,3)
Δr^a_{-1}	-0,26	-0,25	-0,29	-0,20	-0,23	-0,18	-0,18	-0,17
	(2,7)	(2,9)	(3,1)	(1,9)	(2,5)	(2,1)	(2,3)	(2,5)
Δr^p_{-1}	-0,33	0,02	0,18	0,46	0,50	1,42	1,34	1,37
	(0,8)	(0,1)	(0,5)	(1,3)	(1,3)	(4,8)	(4,6)	(5,0)
$(m-p-y)_{-1}$	-0,20	-0,21	-0,21	-0,21	-0,23	-0,23	-0,23	-0,22
	(6,6)	(8,4)	(7,9)	(6,6)	(7,4)	(7,5)	(8,6)	(8,9)
r^a_{-1}	-0,23	-0,22	-0,22	-0,23	-0,18	-0,19	-0,18	-0,18
	(3,2)	(3,3)	(3,4)	(3,1)	(3,3)	(2,9	(3,3)	(3,4)
r^p_{-1}	0,50	0,54	0,53	0,52	0,54	0,42	0,41	0,41
	(4,8)	(4,2)	(3,8)	(3,4)	(3,4)	(2,9)	(3,5)	(3,6)
se	0,34	0,36	0,35	0,36	0,36	0,36	0,35	0,35
$\bar{R}^2$	0,75	0.74	0,77	0,78	0,79	0,77	0,80	0,80
λ_1	1	1	1	1	1	1	1	1
λ_2	1	1	1	1	1	1	1	1
$t(\lambda_1)$	1,0	1,1	1,5	0,6	0,3	0,6	0,8	0,9
$t(\lambda_2)$	0,3	0,6	0,3	0,2	0,3	0,7	0,8	0,9
λ_3	-1,1	-1,0	-1,0	-1,1	-0,8	-0,8	-0,8	-0,8
λ_4	2,5	2,6	2,5	2,5	2,3	1,8	1,8	1,9
λ_5	-1,2	-1,1	-1,0	-1,0	-0,9	-0,9	-0,9	-1,0
λ_6	-0,8	-0,7	-0,7	-0,7	-0,6	-0,7	-0,7	-0,7
LM(4)	11,8	7,8	8,1	5,1	3,1	2,1	1,4	1,5
BJ(2)	2,1	1,7	1,5	2,3	2,1	2,2	2,4	2,3
ARCH(2)	4,6	3,7	4,0	3,8	4,1	3,7	3,3	2,8

Note: The equation contains a linear combination of three seasonal dummies, idem intersected with a (zero mean) linear trend, and a quadratic trend up to 1977 (4) whose coefficients are not reported for brevity; t-ratio in parentheses: s.e.: standard deviation of the residual. R^2 multiple correlation coefficient (corrected by d.f.), LM(·), BJ(·) and ARCH(·) = LM tests for autocorrelation, normality and autoregressive heteroskedasticity with d.f. in brackets.

RECURSIVE ESTIMATION OF DEMAND FOR ALPC
(Dependent Variable: Δ m)

Table 5

	82 (4)	83 (4)	84 (4)	85 (4)	86 (4)	87 (4)	88 (4)	89 (2)
cte	-0,52	-0,52	-0,54	-0,50	-0,58	-0,61	-0,57	-0,57
	(3,6)	(3,9)	(2,8)	(3,5	(4,0	(4,1)	(3,9)	(3,9)
$\Delta(m-p)_{-1}$	0,14	0,16	0,16	0,17	0,20	0,24	0,23	0,23
	(2,1)	(2,4)	(2,6)	(2,8)	(3,2)	(5,5)	(5,2)	(5,89
Δp	0,29	0,27	0,27	0,31	0,27	0,25	0,26	0,26
	(5,4)	(4,5)	(4,1)	(5,8)	(4,7)	(4,3)	(4,3)	(5,5)
$\sum_{0}^{1} \Delta r^{p}$	0,52	0,58	0,50	0,50	0,83	1,00	1,00	1,00
	(1,6)	(2,1)	(1,7)	(1,5)	(2,8)	(5,3)	(5,0)	(5,3)
$(m-p-y)_{-1}$	-0,16	-0,18	-0,15	-0,17	-0,16	-0,16	-0,17	-0,17
	(3,9)	(4,2)	(3,9)	(3,7)	(4,3)	(4,3)	(4,2)	(4,2)
r^{a}_{-1}	-0,16	-0,15	-0,15	-0,17	-0,16	-0,16	-0,17	-0,17
	(2,5)	(2,4)	(2,5)	(3,0)	(2,6)	(2,6)	(2,8)	(2,9)
r^{p}_{-1}	0,54	0,48	0,50	0,60	0,55	0,45	0,45	0,45
	(2,1)	(1,8)	(2,0)	(2,8)	(2,9)	(3,0)	(3,0)	(3,1)
se	0,38	0,41	0,40	0,39	0,41	0,41	0,41	0,40
$\bar{R}^2$	0,66	0,70	0,74	0,77	0,78	0,78	0,77	0,78
λ_1	1	1	1	1	1	1	1	1
λ_2	1	1	1	1	1	1	1	1
$t(\lambda_1)$	0,8	1,8	1,7	1,8	1,4	1,2	0,2	0,2
$t(\lambda_2)$	0,4	1,0	0,9	0,6	0,1	0,2	0,4	0,4
λ_3	-1,0	-0,8	-1,0	-1,1	-0,8	-0,8	-0,9	-0,9
λ_4	3,4	2,7	3,3	3,8	2,9	2,3	2,3	2,4
λ_5	-1,3	-1,2	-1,4	-1,3	-1,0	-1,0	-1,0	-1,4
λ_6	-1,0	-1,0	-1,2	-1,1	-1,0	-0,9	-0,9	-1,0
LM(4)	11,1	6,3	5,9	4,7	1,3	1,0	0,9	1,0
BJ(2)	1,9	1,9	1,4	2,5	2,3	2,2	2,6	2,5
ARCH(2)	4,8	4,0	3,7	4,0	4,0	3,2	2,8	2,8

Note: See Table 4.

RECURSIVE ESTIMATION OF DEMAND FOR ALPOC
(Dependent Variable: Δ m)

Table 6

	82 (4)	83 (4)	84 (4)	85 (4)	86 (4)	87 (4)	88 (4)	89 (2)
cte	-0,61	-0,70	-0,61	-0,56	-0,44	-0,40	-0,41	-0,34
	(3,5)	(4,7)	(4,2)	(4,3)	(4,8)	(4,1)	(4,4)	(3,7)
$\Delta(m-p)_{-1}$	0,34	0,37	0,37	0,33	0,34	0,30	0,29	0,28
	(4,0)	(4,8)	(4,9)	(6,3)	(8,0)	(7,7)	(7,4)	(7,3)
$\sum_{0}^{1} \Delta p_{-i}$	0,17	0,20	0,16	0,17	0,17	0,17	0,17	0,18
	(3,0)	(3,5)	(3,7)	(4,2)	(5,4)	(5,3)	(5,2)	(5,2)
$\Delta^2\ r^P$	0,49	0,42	0,29	0,33	0,36	0,46	0,57	0,46
	(1,3)	(1,3)	(0,8)	(1,0)	(1,1)	(1,7)	(2,2)	(1,9)
$(m-p-y)_{-1}$	-0,20	-0,22	-0,20	-0,19	-0,15	-0,14	-0,14	-0,13
	(3,7)	(5,0)	(4,4)	(4,5)	(5,2)	(4,5)	(4,8)	(4,1)
r^a_{-1}	-0,07	-0,07	-0,06	-0,09	-0,10	-0,11	-0,11	-0,10
	(0,9)	(0,7)	(0,8)	(1,5)	(1,7)	(1,9)	(2,0)	(2,1)
r^p_{-1}	0,80	0,88	0,78	0,66	0,65	0,76	0,82	0,68
	(3,0)	(3,8)	(3,5)	(2,8)	(2,9)	(4,0)	(4,5)	(4,1)
se	0,39	0,39	0,37	0,37	0,36	0,37	0,38	0,39
$\bar{R}^2$	0,67	0,72	0,77	0,88	0,94	0,93	0,92	0,92
λ_1	1	1	1	1	1	1	1	1
λ_2	1	1	1	1	1	1	1	1
$t(\lambda_1)$	1,7	0,5	0,7	0,3	0,5	0,3	0,6	0,2
$t(\lambda_2)$	0,6	0,2	0,2	0,4	0,2	0,1	0,6	0,3
λ_3	-0,4	-0,3	-0,3	-0,5	-0,7	-0,8	-0,8	-0,8
λ_4	4,0	4,0	3,9	3,5	4,3	5,4	5,9	5,2
λ_5	-0,8	-0,7	-0,9	-0,9	-1,1	-1,2	-1,2	-1,2
λ_6	-0,8	-0,7	-0,8	-0,9	-1,1	-1,2	-1,3	-1,4
LM(4)	5,68	7,52	7,73	5,72	4,48	5,09	3,16	3,18
BJ(2)	1,3	0,7	2,1	1,6	1,3	1,2	1,0	1,1
ARCH(2)	2,3	2,1	1,8	1,7	2,1	1,6	1,3	1,5

Note: See Table 4.

RECURSIVE ESTIMATION OF DEMAND FOR ALPOC3
(Dependent Variable: Δ m)

Table 7

	82 (4)	83 (4)	84 (4)	85 (4)	86 (4)	87 (4)	88 (4)	89 (2)
cte	-0,60 (4,2)	-0,73 (5,9)	-0,70 (5,5)	-0,74 (5,8)	-1,02 (5,9)	-1,02 (6,1)	-0,86 (5,3)	-0,83 (5,3)
$\Delta(m-p)_{-1}$	0,35 (6,6)	0,42 (5,9)	0,45 (6,7)	0,49 (7,8)	0,62 (5,6)	0,62 (6,7)	0,63 (6,2)	0,62 (6,1)
$\sum_{0}^{1} \Delta p_{-i}$	0,16 (2,6)	0,19 (2,9)	0,22 (3,3)	0,26 (4,4)	0,22 (3,6)	0,21 (3,7)	0,22 (4,0)	0,22 (3,8)
Δr^P	0,31 (0,8)	0,49 (1,2)	0,43 (1,3)	0,35 (1,0)	1,06 (2,2)	1,27 (2,9)	1,23 (2,9)	1,34 (3,1)
$(m-p-y)_{-1}$	-0,20 (4,4)	-0,23 (6,1)	-0,22 (5,6)	-0,24 (5,8)	-0,32 (6,0)	-0,32 (6,2)	-0,28 (5,5)	-0,26 (5,5)
r^P_1	0,60 (2,2)	0,77 (3,2)	0,78 (3,7)	0,92 (4,8)	1,03 (5,6)	0,99 (6,0)	0,77 (4,9)	0,70 (5,0)
se	0,40	0,39	0,38	0,41	0,52	0,51	0,52	0,52
$\bar{R}^2$	0,65	0,72	0,77	0,82	0,81	0,82	0,80	0,80
λ_1	1	1	1	1	1	1	1	1
λ_2	1	1	1	1	1	1	1	1
$t(\lambda_1)$	1,3	0,3	0,8	0,4	0,8	0,9	1,6	2,0
$t(\lambda_2)$	0,6	0,6	0,4	0,7	1,4	1,2	1,1	1,7
λ_3	–	–	–	–	–	–	–	–
λ_4	3,0	3,3	3,5	3,8	3,2	3,1	2,8	2,7
λ_5	-0,9	-0,7	-0,6	-0,5	-0,4	-0,5	-0,5	-0,5
λ_6	-0,8	-0,6	-0,6	-0,5	-0,3	-0,3	-0,3	-0,4
LM(4)	7,5	5,2	5,2	5,2	6,7	6,6	7,1	7,0
BJ(2)	2,6	1,7	1,5	2,3	5,1	1,7	1,5	0,9
ARCH(2)	3,1	4,1	3,8	4,3	6,2	3,8	3,2	2,8

Note: See Table 4.

RECURSIVE ESTIMATION OF DEMAND FOR ALPOC6
(Dependent Variable: Δ m)

Table 8

	82 (4)	83 (4)	84 (4)	85 (4)	86 (4)	87 (4)	88 (4)	89 (2)
cte	-0,52 (2,9)	-0,68 (4,7)	-0,60 (4,2)	-0,62 (4,3)	-0,52 (4,8)	-0,53 (4,1)	-0,53 (4,4)	-0,50 (3,7)
$\Delta(m-p)_{-1}$	0,33 (4,2)	0,38 (5,2)	0,41 (5,4)	0,39 (6,0)	0,37 (7,5)	0,31 (6,5)	0,31 (6,0)	0,31 (6,0)
$\sum_{0}^{1} \Delta p_{-i}$	0,15 (2,7)	0,19 (3,4)	0,21 (3,7)	0,19 (4,0)	0,17 (5,0)	0,16 (4,4)	0,17 (4,4)	0,17 (4,5)
$\Delta^2 rP$	0,43 (1,1)	0,38 (1,0)	0,25 (0,6)	0,31 (0,8)	0,39 (1,3)	0,78 (2,7)	0,90 (3,0)	0,83 (2,8)
$(m-p-y)_{-1}$	0,17 (3,2)	-0,22 (4,7)	-0,20 (4,3)	-0,20 (5,1)	-0,17 (5,4)	-0,18 (5,2)	-0,18 (5,1)	-0,17 (4,1)
r^a_{-1}	-0,03 (0,5)	-0,01 (0,0)	-0,01 (0,2)	-0,02 (0,4)	-0,04 (0,9)	-0,07 (1,6)	-0,08 (1,7)	-0,08 (1,8)
r^P_{-1}	0,60 (2,6)	0,71 (3,5)	0,68 (2,8)	0,67 (3,0)	0,62 (2,9)	0,88 (4,6)	0,93 (7,4)	0,87 (7,7)
se	0,40	0,40	0,39	0,37	0,38	0,38	0,40	0,40
$\bar{R}^2$	0,65	0,72	0,77	0,87	0,93	0,92	0,91	0,91
λ_1	1	1	1	1	1	1	1	1
λ_2	1	1	1	1	1	1	1	1
$t(\lambda_1)$	2,1	0,0	0,6	0,4	0,7	1,1	1,4	1,0
$t(\lambda_2)$	1,4	1,2	0,9	1,0	0,6	1,4	1,4	1,2
λ_3	-0,2	-0,0	-0,0	-0,1	-0,2	-0,4	-0,4	-0,5
λ_4	3,5	3,2	3,4	3,4	3,6	4,9	5,2	5,1
λ_5	-1,0	-0,7	-0,7	-0,8	-1,0	-0,9	-0,9	-1,0
λ_6	-1,0	-0,7	-0,7	-0,8	-1,0	-1,0	-1,0	-1,0
LM(4)	5,17	6,96	7,85	6,08	3,59	5,71	4,23	4,58
BJ(2)	3,6	2,7	2,1	0,9	1,0	0,8	1,2	1,1
ARCH(2)	3,2	2,8	3,1	4,6	3,2	2,6	3,1	3,0

Note: See Table 4.

