Money as an Indicator

by

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Abstract

We assess the leading indicator properties of various of the money and credit aggregates over real activity and inflation, using Granger-causality tests and impulse response functions. The approach is explicitly disaggregated, looking at sectoral measures of money and credit and various disaggregations of activity - in line with the results of earlier Bank research. We find strong and significant effects from narrow money through to nominal GDP and, in particular, prices. Broader measures of money/credit - M4, M4 lending and Divisia - do much less well at an aggregate level. But sectoral disaggregation helps matters: for example, corporate M4 and Divisia appear to have a reliable mapping with investment and production and some measures of prices. However, none of the monetary aggregates offer sufficiently robust early warning signals to justify intermediate target status. Rather the message is that, when used alongside other information variables such as the Bank's inflation projection, some of the monetary aggregates offer useful corraborative information about incipient activity and price developments.

1 Introduction

In 1970 the Bank of England published two important papers on money. The first, *'The Importance of Money'* (1970) by Charles Goodhart and Andrew Crockett, is widely known. It set down the conceptual foundations underlying the analysis of monetary aggregates, in particular broad money. And it provided some of the earliest econometric evidence on the robustness of UK money demand functions - the *sine qua non* of monetary targets.

'The Importance of Money' set in train a whole literature on the stability properties of money demand equations in the UK. This reached its zenith during the period of broad money targeting in the UK between 1976-1986. But latterly, with the demise of explicit monetary targets, work on money demand equations has lessened in importance. Money remains important - in the sense of Goodhart and Crockett. But its importance is no longer seen as being linked umbilically to money demand (in)stabilities.

The second paper, also by Andrew Crockett and titled *'Timing Relationships Between Movements of Monetary and National Income Variables'* (1970), has received rather less academic attention. The paper was unashamedly astructural. But it was one of the first in the UK to identify empirically the potentially powerful leading indicator properties of money (and some of its counterparts and components) over nominal spending (and some of its components). And, significantly, the current monetary policy framework in the UK lends itself much more naturally to this latter mode of analysis.

The UK's new monetary framework, introduced following sterling's suspension from the ERM in September 1992, has as its centrepiece an explicit target range for underlying price inflation. This is supplemented by monitoring ranges for two monetary aggregates, one broad (M4), one narrow (M0). Under the new framework, the role of these monetary aggregates - and of other real and monetary variables -

is as *indicators* of incipient inflation or spending patterns; or, to borrow some more history, they are information variables (Brunner and Meltzer (1967), Kareken *et al* (1973)). Movements in these indicator variables do not carry the policy automaticity implied by the use of money as an intermediate target. To be useful these variables need only contain information on the final target variable, which in turn helps inform monetary policy choices.

In the spirit of Crockett (1970), this paper offers a re-reading of the time-series entrails on the extent of this information, searching across a range of monetary aggregates and disaggregations of nominal spending. It takes much of its motivation from recent Bank of England monetary research.

The paper is planned as follows. Section 2 discusses the current monetary policy framework in the UK, and the role of indicators in general, and monetary indicators in particular, within it; while section 3 covers some methodological issues. Sections 4, 5 and 6 discuss our results. Section 7 concludes with some policy implications.

2 Motivation

(a) *The UK's New Monetary Framework*

Through the 1970s and 1980s, the UK experimented with a number of *intermediate* targeting strategies for monetary policy: for the exchange rate (during the Bretton Woods and "snake" periods in the early 1970s, and the "DM shadowing" and ERM episodes in the late 1980s); and, in between, for money itself (first broad money beginning in the mid-1970s, and later in the 1980s a mix of both broad and narrow money measures). All of these intermediate target strategies in the UK are commonly perceived to have failed - some for largely external reasons (Bretton Woods and the ERM), others for reasons more home-grown (for example, financial liberalisation in the case of broad money targeting).

Since October 1992, the UK has pursued a *final* targeting strategy for monetary policy. This centres on an explicit target of 1%-4% for underlying RPIX inflation, with the intention of being in the lower half of this range by 1997. This new approach is founded on eclecticism - or at least a recognition that no *single* intermediate variable can accurately serve as a guidepost for policy. The intermediate variable for monetary policy under the new monetary framework is the Bank's *projection* of inflation two years ahead (see King (1994)).(1) These inflation projections should satisfy exactly the three properties required of any intermediate policy variable: they are *controllable* - the policy instrument forms one of the projection's inputs; they are *predictable* in their relation with prices - the projections are (one hopes) unbiased; and they are a *leading indicator* - they are explicitly forward-looking. These inflation projections are published quarterly in the Bank's *Inflation Report*. And, most importantly, they embody the information contained in the myriad macro variables the Bank monitors when forming an outlook for prices two years hence - obviating the need to look at one or other intermediate target variables in isolation.