RECURSIVE ESTIMATION OF DEMAND FOR ALPC3
(Dependent Variable: Δ m)

Table 9

	82 (4)	83 (4)	84 (4)	85 (4)	86 (4)	87 (4)	88 (4)	89 (2)
cte	-0,58 (3,3)	-0,77 (5,8)	-0,72 (5,7)	-0,62 (5,0)	-0,56 (5,1)	-0,59 (4,6)	-0,52 (4,7)	-0,50 (4,5)
$\Delta(m-p)_{-1}$	0,22 (3,5)	0,27 (5,3)	0,30 (6,8)	0,28 (6,1)	0,32 (8,4)	0,31 (8,3)	0,30 (8,2)	0,30 (8,2)
$\sum_{0}^{1} \Delta p_{-i}$	0,10 (1,8)	0,14 (2,1)	0,15 (3,6)	0,13 (3,5)	0,15 (5,0)	0,16 (5,1)	0,16 (5,2)	0,17 (5,4)
$\Delta^2 r^p$	1,03 (2,9)	1,10 (2,9)	0,90 (2,6)	0,89 (2,6)	0,82 (2,5)	0,77 (2,7)	0,78 (2,8)	0,71 (2,5)
Δy	0,30 (2,1)	0,28 (2,1)	0,23 (2,0)	0,20 (1,8)	0,20 (1,8)	0,15 (1,2)	0,16 (1,6)	0,15 (1,5)
$(m-p-y)_{-1}$	-0,19 (3,6)	-0,25 (6,2)	-0,23 (6,0)	-0,20 (5,2)	-0,19 (5,4)	-0,18 (5,0)	-0,17 (5,0)	-0,17 (5,0)
r^a_{-1}	-0,04 (0,5)	-0,01 (0,0)	-0,01 (0,2)	-0,04 (0,7)	-0,06 (1,2)	-0,07 (1,4)	-0,07 (1,5)	-0,07 (1,6)
r^p_{-1}	0,89 (2,8)	1,05 (3,3)	0,97 (3,4)	0,83 (3,0)	0,83 (3,2)	0,85 (3,7)	0,86 (4,1)	0,80 (3,8)
se	0,40	0,40	0,39	0,38	0,37	0,37	0,37	0,38
$\bar{R}^2$	0,66	0,71	0,77	0,86	0,92	0,93	0,93	0,92
λ_1	1	1	1	1	1	1	1	1
λ_2	1	1	1	1	1	1	1	1
$t(\lambda_1)$	1,7	0,9	1,1	0,9	0,8	0,7	0,7	0,3
$t(\lambda_2)$	0,2	0,2	0,2	0,5	0,3	0,4	0,5	0,8
λ_3	-0,2	-0,0	-0,0	-0,2	-0,3	-0,4	-0,4	-0,4
λ_4	4,7	4,2	4,2	4,2	4,4	4,7	5,0	4,7
λ_5	-1,1	-0,7	-0,8	-0,9	-0,9	-0,9	-1,0	-1,0
λ_6	-0,6	-0,5	-0,5	-0,7	-0,6	-0,8	-0,8	-0,8
LM(4)	4,25	2,28	3,12	3,44	2,46	4,13	3,20	2,34
BJ(2)	3,4	2,8	2,3	1,1	1,2	0,9	1,3	1,3
ARCH(2)	2,9	2,7	2,9	4,1	3,6	2,8	2,9	2,8

Note: See Table 4.

TRANSFER FUNCTION FOR ALP Table 10

$$\blacktriangle alp_t = \frac{\alpha_0 L^2}{(1-\alpha_1 L)} \blacktriangle ipc_t + \frac{\alpha_2 L^2}{(1-\alpha_3 L)} \blacktriangle pib_t + \alpha_4 \blacktriangle^2 RP_t +$$

$$\alpha_5 (L^3+L^4) \blacktriangle RP_t + (\alpha_6 L^2+\alpha_7 L^4) \blacktriangle RA_t + \alpha_8 \blacktriangle D853_t +$$

$$\alpha_9 \blacktriangle D1_t + \alpha_{10} \blacktriangle D2_t + \alpha_{11} \blacktriangle D3_t + \frac{1}{(1-\alpha_{12} L)} a_t$$

	1974.1-1987.4		1974.1-1989.2	
α_0	0,09	(6,10)	0,09	(5,81)
α_1	0,90	(61,15)	0,90	(55,17)
α_2	0,44	(5,11)	0,41	(4,42)
α_3	0,43	(2,72)	0,55	(4,78)
α_4	0,80	(3,28)	0,71	(2,74)
α_5	0,66	(2,24)	0,56	(2,48)
α_6	-0,18	(2,43)	-0,10	(1,31)
α_7	-0,28	(3,47)	-0,29	(3,66)
α_8	-0,016	(4,56)	-0,014	(3,72)
α_9	-0,0023	(4,81)	-0,0024	(4,99)
α_{10}	-0,0031	(6,36)	-0,0023	(4,67)
α_{11}	0,0023	(4,77)	0,0020	(4,10)
α_{12}	0,28	(2,02)	0,34	(2,65)
SE	0,0032		0,0035	
R^2	0,82		0,80	
g.l.	50		56	
BPL(4)	2,4		3,2	
BJ	2,7		2,6	
ARCH(2)	1,1		0,4	

TRANSFER FUNCTION FOR ALPC Table 11

$$\Delta alpc_t = \frac{\alpha_0 L^2}{(1-\alpha_1 L)} \Delta ipc_t + \frac{\alpha_2 L^2}{(1-\alpha_3 L)} \Delta pib_t + \alpha_4 \Delta^2 RP_t +$$

$$\alpha_5 (L^3+L^4) \Delta RP_t + \alpha_6 (L+L^2+L^3+L^4) \Delta RA_t + \alpha_7 \Delta D853_t +$$

$$\alpha_8 \Delta D1_t + \alpha_9 \Delta D2_t + \alpha_{10} \Delta D3_t + \frac{1}{(1-\alpha_{11} L)} a_t$$

	1974.1-1987.4		1974.1-1989.2	
α_0	0,12	(4,48)	0,10	(3,78)
α_1	0,88	(35,98)	0,90	(34,12)
α_2	0,39	(4,10)	0,38	(2,96)
α_3	0,29	(1,23)	0,50	(2,96)
α_4	0,62	(2,33)	0,51	(1,98)
α_5	0,83	(2,08)	0,95	(2,65)
α_6	-0,17	(2,75)	-0,18	(2,88)
α_7	-0,012	(3,33)	-0,011	(3,02)
α_8	-0,0025	(4,80)	-0,0025	(5,37)
α_9	-0,0034	(6,49)	-0,0029	(6,15)
α_{10}	0,0027	(5,32)	0,0026	(5,52)
α_{11}	0,45	(3,47)	0,58	(5,09)
SE	0,0037		0,0037	
R^2	0,81		0,81	
g.l.	50		56	
BPL(4)	2,0		1,5	
BJ	2,0		1,7	
ARCH(2)	6,7		2,7	

TRANSFER FUNCTION FOR ALPC6 Table 12

$$\Delta alpc6_t = \frac{\alpha_0 L^2}{(1-\alpha_1 L)} \Delta ipc_t + \alpha_2 \Delta pib_t + \alpha_3 \Delta^2 RP_t +$$

$$\alpha_4 L^3 \Delta RP_t + \alpha_5 (L+L^2+L^3+L^4) \Delta RA_t + \alpha_6 \Delta D853_t +$$

$$\alpha_7 \Delta D1_t + \alpha_8 \Delta D2_t + \alpha_9 \Delta D3_t + \frac{1}{(1-\alpha_{10} L)} a_t$$

	1974.1-1987.4		1974.1-1989.2	
α_0	0,14	(2,15)	0,14	(2,09)
α_1	0,86	(14,13)	0,90	(14,68)
α_2	0,21	(1,56)	0,18	(1,49)
α_3	0,58	(1,71)	0,48	(1,49)
α_4	1,05	(1,85)	1,04	(2,11)
α_5	-0,26	(2,22)	-0,29	(2,65)
α_6	-0,015	(3,23)	-0,042	(3,25)
α_7	-0,0026	(3,73)	-0,0027	(4,58)
α_8	-0,0042	(6,02)	-0,0039	(6,11)
α_9	0,0029	(4,32)	0,0030	(4,92)
α_{10}	0,73	(6,89)	0,80	(8,93)
SE	0,0054		0,0053	
R^2	0,77		0,77	
g.l.	50		56	
BPL(4)	2,4		1,9	
BJ	4,1		15,2	
ARCH(2)	2,6		0,4	

TRANSFER FUNCTION FOR ALPC3

Table 13

$$\Delta alpc3_t = \frac{\alpha_0 L^2}{(1-\alpha_1 L)} \Delta ipc_t + \alpha_2(1+L)\Delta pib_t + \alpha_3 \Delta^2 RP_t +$$

$$\alpha_4 L^3 \Delta RP_t + [\alpha_5(L+L^2)+\alpha_6(L^3+L^4)]\Delta RA_t + \alpha_7 \Delta D853_t +$$

$$\alpha_8 \Delta D1_t + \alpha_9 \Delta D2_t + \alpha_{10} \Delta D3_t + \frac{1}{(1-\alpha_{11} L)} a_t$$

	1974.1-1987.4		1974.1-1989.2	
α_0	0,16	(2,24)	0,15	(2,09)
α_1	0,84	(12,72)	0,85	(14,68)
α_2	0,14	(1,25)	0,13	(1,49)
α_3	0,64	(1,79)	0,53	(1,49)
α_4	0,78	(1,39)	0,80	(1,56)
α_5	-0,16	(1,20)	-0,19	(1,53)
α_6	-0,30	(2,27)	-0,29	(2,29)
α_7	-0,018	(3,55)	-0,017	(3,25)
α_8	-0,0024	(3,39)	-0,0027	(4,31)
α_9	-0,0046	(6,23)	-0,0043	(6,29)
α_{10}	0,0028	(3,95)	0,0030	(4,71)
α_{11}	0,69	(6,41)	0,74	(7,68)
SE	0,0055		0,0054	
R^2	0,77		0,78	
g.l.	50		56	
BPL(4)	1,3		0,7	
BJ	7,7		23,2	
ARCH(2)	2,6		2,1	

TRANSFER FUNCTION FOR ALPOC Table 14

$$\Delta alpoc_t = \frac{\alpha_0 L^2}{(1-\alpha_1 L)} \Delta ipc_t + [\alpha_2(1+L)+\alpha_3 L^2] \Delta pib_t + \alpha_4 \Delta^2 RP_t +$$

$$\alpha_5(L^3+L^4) \Delta RP_t + \alpha_6(L^3+L^4) \Delta RA_t + \alpha_7 \Delta TEN_t +$$

$$\alpha_8 \Delta D1_t + \alpha_9 \Delta D2_t + \alpha_{10} \Delta D3_t + \frac{1}{(1-\alpha_{11} L)} a_t$$

	1974.1-1987.4		1974.1-1989.2	
α_0	0,09	(4,38)	0,09	(5,09)
α_1	0,90	(43,13)	0,90	(51,08)
α_2	0,27	(3,60)	0,27	(3,88)
α_3	0,45	(4,20)	0,52	(5,39)
α_4	0,46	(1,47)	0,34	(1,11)
α_5	0,62	(2,13)	0,55	(2,02)
α_6	-0,14	(1,79)	-0,16	(2,38)
α_7	-0,041	(12,98)	-0,042	(14,45)
α_8	-0,0024	(3,95)	-0,0028	(5,02)
α_9	-0,0045	(7,37)	-0,0042	(7,39)
α_{10}	0,0024	(4,08)	0,0026	(4,70)
α_{11}	0,31	(2,35)	0,31	(2,44)
SE	0,0041		0,0040	
R^2	0,92		0,91	
g.l.	50		56	
BPL(4)	5,5		6,5	
BJ	2,1		1,6	
ARCH(2)	4,0		2,0	

TRANSFER FUNCTION FOR ALPC6 Table 15

$$\Delta alpoc6_t = \frac{\alpha_0 L^2}{(1-\alpha_1 L)} \Delta ipc_t + \alpha_2[1+L+L^2]) \Delta pib_t + \alpha_3(L+L^2)\Delta^2 RP2_t +$$

$$\alpha_4(L^3+L^4)\Delta RA1_t + \alpha_5(L+L^2)\Delta RA2_t + \alpha_6 \Delta TEN_t +$$

$$\alpha_7 \Delta D1_t + \alpha_8 \Delta D2_t + \alpha_9 \Delta D3_t + \frac{1}{(1-\alpha_{10}L)} a_t$$