But the Bank's inflation projection is not purely macromodel based. Why? Because a pure macromodel based inflation projection would not be information encompassing. Macromodel forecasts are hamstrung by degrees of freedom and by their structural underpinnings. So they cannot reasonably embody *all* useful indicator information on the final target. And for this reason, a model-based forecast is just the starting point in the monetary policy-setting process.

Thereafter "off-model" information - judgment, surveys, leading indicator models *etc* - comes into play in the policy process (see, eg,

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(1) The need for a projection stems from the well-documented lags between monetary policy actions and their final effects upon demand and prices. The Bank of England's reaction function under the new monetary framework can thus be interpreted as a *feedback* rule, where the feedback variable is the Bank's inflation projection. The optimality of feedback rules over alternative targeting devices is well-established in the literature (see Friedman (1990) for a survey).

Henry and Pesaran (1993)). This offers a set of additional information variables which combine with the macromodel projection to give the Bank's inflation projection. As Friedman (1975) discusses, the long-run structural significance of these extra indicator variables is unimportant. Under an information variable approach, an indicator need not necessarily have any well-defined *steady-state* structural relation with the final target; it need only possess *short-run* information, which complements or extends the existing forecast information set. Here we look to uncover those indicators which might usefully extend or complement the UK authorities' information set, focusing in particular upon the role of the monetary aggregates.(2)

(b) Money as an Indicator

Indicator variables fulfill one of two functions. Some embody information which is not available from other sources: the variable is an *incremental* indicator. But because they are largely demand-determined, we might reasonably expect money quantities, of whatever definition, to perform fairly poorly as indicators on this criterion. Monetary quantities may often be little more than *corroborative* indicators of activity trends. Much of the empirical literature in the US confirms this picture: that the independent explanatory power of money quantities tends to be absorbed if, for example, short-term interest rates are included as an indicator (*eg* Sims (1980)).

But this does not negate money's role as an indicator variable, for three reasons. First, because while corroborative of activity trends, money may *lead* inflation. This could occur, for example, if the world worked according to some short-run, non-vertical Phillips curve. Second, even if behavioural lags between money and activity do not exist, statistical

(2) This exercise is analogous to that conducted by the Bank of Canada (Muller (1992)), who actively use their monetary indicator models in the policy-setting process as an "add-on" to formal forecasting.

lags may still mean that there is a premium on monitoring money. And third, indicator information need not be new to be useful. Economy-watching is a probabilistic science. So even indicators which replicate information elsewhere are useful for helping corroborate a trend. In this role, money is plainly operating as a *corroborative* indicator. And given its role in the new monetary framework, it is the corroborative function of money which we focus upon here.

Our testing strategy reflects these empirical and conceptual considerations. In particular, we focus upon the *bivariate Granger-causal* links between money and nominal spending.(3) Such a simplistic approach requires some justification. Our rationale for looking just at *bivariate* relations is twofold. First, this equates most closely with the authorities' use of money for policy purposes. Policymakers' discussion is usually of the form: is this measure of money telling us anything about future inflation?; rather than: is this measure of money useful, controlling for factors x and y and z? Put differently, leading indicator models are complements to - rather than substitutes for - multivariate conditional inflation projections.

Second, our exercise can be seen as an initial - pre-screening - stage of a wider multivariate leading indicator analysis. Pre-screening is a natural precursor to multivariate analysis, because it restricts the feasible combinations of variables to a manageable number. Both Stock and Watson (1989) and Henry and Pesaran (1993) used bivariate screens as the first stage of their multivariate leading indicator analyses.

On *Granger-causality*, it is well-known that this is neither a necessary nor sufficient condition for the existence of a well-defined structural relationship between two or more variables. Granger-causality tests are

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(3) We do not look to test reverse-causality from income to money. If money is serving as a corroborative indicator - as we might expect - then the direction of Granger-causation between money and income is much less important than its existence.

theoretically mute. But this is unimportant for our exercise. The logic of information variables is that they need not have any well-defined structural relation with the final targets; they need only possess systematic, leading indicator information over them. This is precisely what Granger-causality aims to test.