	1974.1-1987.4		1974.1-1989.2	
α_0	0,12	(4,61)	0,11	(4,99)
α_1	0,88	(35,80)	0,89	(42,19)
α_2	0,21	(3,32)	0,24	(4,34)
α_3	0,92	(1,87)	1,14	(2,76)
α_4	-0,16	(1,73)	-0,17	(1,87)
α_5	-0,21	(2,34)	-0,22	(2,97)
α_6	-0,035	(11,04)	-0,036	(12,60)
α_7	-0,0024	(4,16)	-0,0026	(4,99)
α_8	-0,0051	(8,49)	-0,0048	(8,88)
α_9	0,0026	(4,55)	0,0026	(4,98)
α_{10}	0,37	(2,78)	0,41	(3,32)
SE	0,0039		0,0038	
R^2	0,91		0,92	
g.l.	50		56	
BPL(4)	5,6		7,1	
BJ	2,9		3,4	
ARCH(2)	9,3		4,8	

TRANSFER FUNCTION FOR ALPC3 Table 16

$$\Delta alpoc3_t = \frac{\alpha_0 L^2}{(1-\alpha_1 L)} \Delta ipc_t + (\alpha_2[1+L]+\alpha_3 L^2) \Delta pib_t +$$

$$\alpha_4(L+L^2+L^3) \Delta RP2_t + \alpha_5(L^3+L^4) \Delta RA1_t + \alpha_6(L+L^2) \Delta RA2_t + \alpha_7 \Delta TEN_t +$$

$$\alpha_8 \Delta D1_t + \alpha_9 \Delta D2_t + \alpha_{10} \Delta D3_t + \frac{1}{(1-\alpha_{11}L)} a_t$$

	1974.1-1987.4		1974.1-1989.2	
α_0	0,12	(4,36)	0,12	(4,90)
α_1	0,87	(32,09)	0,87	(34,45)
α_2	0,18	(2,53)	0,19	(2,79)
α_3	0,30	(3,02)	0,33	(3,45)
α_4	0,72	(1,77)	0,97	(2,02)
α_5	-0,16	(1,70)	-0,15	(1,56)
α_6	-0,19	(2,19)	-0,11	(1,49)
α_7	-0,035	(10,04)	-0,034	(10,39)
α_8	-0,0025	(4,30)	-0,0028	(4,94)
α_9	-0,0053	(8,84)	-0,0050	(8,52)
α_{10}	0,0027	(4,78)	0,0029	(5,07)
α_{11}	0,38	(2,93)	0,37	(2,96)
SE	0,0040		0,0041	
R^2	0,91		0,91	
g.l.	50		55	
BPL(4)	4,7		5,2	
BJ	1,9		2,8	
ARCH(2)	1,3		2,8	

Table 17

SUMMARY OF THE ESTIMATION RESULTS

	ECM EQUATIONS					TRANSFER FUNCTIONS		
	Cointegration	Fit (SE%)	Sample Stab.	Postsam.Stab.8801-8902	Postsam.Stab.8903-9002	Fit (SE%)	Sample Stab.	Postsa.Stab.8801-8902
ALP	yes	0,36	yes	0,25	1,49	0,32	yes	0,70
ALPC	yes	0,41	yes (?)	0,46	1,20	0,37	yes	0,78
ALPC6	no		no			0,54	no	0,87
ALPC3	yes (?)	0,52	no	0,88	1,13	0,55	no	0,77
ALPOC	yes	0,37	yes (?)	0,54	1,60	0,41	yes (?)	0,52
ALPOC6	yes	0,38	yes (?)	0,59	1,24	0,39	yes	0,53
ALPOC3	yes	0,37	yes	0,46	1,36	0,40	yes (?)	0,73

(?) denotes the results are less conclusive

Chart 1

INTERNAL STRUCTURE OF ALP
breakdown by instruments

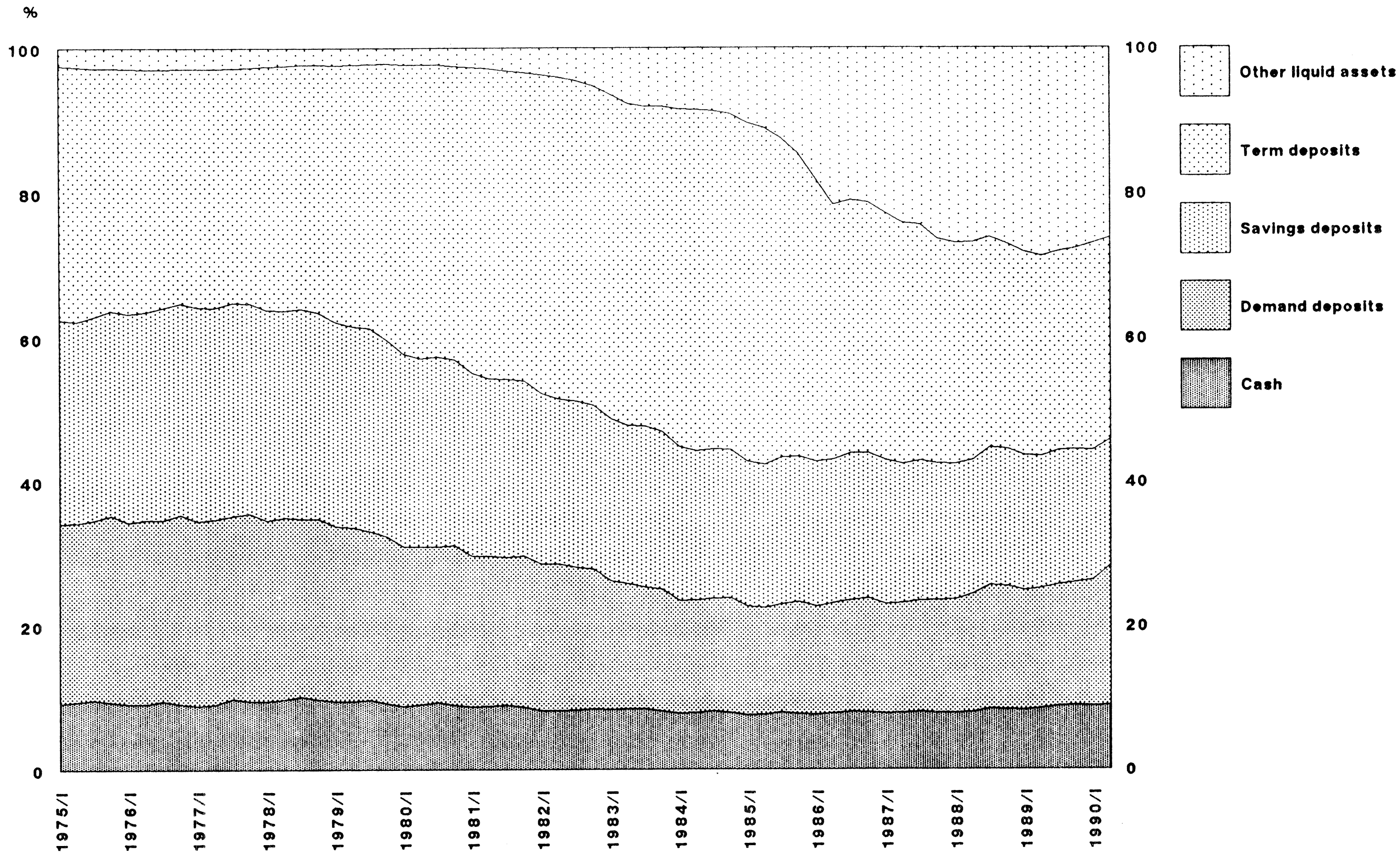


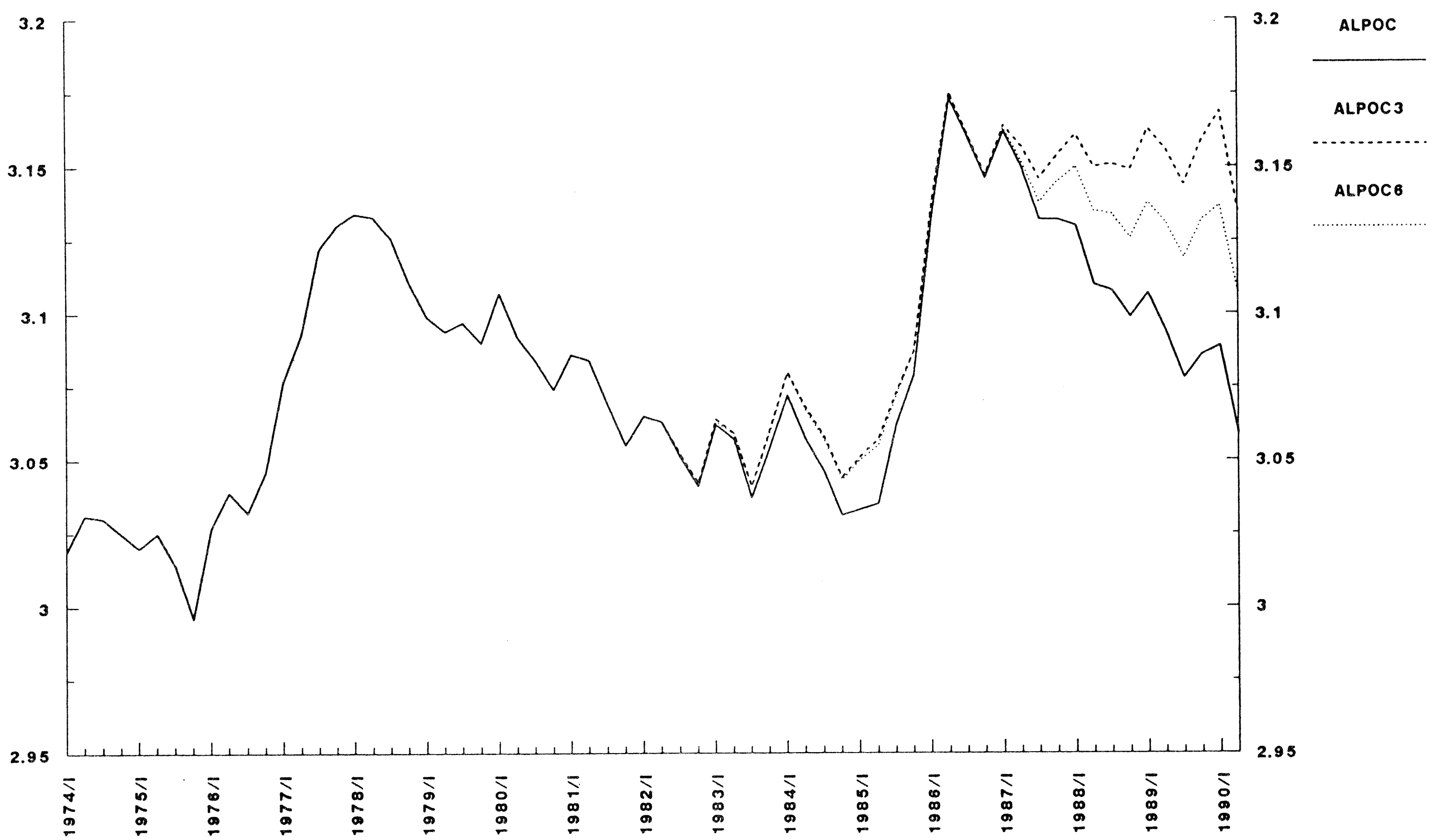
Chart 2

VELOCITY OF DIFFERENT MONETARY AGGREGATES

ALPC: ALP - government securities purchased outright
ALPC3: ALPC - "repos" government securities over 3 months
ALPC6: ALPC - "repos" government securities over 6 months

Chart 3

VELOCITY OF DIFFERENT MONETARY AGGREGATES (*)



(*). The Treasury notes balance is adjusted.