Of course, some of our results may indeed have structural content. Granger-causality tests do not rule this out, just as they do not rule it in. So while the results we present are largely atheoretic, they might usefully be regarded as "stylised facts" about money-income linkages which could then be pursued further in a structural setting. Likewise, the absence of a short-run indicator role for money quantities in no sense negates money's *long-run* role in the inflationary process. Certain measures of money may have little systematic short-run relation with the target. Yet their mapping with prices over the longer term may still be such as to warrant careful monitoring of medium-term monetary trends. Indeed, it is in precisely this way that the UK's monitoring ranges for M0 and M4 should be viewed.

The general point here is that our bivariate tests do not aim to provide a fully-articulated model of the transmission mechanism of monetary policy. This would require that we consider a much wider range of mediating monetary and real-side variables - for example, the role of interest rates (and the term structure in general). These might have important implications for the role of money within the transmission mechanism (see, for example, Friedman and Kuttner (1992)). But since our concern here is neither with modelling the transmission mechanism in its entirety, nor with testing the <u>relative</u> performance of various financial indicators, these points are largely tangential to our exercise.

(c) *Choice of Variables*

Which measure of money should be used as an indicator? Recent Bank of England research offers a guide. Two obvious *aggregate* measures of money are M0 and M4, for which the new monetary framework offers monitoring ranges. The behaviour of these aggregates has recently been considered, in a structural setting, by Breedon and Fisher (1994) and Fisher and Vega (1994). Henry and Pesaran (1993), using a multivariate framework, found narrow money (notes and coin or M0) to have particularly strong indicator properties over future inflation. And Breedon and Fisher (op.cit.) and Artis *et al* (1994) have recently reached similar conclusions. Clearly, given their monitoring range status, M0 and M4 are two monetary variables whose indicator properties we are interested in considering.

Of the other aggregate measures of money, a recent Bank study (Fisher, Hudson and Pradhan (1993)) looked at the properties of a Divisia monetary aggregate. It found evidence of M4 Divisia being marginally preferred to aggregate M4 as a leading indicator of inflation, though not to M0. We reconsider Divisia's indicator properties here. On a different theme, recent work by Dale and Haldane (1993a,b) has looked at measures of M4 lending (credit), rather than M4 deposits (money), as a monetary propagation mechanism. An emerging body of literature, originating in the US, has also looked for an effect from bank assets in addition to, or instead of, bank liabilities as a monetary transmission channel. See, for example, the survey of this "credit channel" literature in Kashyap and Stein (1993) and the references contained therein. But the results from this literature are equivocal.(4) And given these ambiguities, the indicator properties of aggregate credit are therefore usefully reconsidered here in a UK context.

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(4) Contrast, eg, Romer and Romer (1990) and Ramey (1993) with Kashyap, Stein and Wilcox (1993) and Kashyap, Lamont and Stein (1993).

Another strand of recent Bank research has considered ***disaggregations*** of monetary variables (Fisher and Vega (op.cit.), Dale and Haldane (1995)). These studies have typically considered sectoral breakdowns of money and credit. Sectoral money studies are better able to disentangle the heterogeneity of motives for holding financial balances, which we know to be important for broader measures of money such as M4 (see, eg, Salmon (1995)). In particular, we break down aggregate M4, M4 lending and Divisia into its personal (households and unincorporated businesses) and corporate (industrial and commercial companies (ICCs) and other financial institutions (OFIs)) sector components. In some cases, we use finer gradations still: for example, we split personal sector lending according to its use (house purchase or consumption), and corporate M4/M4 lending into its ICCs and OFIs components.

So which measures of spending would we expect money variables to offer information on? As with money, we consider both aggregate and disaggregate measures of spending. At an aggregate level, we consider the inflation/activity split of money GDP as well as the aggregate. Because indicators may serve only a short-run role, the real/nominal split of activity is in many ways the most interesting issue if we believe money is neutral over the longer run.

We also experiment with disaggregations of the activity component of spending - by consumption (durables/nondurables, retail sales), investment (inventories, fixed investment) and measures of manufacturing output *etc.* We have good theoretical and empirical reasons for believing that certain measures of money should map more neatly into particular components of spending: for example, narrow money and retail sales (Breedon and Fisher (1994)); personal sector M4 and consumption (Fisher and Vega (1994)); and companies' deposits and output (Dale and Haldane (1995)). Here we are looking to explore further many of these aggregate and disaggregate money/income correlations, in a similar fashion to Crockett (1970).