ALPOC: ALPC - "anonymous securities"
ALPOC3: ALPOC - "repos" government securities over 3 months
ALPOC6: ALPOC - "repos" government securities over 6 months

Chart 4

GDP: rate of growth

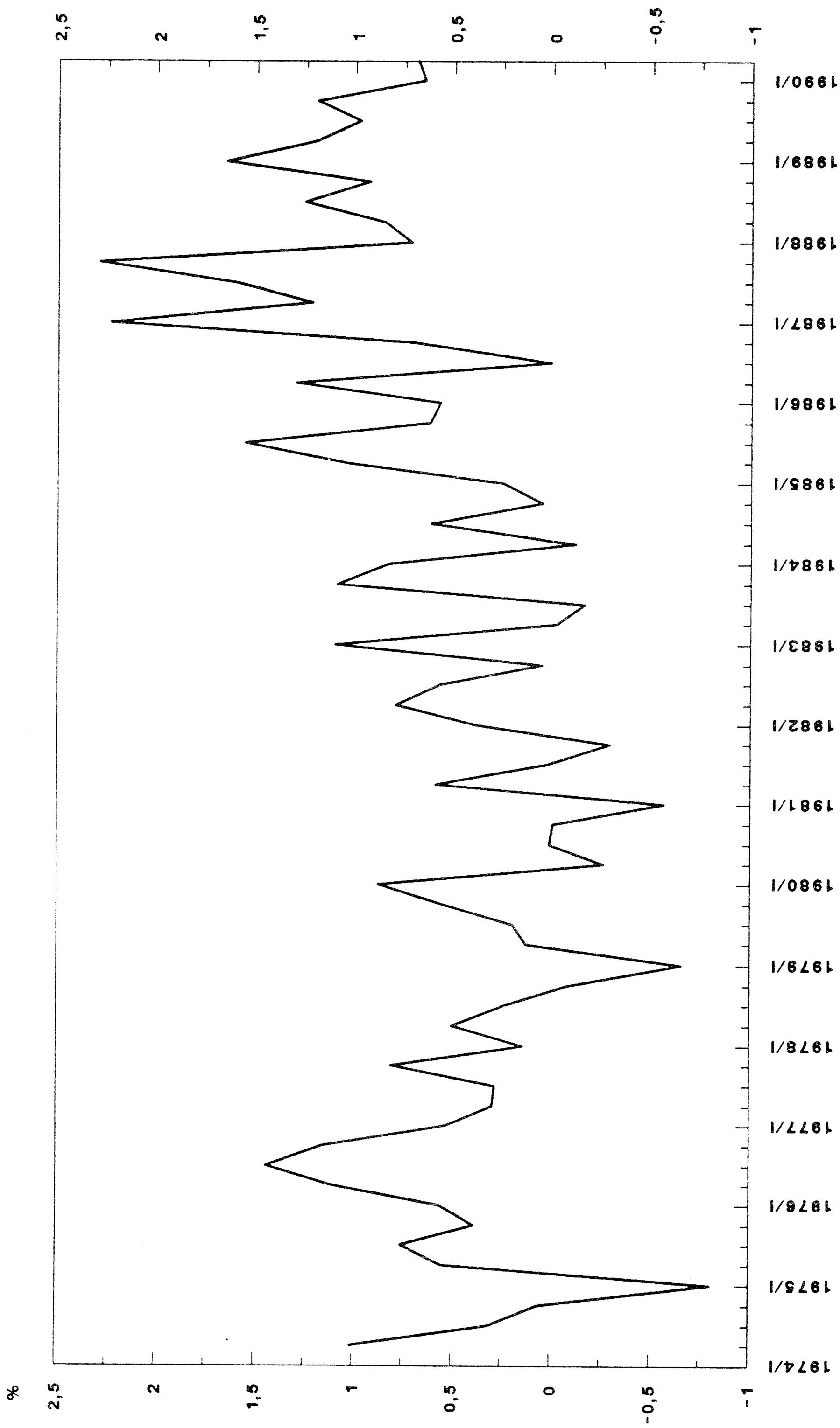


Chart 5

CPI: rate of growth

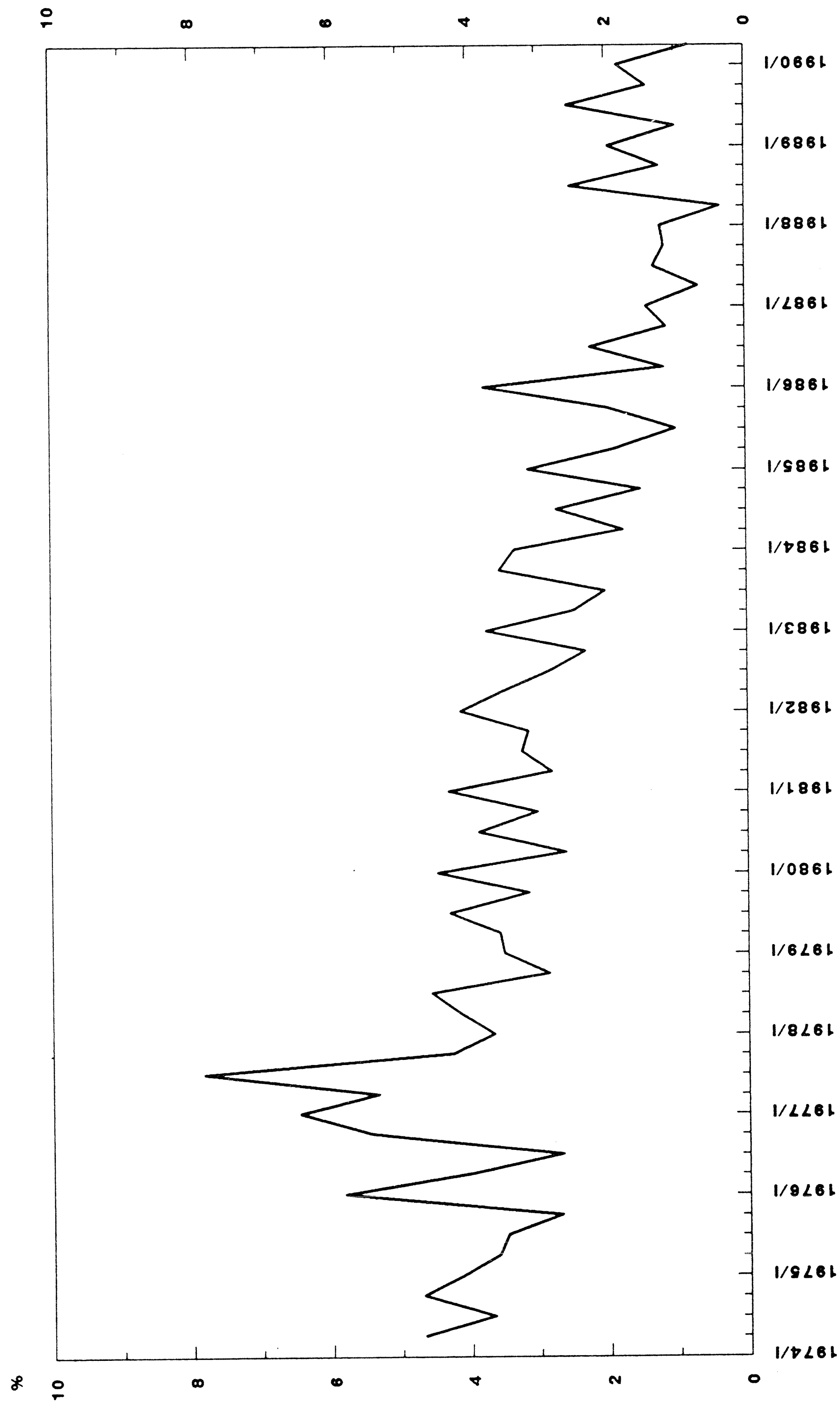


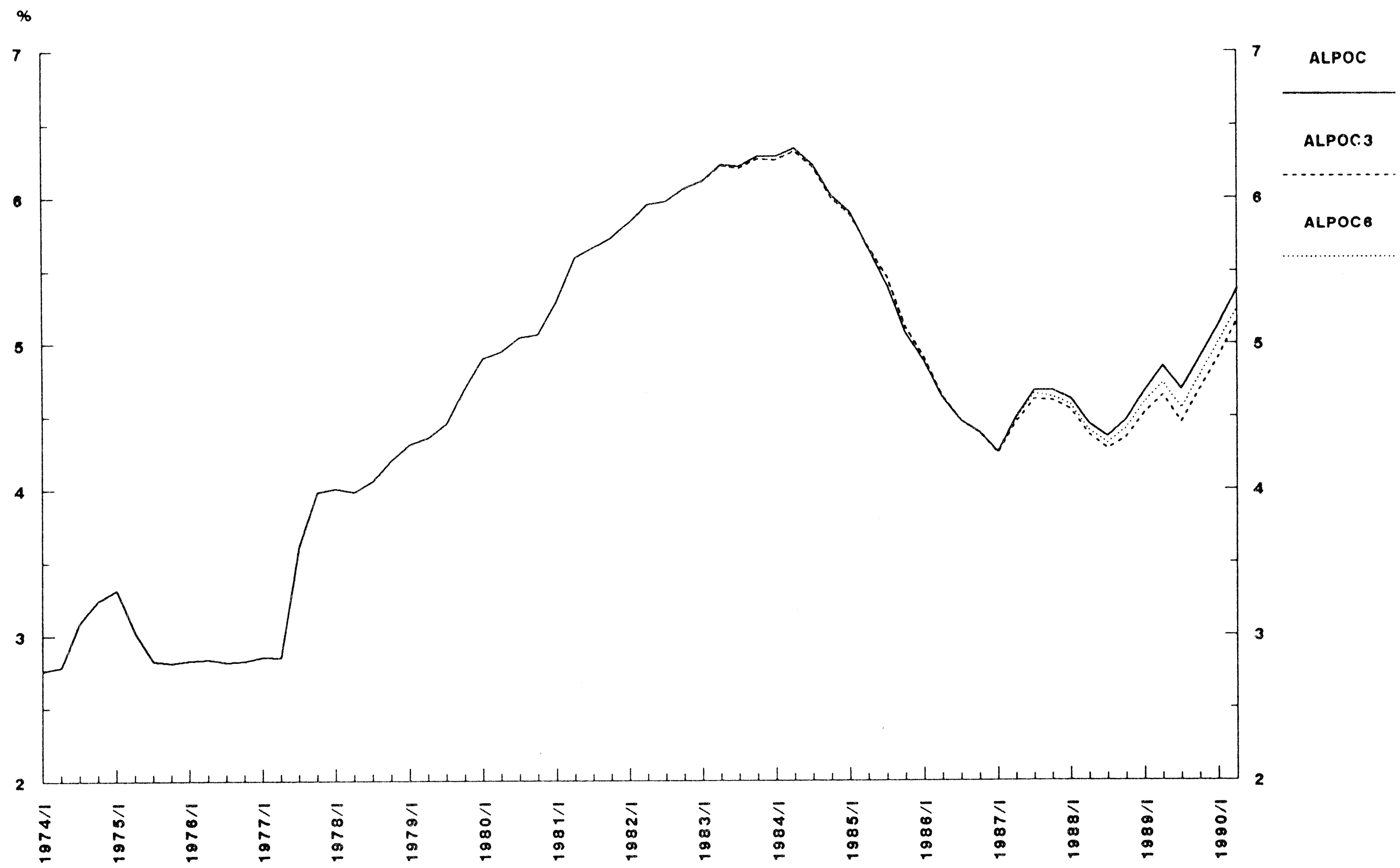
Chart 6

DIFFERENT MONETARY AGGREGATES OWN INTEREST RATES

ALPC: ALP - government securities purchased outright
ALPC3: ALPC - "repos" government securities over 3 months
ALPC6: ALPC - "repos" government securities over 6 months

Chart 7

DIFFERENT MONETARY AGGREGATES (*)
OWN INTEREST RATES



(*). The Treasury notes balance is adjusted.

ALPOC: ALPC - "anonymous securities"
ALPOC3: ALPOC - "repos" government securities over 3 months
ALPOC6: ALPOC - "repos" government securities over 6 months

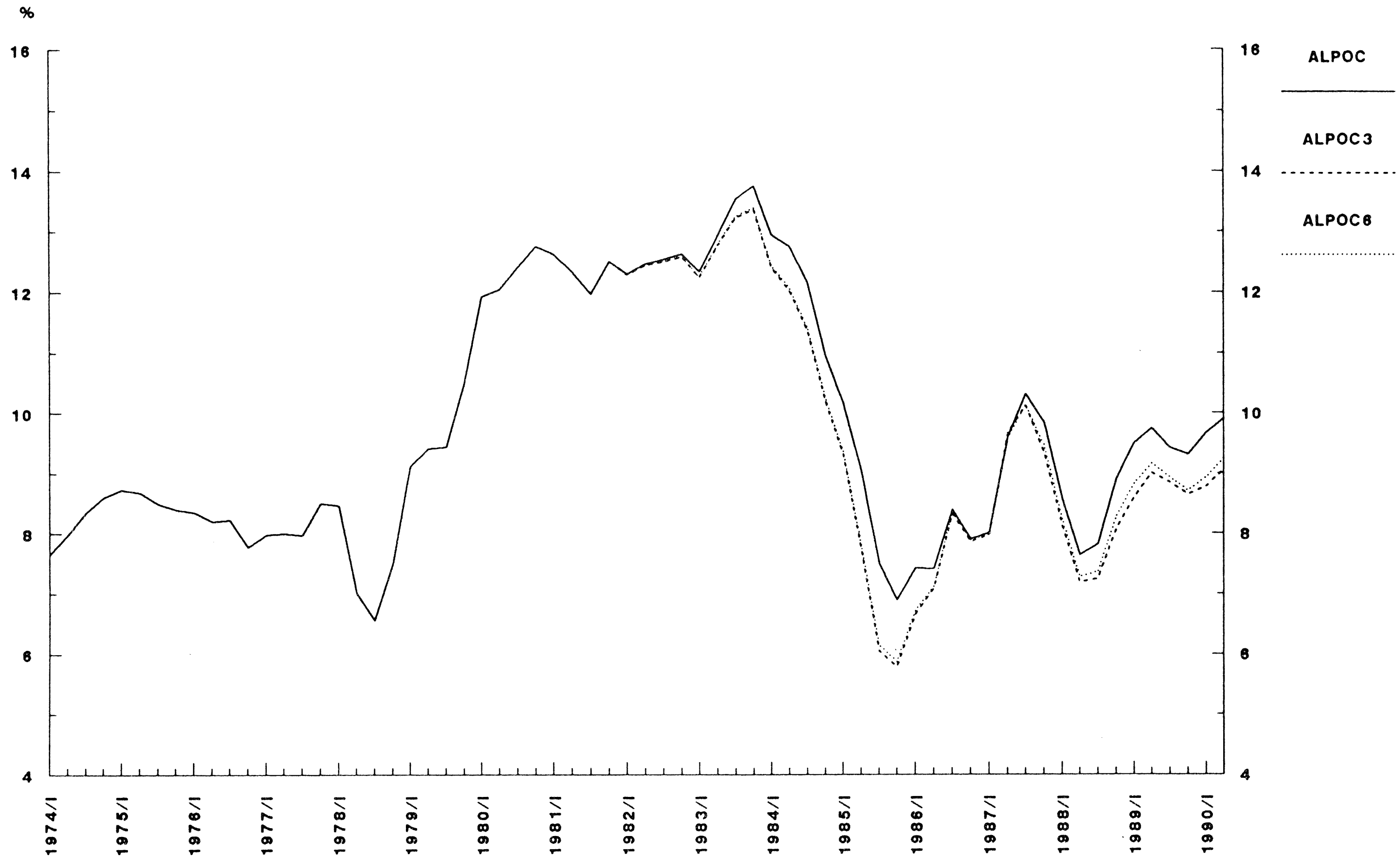
Chart 8

DIFFERENT MONETARY AGGREGATES
ALTERNATIVE INTEREST RATES

ALPC: ALP - government securities purchased outright
ALPC3: ALPC - "repos" government securities over 3 months
ALPC6: ALPC - "repos" government securities over 6 months