(d) Data

The Appendix and Table 1 offer a full listing of the money and income variables we considered. These comprise quarterly observations of seventeen activity variables, and fifteen monetary variables.[5] The main sample period is 1969Q1 to 1993Q3. In some cases, however, the sample is shorter: for example, RPIX is only available from 1974; and the Divisia and RPIY series only begin in 1977. Some variables or disaggregations which we would like to include are simply not available over a sufficiently lengthy sample and so were excluded. For example, the retail/wholesale split of M4 is only available from 1982; while companies' sterling capital issues data - an increasingly important source of external finance for medium/large firms - are only available from 1986.

3 Method

While the themes motivating monetary analysis have remained reasonably stationary over the last three decades, the econometric tools used to carry out such analyses have not. So while the framework we use to test various monetary variables' leading indicator properties is familiar from Granger (1969) and Sims (1972), we are mindful of a number of additional technical considerations.

(a) Seasonality

The compelling critiques made in Sims (1974) and Wallis (1974) mean that seasonality needs to be taken seriously if statistical inference is not to be upset. Applying the wrong seasonal filter will complicate the autocorrelation structure of the error term. This is particularly damaging to our exercise, since it is precisely these dynamic

(5) Some - but only some - of the monetary and real indicators are available on a monthly basis. But most of the important disaggregations are not and so we stick to the fuller quarterly dataset.

correlations which we are interested in testing. Granger-causality test statistics would be biased if an inappropriate seasonal filter was applied.

Assume for example that seasonality is modelled as a deterministic process using a set of seasonal dummies. If the 'true' seasonality process is in fact stochastic, and this stochastic element has some commonality across variables (there is seasonal cointegration), then this will appear as a significant (deseasonalised) cross-correlation, even if the 'true' (deseasonalised) cross-correlation is zero. To guard against this, we modelled explicitly and stochastically the seasonal filter for each of our series using Andrew Harvey's STAMP package. The only restriction this imposes is that the stochastic process followed by the seasonality coefficients is a random walk. Otherwise it is completely general.(6)

(b) Univariate Stochastic Properties of the Data

It is widely recognised that many macroeconomic time-series contain unit roots (see, *inter alia,* Nelson and Plosser (1982)). At the same time, Stock and Watson (1989) have shown that the asymptotic distribution of Granger-causality test statistics is extremely sensitive to the presence of unit roots and time trends in the data. Stock and Watson (op.cit.) illustrate how three empirical "puzzles" regarding the predictive power of money over income can be reconciled by a careful decomposition of deterministic and stochastic trends in the time-series. Without this, distributions of the test statistics will be non-standard, thereby complicating inference (see Christiano and Ljungqvist (1987)).

We are mindful of these problems here. In particular, we follow Stock and Watson (op.cit.) in conducting our Granger-causality tests upon mean zero, stationary transformations of the variables. For example, if

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(6) The variables were logged before being seasonally adjusted, so the seasonal filter can be considered multiplicative in the seasonal parameters.

we find, as Stock and Watson crucially do for M1 in the US, that the log of money (m) follows the process:

$$\Delta m_t = \beta_1 + \beta_2 t + \Delta u_t \tag{1}$$

- that is, stationary in differences around a deterministic trend - then we use the mean zero, stationary variable Δu as our measure of 'detrended' money growth. Because of its properties, we know from Stock and Watson (op.cit.) that asymptotic distribution theory allows us to use standard F-tests of significance upon Δu. The first step in any of this is, of course, to check the form of (1) for each of the variables we use, to allow us to extract the mean zero stationary component embedded within them. This is done in the next section using standard Dickey Fuller/Augmented Dickey Fuller test statistics.

(c) Multivariate Stochastic Properties of the Data

It is well-known that multivariate representations of non-stationary variables will in general have as many unit roots as there are variables. This will be true unless variables have stochastic trends which exhibit a commonality in which case they are said to be cointegrated, in the sense of Engle and Granger (1987). The system then has one fewer unit root for each cointegrating relationship which exists.