Chart 9

DIFFERENT MONETARY AGGREGATES (*)
ALTERNATIVE INTEREST RATES

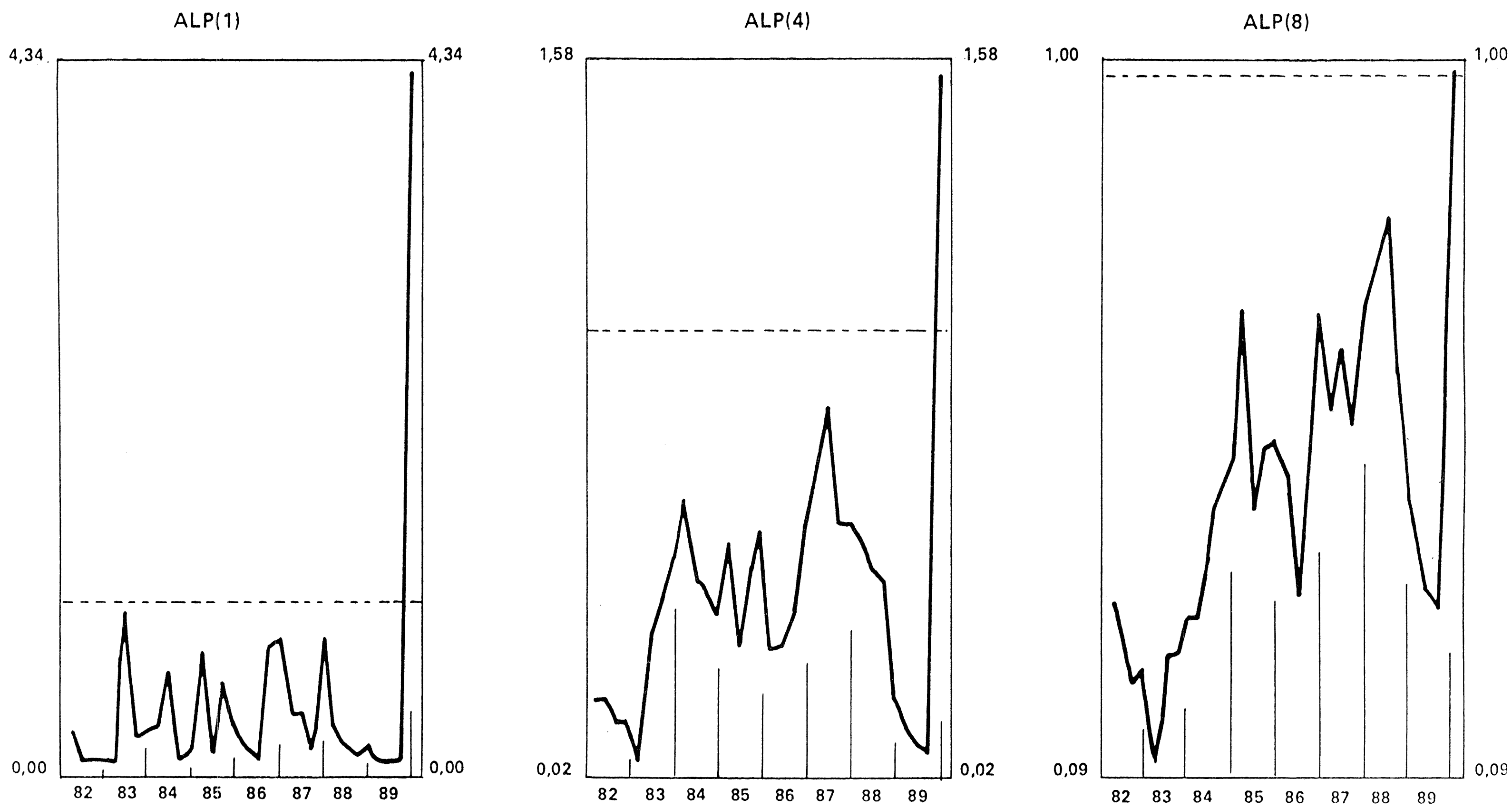


ALPOC: ALPC - "anonymous securities"
ALPOC3: ALPOC - "repos" government securities over 3 months
ALPOC6: ALPOC - "repos" government securities over 6 months

(*). The Treasury notes balance is adjusted.

Chart 10

CHOW RECURSIVE STABILITY TEST

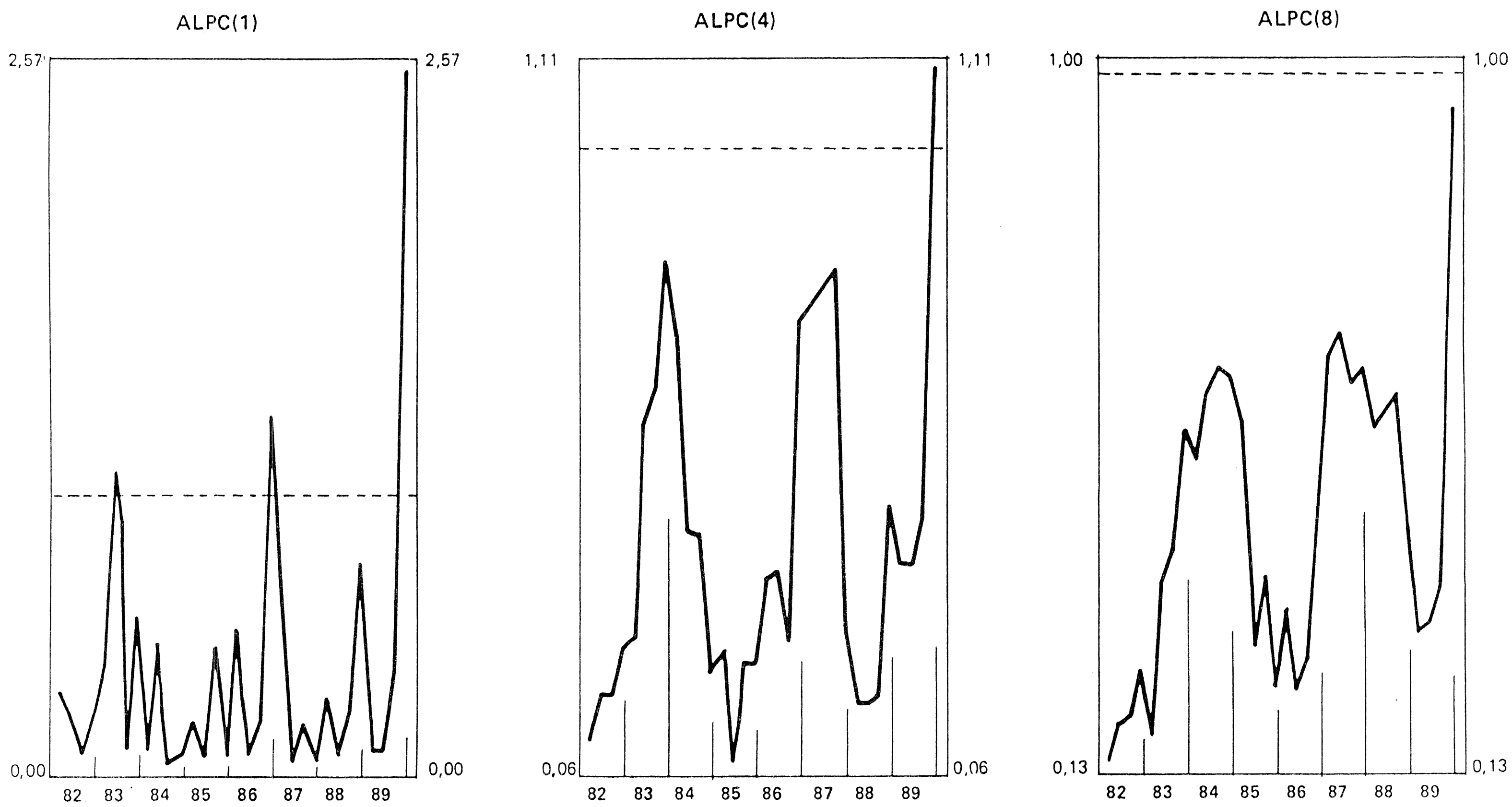


* In ALP(i) i denotes de number of d. f. in the numerator of the F. test.

* The dotted line represents the 5% significative level.

Chart 11

CHOW RECURSIVE STABILITY TEST

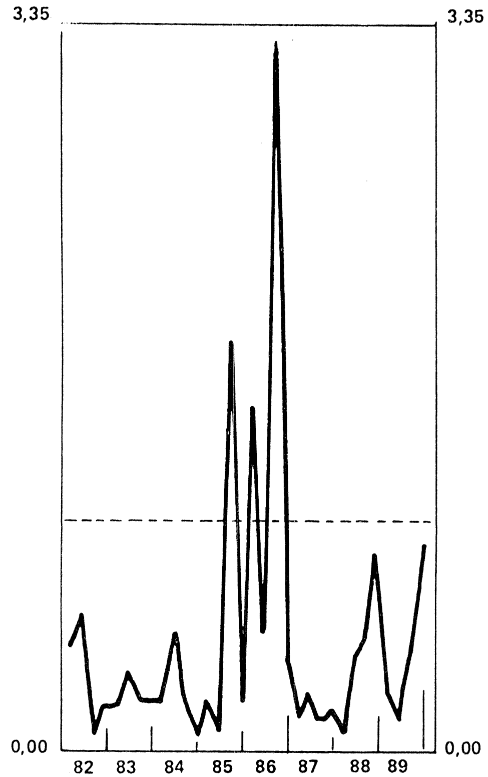


Note: see chart 10

Chart 12

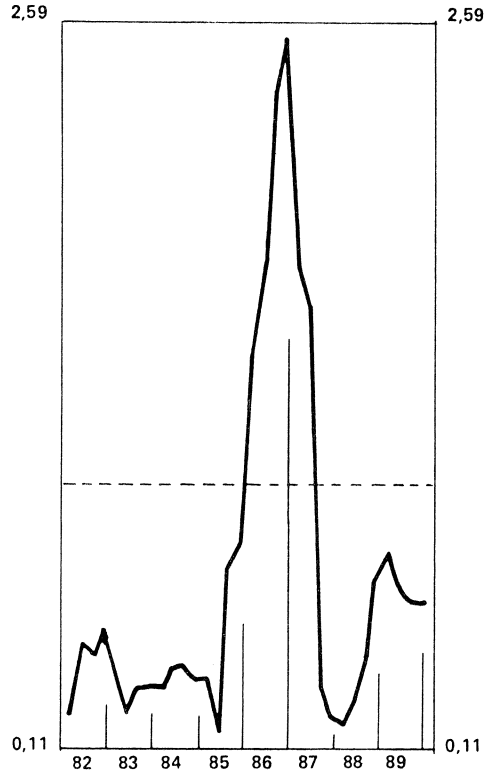
CHOW RECURSIVE STABILITY TEST

ALPC3(1)



Note: see chart 10

ALPC3(4)



ALPC3(8)

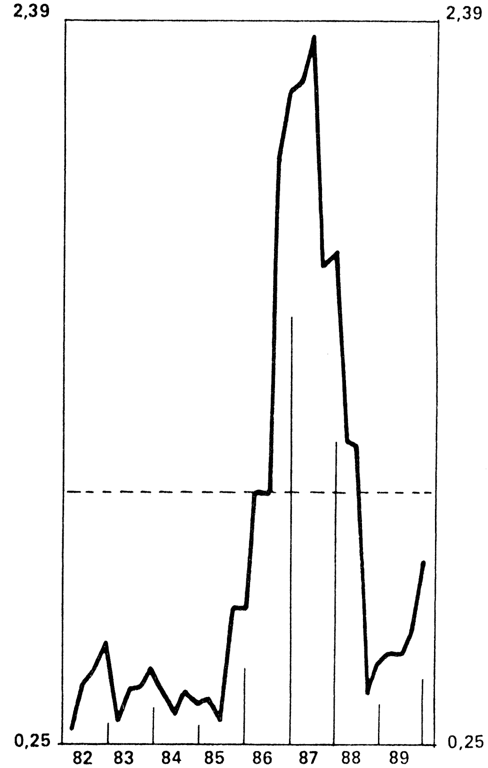
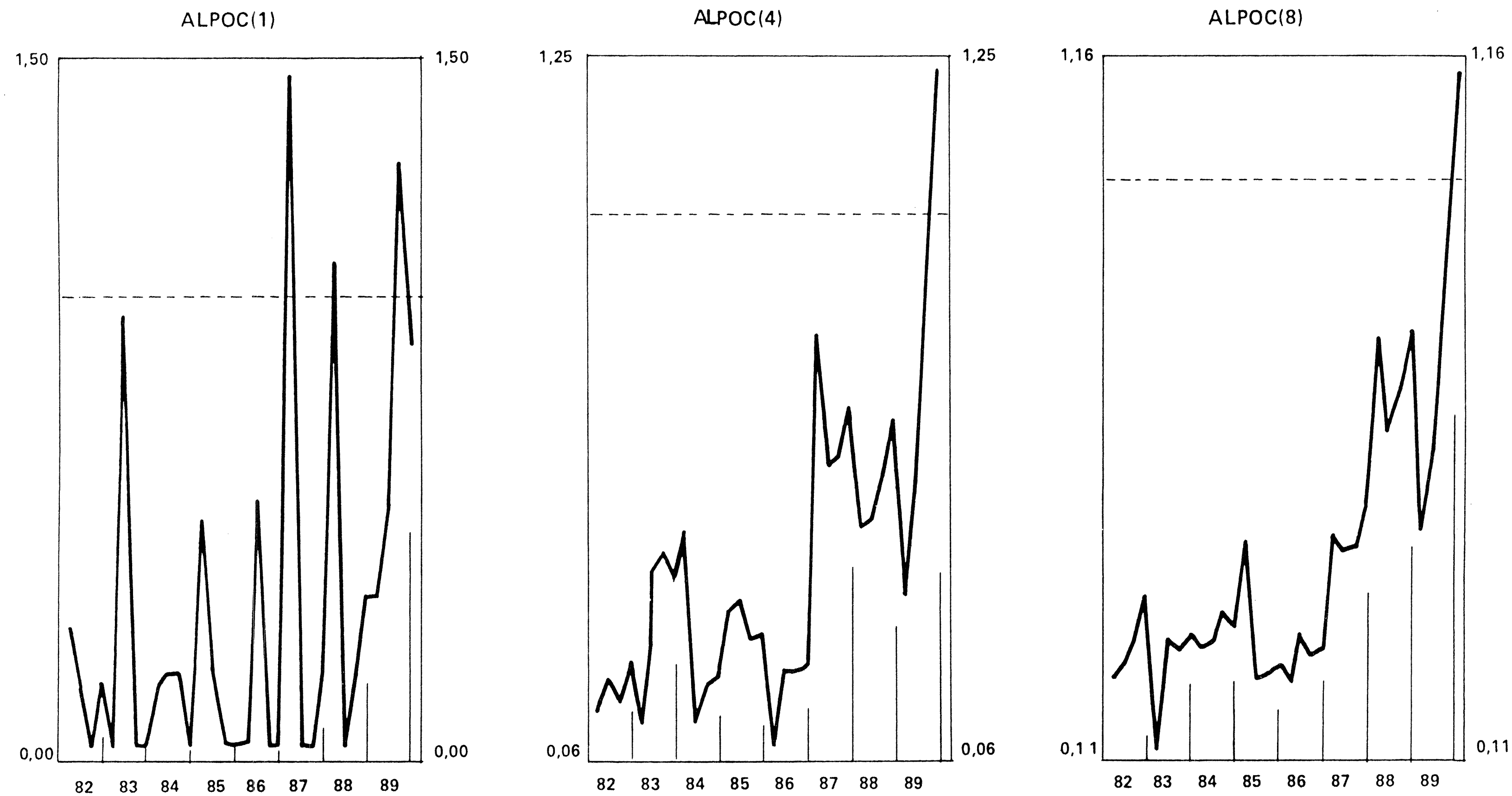