Checking the size of the cointegration sub-space remains important even in bivariate systems. Toda and Phillips (1993) have recently illustrated the problems which arise when a levels solution is imposed within a multivariate system where cointegration does not exist. It is then impossible to determine the appropriate limit theorem for test statistics, and so Granger-causality tests are rendered meaningless. Stock and Watson (1989) highlight the dangers apparent in framing inference in levels VARs without first pre-testing for cointegration, even when working with deterministically detrended variables. These papers offer a clear warning that cointegration - a levels solution - cannot be assumed arbitrarily to exist.

The converse criticism is equally damaging. A model specified in pure differences will generate inconsistent parameter estimates if cointegration exists between the variables. There is an omitted - levels - variable problem. We therefore pre-screened each of our pairs of variables for bivariate cointegration, using the Johansen (1988) maximum likelihood technique, before conducting our tests. The size of our system means that we are able to sidestep many of the problems typically associated with non-uniqueness of cointegrating vectors using the Johansen method. Either there is a unique pairwise cointegrating relationship in the system, or there is none at all. If bivariate cointegration is found to be present, then this levels solution (or some restricted version of it) was included within our specification. Because this levels (error correction) term is a mean zero, stationary process, it does not distort the asymptotics of our test statistics. When no cointegration is found, the system is estimated in simple differences.

(d) Granger-Causality and Variance Decompositions

Our measure of the information contained in money is a standard Granger-causality test. As we have discussed, such tests do not equate with causality in any structural sense. But they do equate with what we might reasonably expect of monetary indicators: that they possess short-run information over future prices or income.

Our reasons for using Granger-causality tests rather than, for example, impulse response functions or variance decompositions are twofold. First, Granger-causality tests use standard asymptotic distribution theory and thus are simpler to interpret. Second, Granger-causality and impulse response/variance decomposition functions have an exact equivalence in bivariate systems; Sims (1972) establishes this.(7) Intuitively this is straightforward to see: one is simply a test of restrictions on the AR representation of the data; the other a mapping

(7) Dufour and Tessier (1993) have recently shown that this equivalence is lost in trivariate or larger systems.

based on an MA reparameterisation of this process. The two are nested tests.

But impulse response functions do have one advantage over Granger-causality tests - they make for nice pictures. In reporting our results, therefore, we use both impulse response functions and Granger-causality test statistics: the latter to determine the *statistical* significance of money's informational content over income; the former to help determine whether these statistical correlations are significant, in size and duration, in an *economic* sense. Impulse response functions are a *policy* diagnostic on the usefulness of our findings.

Given the above, our estimated bivariate equations are of the form:

$$\Delta y_t = k + \Sigma_j \chi_j \Delta y_{t-j} + \Sigma_i \delta_i \Delta m_{t-i} + \phi (y - \gamma m)_{t-1} + \epsilon_t \qquad (2)$$

where Δy and Δm are deseasonalised (according to (a)), detrended (mean zero, stationary) income and money variables (derived from (b) above); the third term is an error-correction term included if pairwise cointegration is found between y and m (and excluded otherwise), with Johansen-estimated coefficient γ (derived from (c)); k is a constant; and ϵ is an error term satisfying the normal properties. Our Granger causality test is then simply: $\delta_i = 0$, for all i.(8) In the results below, we report F-statistics of this test.

Finally, we determined the lag length (the order of i and j in (2)), by testing down sequentially from higher-order lag structures using likelihood ratio tests. This is to be preferred to imposing arbitrarily a fixed window because Granger causality tests are known to be sensitive to the choice of lag length.

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(8) Stock and Watson (1989) also test for money neutrality - $\Sigma_i \delta_i = 0$ in (2). But this seems less relevant to our indicator analysis.

Note that the functional form we impose on the money-income relationship, (2), is quite restrictive: in particular, it is linear and symmetric. There are good empirical and conceptual grounds for believing the effects of a monetary shock upon income may be asymmetric - stronger for monetary tightenings than for loosenings (see, for example, Cover (1992) for the US). Further, there is evidence that money may have different effects in cyclical upturns than in downturns (Thoma (1994)). And, certainly, we would not necessarily expect our relationships to be invariant to the very different monetary regimes which our data-series span in the UK (see, for example, Cuddington (1981)). Our linear symmetric approach averages across these phenomena, and so leaves to a later task the identification of potential non-linearities, asymmetries or regime-shifts in the money-income relationship.(9) These effects might anyway be better detected by structural money demand estimation, rather than the theoretically agnostic bivariate relations we use here.