Chart 13

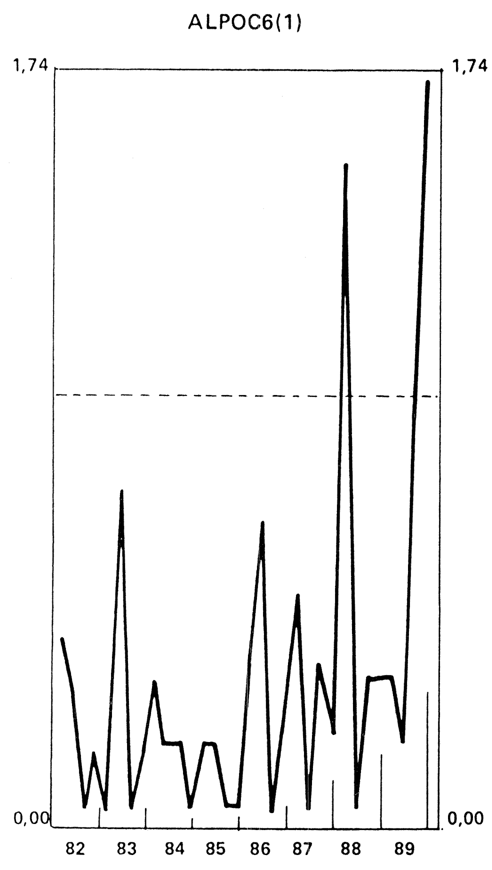
CHOW RECURSIVE STABILITY TEST

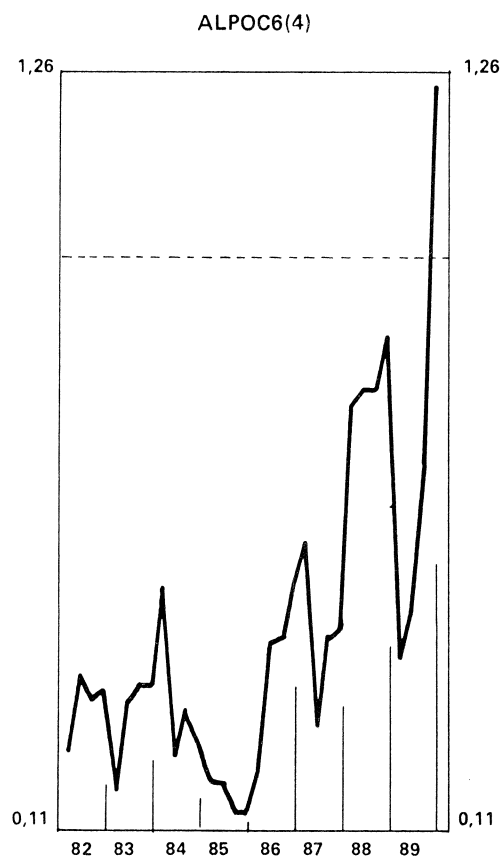


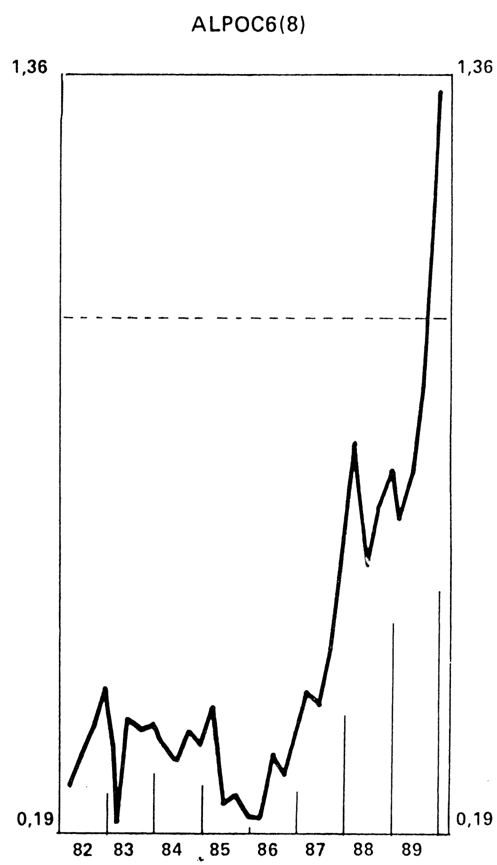
Note: see chart 10

Chart 14

CHOW RECURSIVE STABILITY TEST



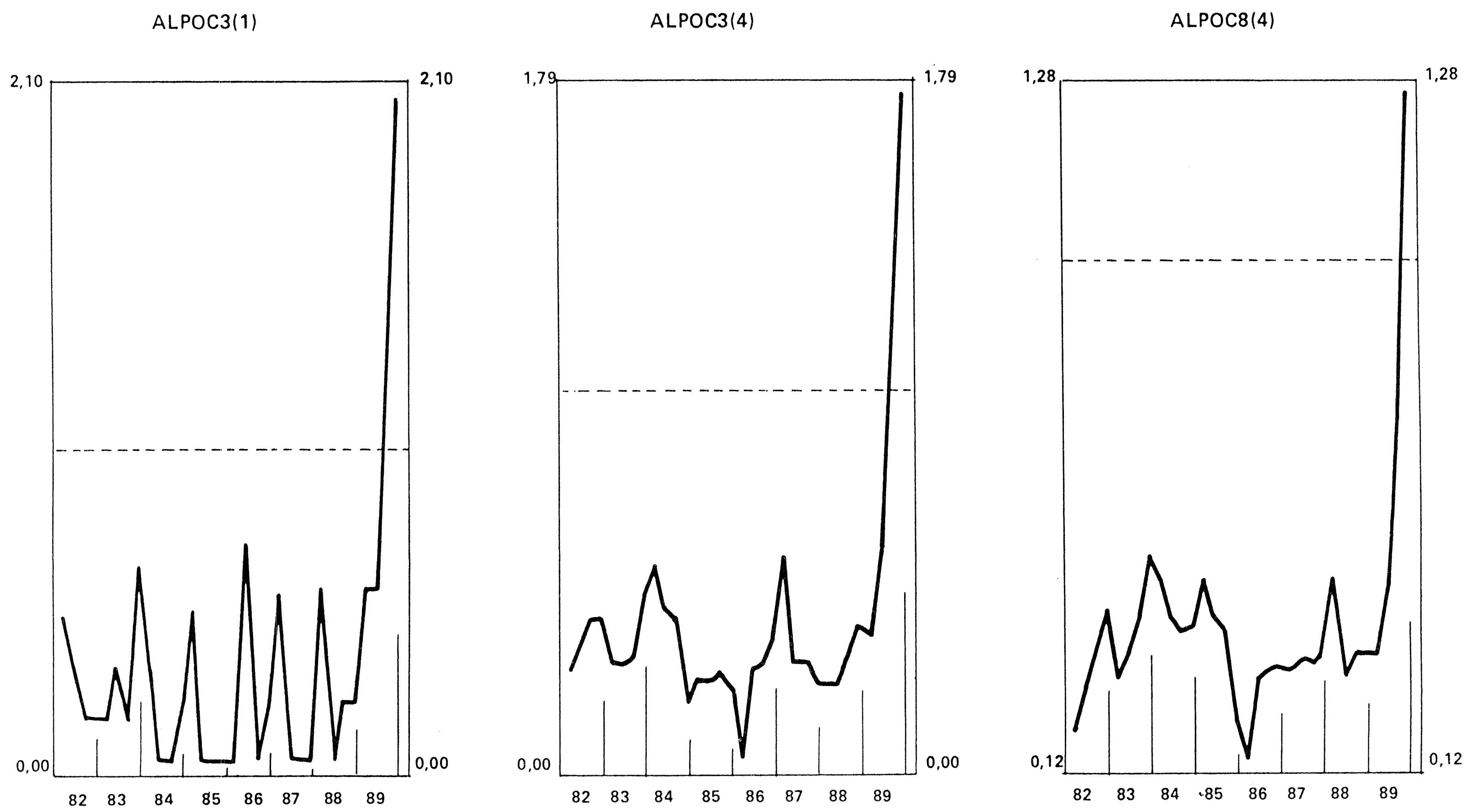




Note: see chart 10

Chart 15

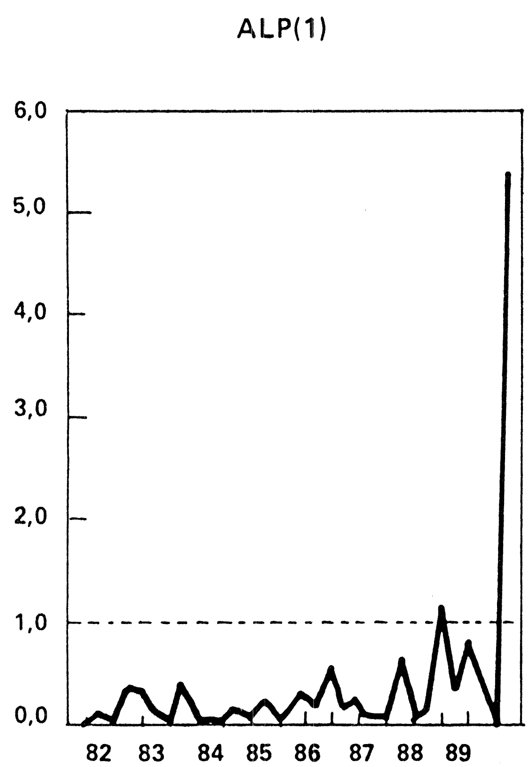
CHOW RECURSIVE STABILITY TEST

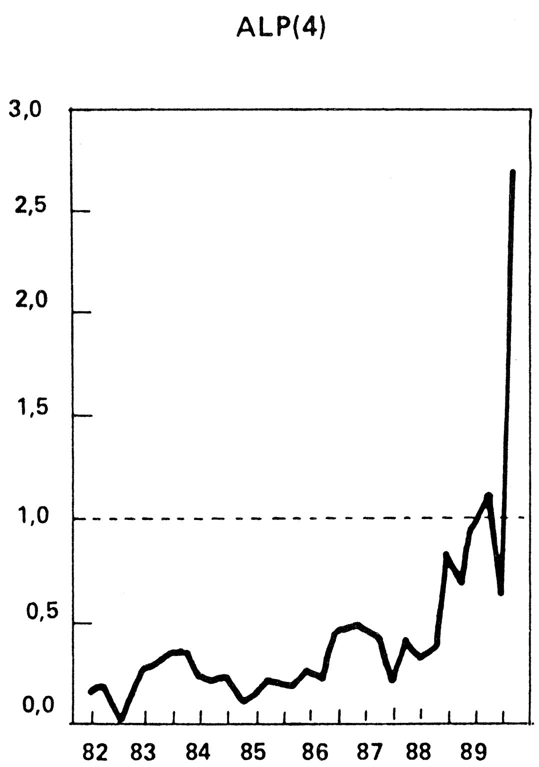


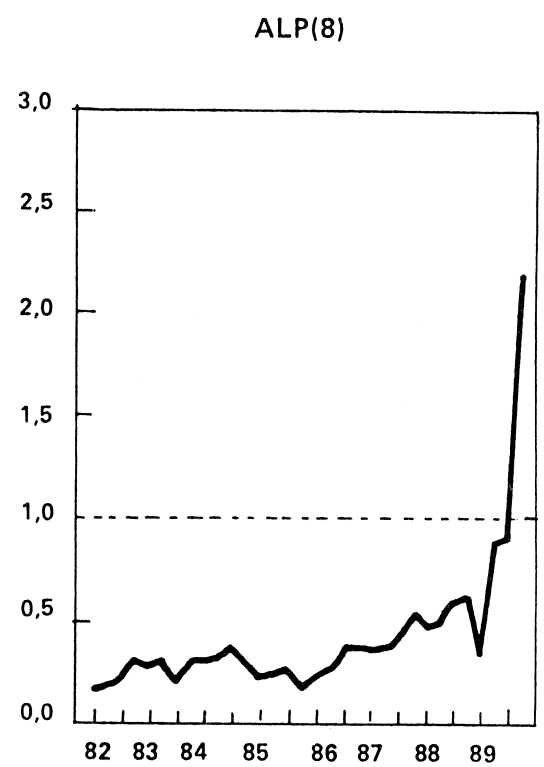
Note: see chart 10

Chart 16

CHOW RECURSIVE STABILITY TEST



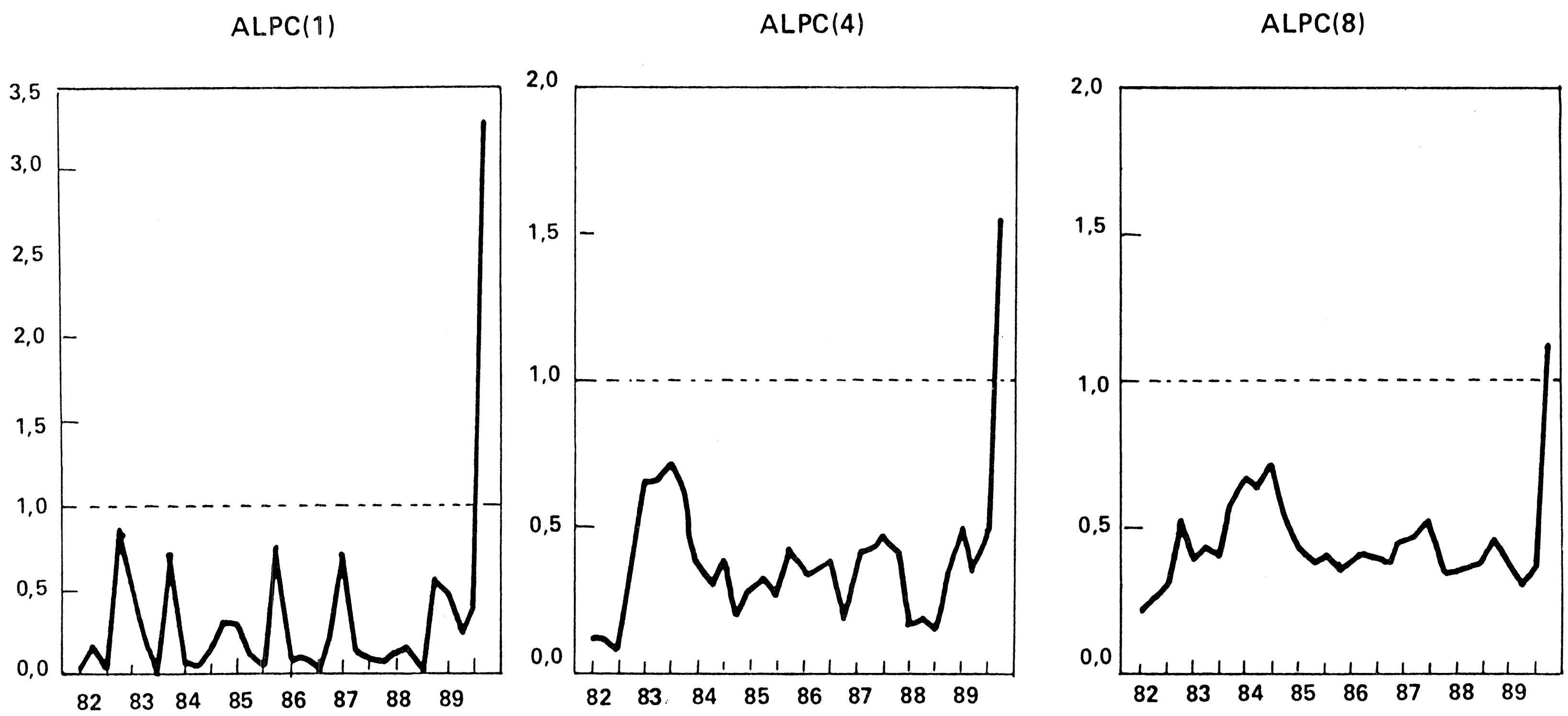




Note: see chart 10

Chart 17

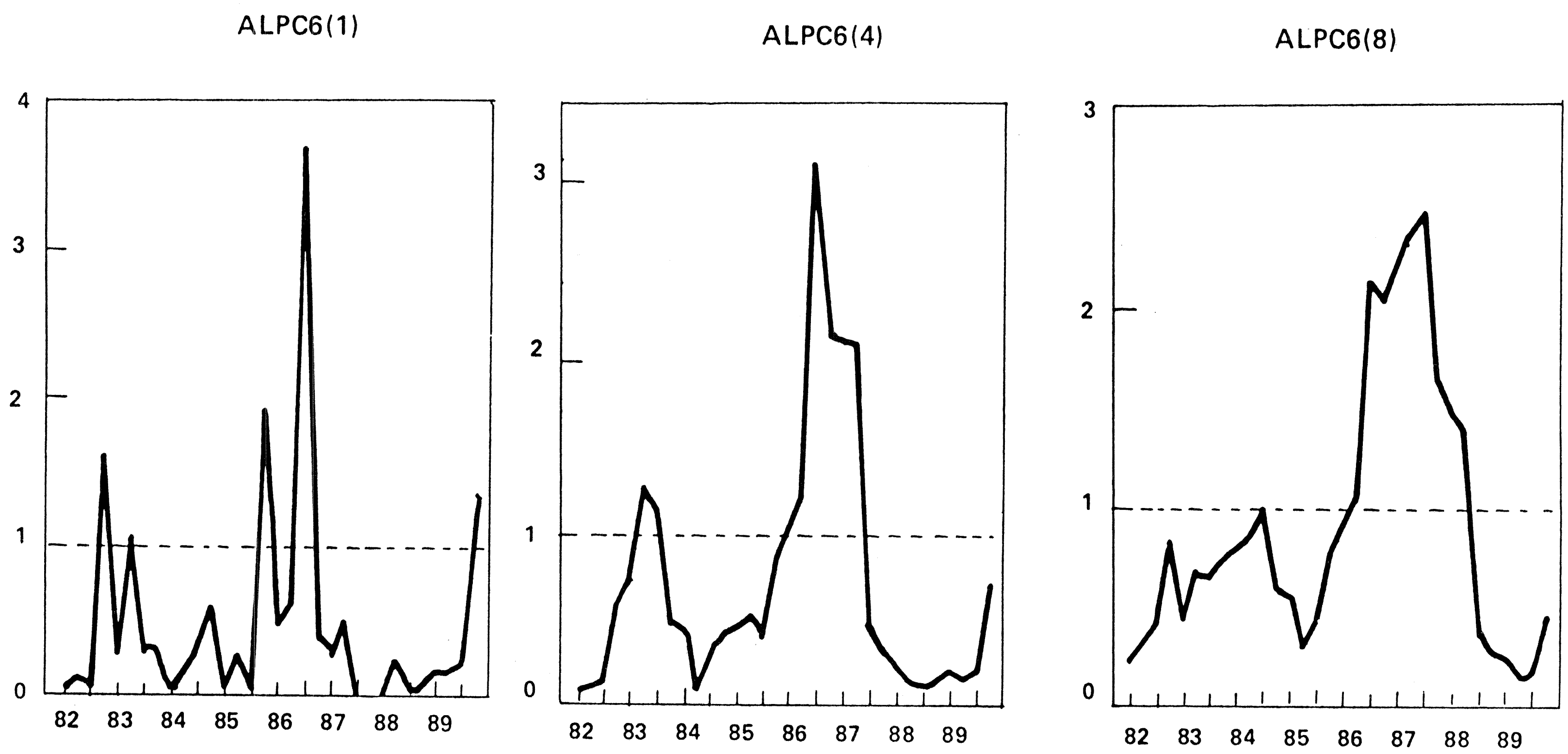
CHOW RECURSIVE STABILITY TEST



Note: see chart 10

CHOW RECURSIVE STABILITY TEST

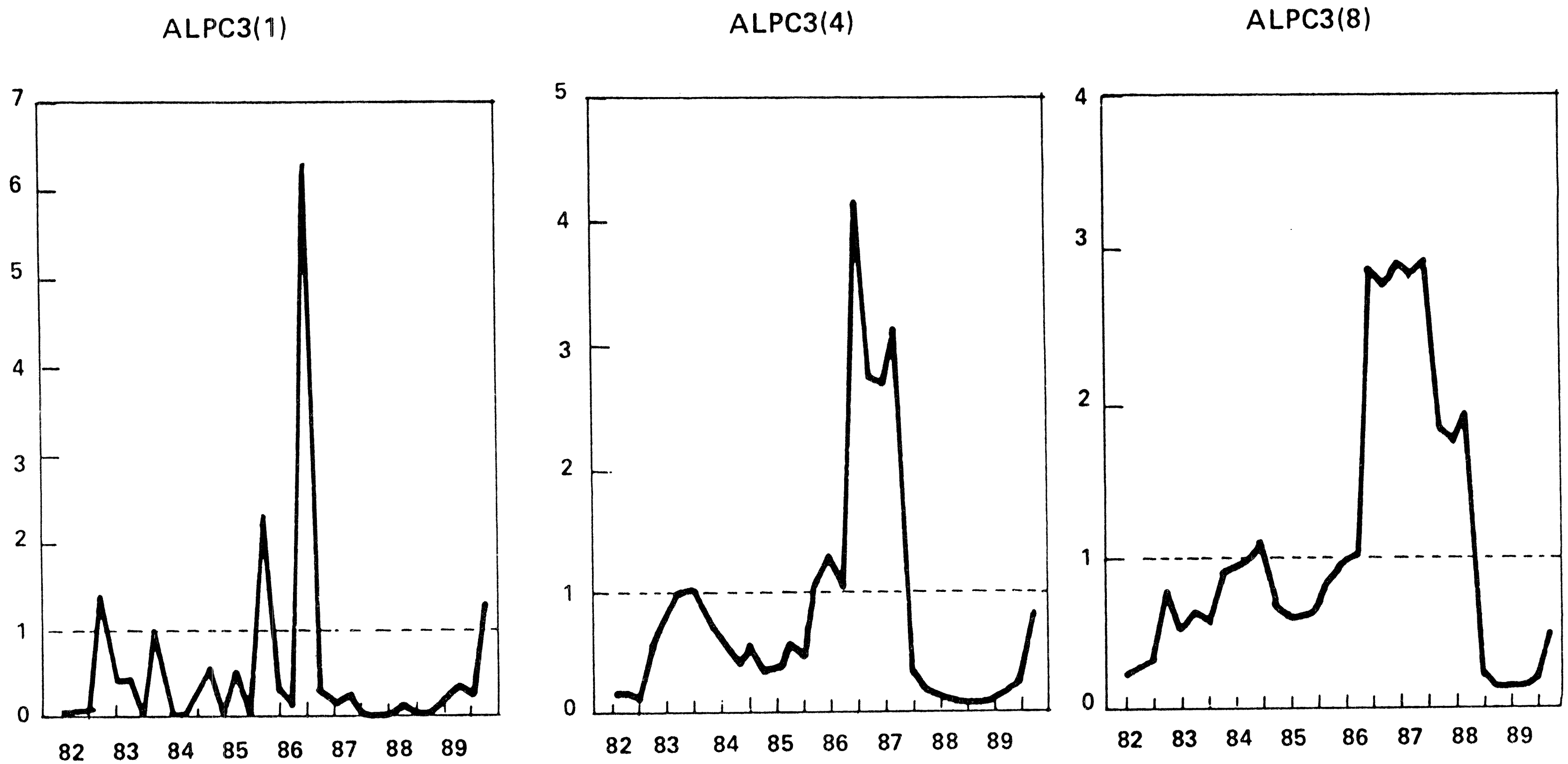
Chart 18



Note: see chart 10

Chart 19

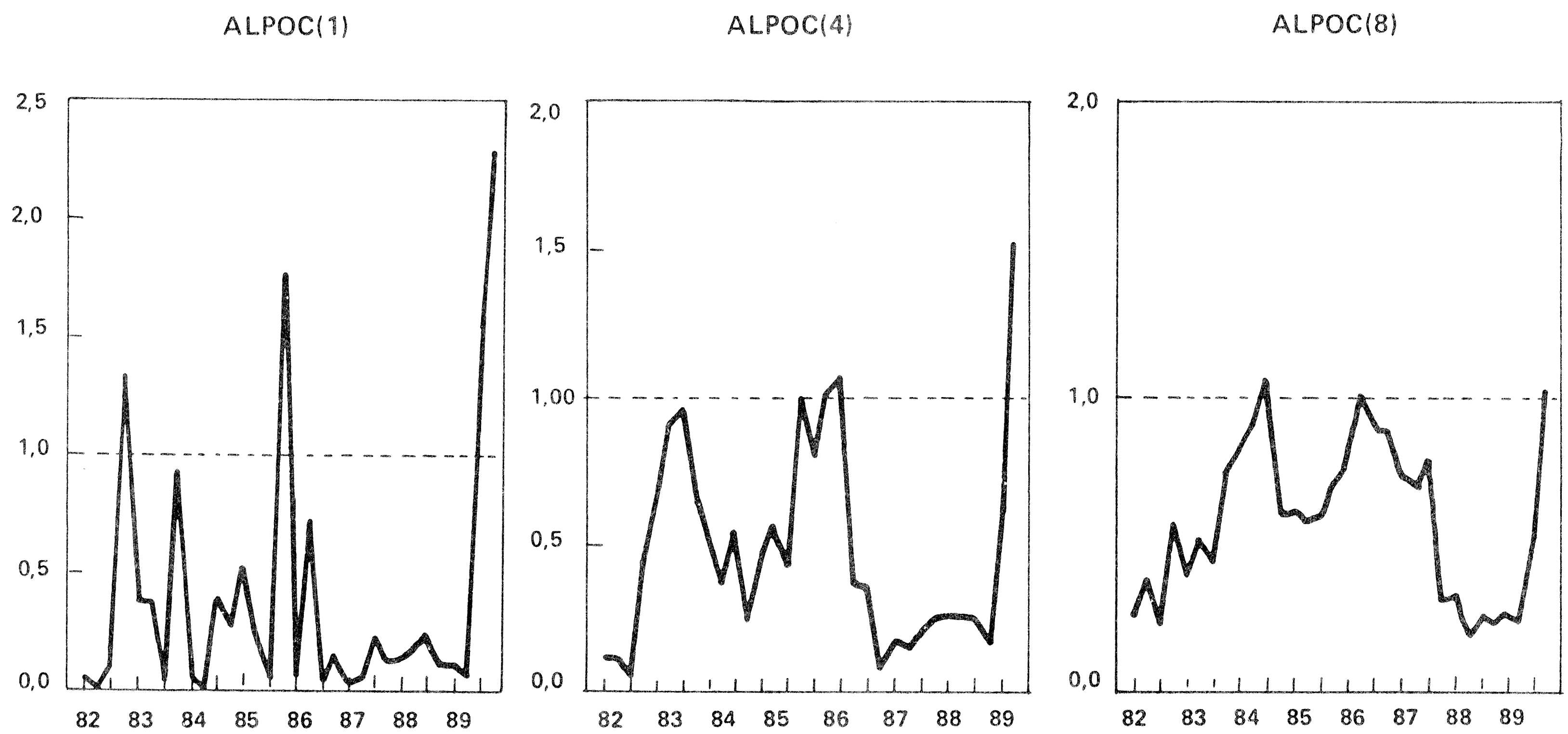
CHOW RECURSIVE STABILITY TEST



Note: see chart 10

Chart 20

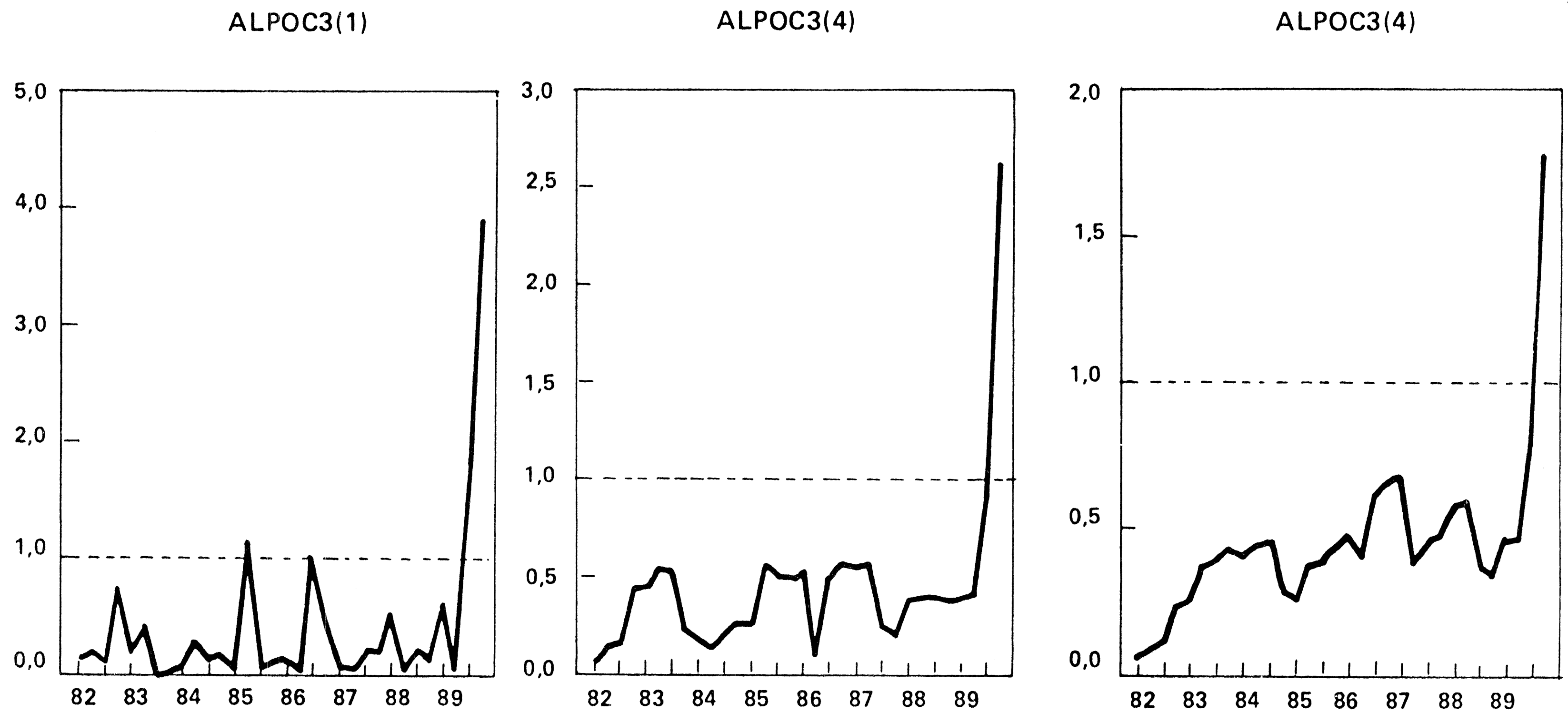
CHOW RECURSIVE STABILITY TEST



Note: see chart 10

Chart 21

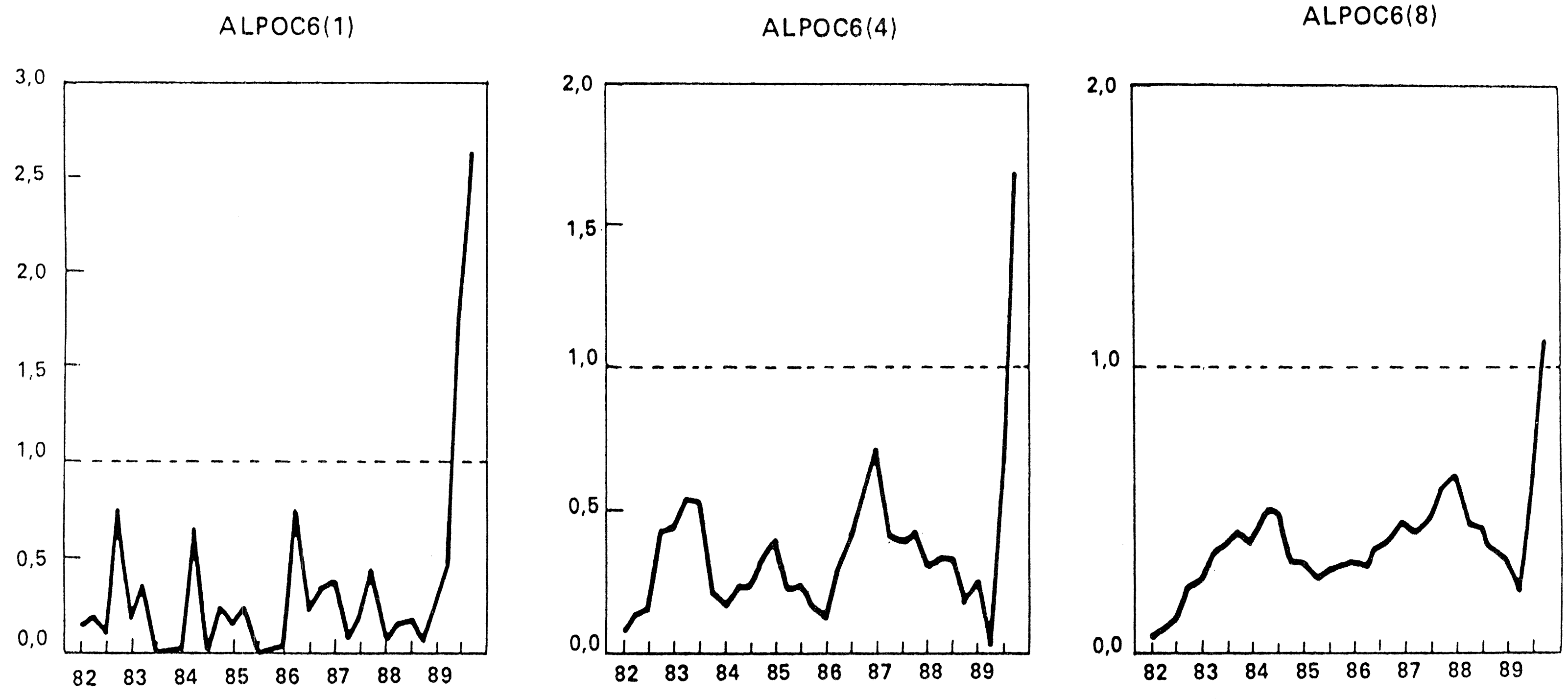
CHOW RECURSIVE STABILITY TEST



Note: see chart 10

Chart 22

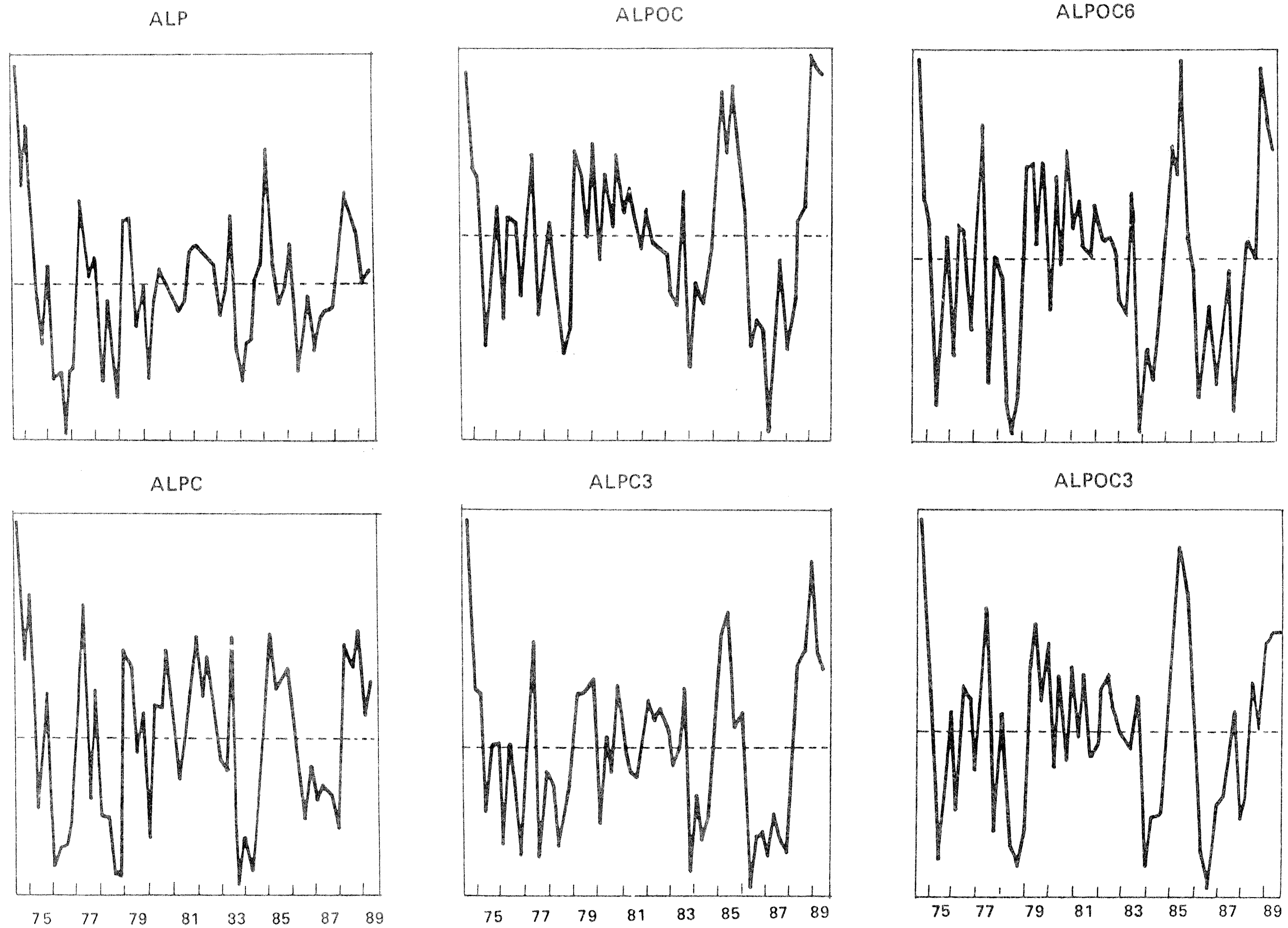
CHOW RECURSIVE STABILITY TEST



Note: see chart 10

Chart 23

COINTEGRATING VECTORS



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