4 Univariate and Multivariate Properties of the Data

(a) *Univariate Properties*

Our main vehicle for testing the univariate stochastic properties of each series were Augmented Dickey-Fuller (ADF) tests. Unit root tests are well-known to have low power. So, in addition, we typically also looked at data plots, serial correlation functions and the spectrum of residuals where results looked ambiguous. The ADF test statistics are shown in Table 1.(10)

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(9) Though we do conduct some structural stability tests of the relationships we find to be important.

(10) Where different lag lengths gave conflicting conclusions the tests were run manually to determine the appropriate lag length.

Unsurprisingly, all of the series appeared non-stationary in levels.(11) Almost all appeared to contain one - and only one - unit root over our sample. Significantly, a number appeared to be difference-stationary around a deterministic trend - the case highlighted by Stock and Watson (1989) in equation (1). For the monetary variables, these included measures of narrow money, disaggregations of M4 lending, and some of the Divisia series; among the activity variables, the various price indices were also often of this form. This suggests the need to accommodate - partial out - the deterministic trend within these variables when considering their bivariate relationship with other aggregates. Table 1 tells us exactly which transformation we need to apply to each variable to arrive at the mean zero, stationary process underlying it, upon which our tests will be based.

(b) Bivariate Properties

For two series to display a long-run relationship they must be cointegrated. Pairwise cointegration between the activity and money variables was tested using the Johansen (1988) procedure.(12) The existence, or otherwise, of pairwise cointegration is shown alongside the Granger-causality test statistics in the tables at the back.

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(11) Except two of the investment series.

(12) The Johansen programme in MICROFIT does not define critical values between variables exhibiting quadratic trends in their levels (linear trends in their differences). Our approach was to detrend these variables manually. This means that we are in effect dealing with *derived* distributions, which may alter the critical values of the test statistics. A Monte Carlo simulation exercise would then be required to determine the exact effect of this on critical values (Stock and Watson (1989)). But all of the alternative ways of dealing with this suffer equally from this problem. For these reasons, we also did some cross-checks on our results - see below.

As a cross-check on the economic plausibility of our Johansen estimates,[13] we experimented with OLS levels estimates of the long-run - in effect, the first stage of an Engle and Granger (1988) two-step procedure. We also experimented with alternative lag lengths (5 and 8) on the Johansen VAR model, and where possible restricted the long-run implied elasticities in line with theoretical priors.[14] For example, we restricted to unity the long-run relation between (detrended) notes and coin and nominal GDP, and (broadly) likewise the relation between notes and coin and prices. These restrictions can be likened to long-run money neutrality conditions - a one-to-one money-price mapping and a one-to-zero money-real GDP mapping. Both are clearly well-founded as a theoretical matter.

But in many other cases, simple cointegrating restrictions were not so forthcoming. Indeed, sometimes steady-state relations were "wrongly" - negatively - signed.[15] This should not be too surprising since our bivariate indicator models fall well short of offering a well-articulated equilibrium model of money holdings. Most obviously, our long-run relations make no attempt to model, behaviourally, velocity trends. The error-correction terms we include should therefore be seen in the main as an attempt to ensure consistency of our estimates, rather than as legitimate measures of monetary equilibrium. Nonetheless, it is interesting to note that it is relatively straightforward to pin down sensible long-run relations between narrow measures of money and activity, but much harder for broader money measures. This most

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(13) Again, it is well-known that the vectors the Johansen method chooses are those giving the most stationary set of residuals, rather than those giving the most easily interpretable parameter estimates. Also, cointegration results are notoriously sensitive to small sample biases (see, for example, Banerjee, Dolado, Galbraith and Hendry (1993)), which hopefully helps justify our rather eclectic approach to arriving at long-run relations.

(14) We also inspected plots of the residuals from the cointegrating relationships (corrected for short-run dynamics in the Johansen case) for their stationarity, to guard against outlier or structural break problems.

(15) The cointegration restrictions are available from the authors on request.

probably reflects the relative difficulty of empirically modelling the velocity trend of these two monetary assets: financial liberalisation has affected narrow money velocity in a much more predictable way than broad money velocity.

5 Results

With over 250 bivariate relations to test, we need some simple taxonomy of the results. We choose the following: first, we consider the results for narrow measures of money over (aggregate and disaggregated) measures of nominal income (and its real/nominal split); second, we consider M4 money-income relations - aggregate and disaggregated; third, the relation between M4 lending and nominal income (and its split); fourth, the relation between M4 Divisia and money GDP; and finally the mapping between RPIX - the government's target variable - and RPIY and various money disaggregations. In considering these relations, we look first at Granger-causality test statistics.(16) If these are found significant, we then consider the bivariate relation's impulse-response form to check its economic plausibility. These are shown in the charts below. In most cases the pictures painted are fairly noisy, but they suffice for casual inference.(17) As a final check, we look in section 6 at the relations' out-of-sample performance.

(a) *Narrow Money Relations*

Table 2 presents Granger-causality test statistics of the relation between nominal GDP (and various inflation/activity disaggregations) and M0 and notes and coin. The lag length on the VAR (used for causality

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(16) We also ruled out some sets of relationships on the grounds of economic (im)plausibility: for example, between personal sector money and credit and manufacturing output and investment.

(17) This partly reflects the inherent noisiness of any (atheoretic) bivariate relationship, and partly the fact that it is volatile one-quarter growth rates which we are plotting.

testing) and the presence (or otherwise) of a cointegrating relationship is also indicated in Table 2. The following points are worth noting:

(i) *M0* Granger-causes both nominal spending and prices and has a well-defined long-run relationship with both of them. For prices, these results are largely familiar from Henry and Pesaran (1993), Artis *et al* (1994) and Breedon and Fisher (1994). M0 appears also, however, to have a significant short-run relation with real activity. So statistically narrow money seems to contain information about both the nominal and real components of money GDP.

(ii) The dynamics of these M0 relations, and their plausibility, can be seen by tracing out the effects of a shock to narrow money - an *impulse response function*. In the charts which follow, the responses are shown for a 1% point shock to (the residuals from) M0 in a bivariate VAR containing M0 and the income variable. The responses are plotted over a five-year (twenty-quarter) window - though, as indicators, we are only really interested in behavioural responses over the first two or so years. All the responses are measured as one-quarter growth rates.

(iii) The *responses of nominal GDP growth and inflation* are both immediately positive and remain so for between two and three years (Chart 1); thereafter they die away.(18) Although volatile, these patterns are consistent with M0 being a relatively useful and timely information variable as regards medium-term inflation pressures. A temporary 1% point shock to narrow money has a maximum effect upon inflation - measured by the GDP deflator - of around 0.2%. This response peaks after eighteen months and persists for a further year. This M0-inflation relationship is also apparent for other deflators. For example, for producer prices the responses are generally

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(18) One reason for this - and, in particular, for the negative responses of many of the variables after two years or so - is that monetary policy is an omitted variable from our bivariate analysis. We would typically expect any incipient build-up of price or demand pressures to be defused by monetary policy actions, working with an eighteen-month to two-year lag. This may help explain the pattern of zero or negative impulses responses in the latter half of the five-year window. This is another reason for concentrating our analysis on responses over the first two or so years.

faster and larger and have the "correct" sign throughout (Chart 1). In general, it appears from Chart 1 that it is prices (rather than real GDP) which account for most of narrow money's indicator properties over future nominal spending.

(iv) Our atheoretic bivariate VAR leaves unexplained the source of this explanatory power. The impulse responses are effectively simulating the effects of a helicopter drop of cash. But the results in Breedon and Fisher (1994) suggest that this explanatory power is unlikely to be accounted for by narrow money's conventional determinants.[19] That is, narrow money is more than just an efficient aggregator of the information contained in other variables; it is an incremental indicator.

(v) The *dynamics of aggregate real activity* following a narrow money shock are less well-defined (Chart 2). For the first year the response is as expected - positive. Exogenously higher cash balances precede higher spending. But thereafter the responses are predominantly negative. In general, the aggregate real activity response seems fairly weakly determined over anything other than the short-run - unlike that of prices.

(vi) But looking at narrow money's relation with the expenditure components of real GDP improves matters (Table 2). Predictably, it is the *consumption* component of real spending with which narrow money appears to be most closely linked. And looking within consumption, retail sales do best as a disaggregation. Retail sales probably map better into the cash-financed component of consumption than a durable/non-durable split - consistent with the conclusions of Breedon and Fisher's (1994) structural modelling exercise. Chart 3 plots the responses of retail sales volume to a 1% point innovation in narrow money.

(vii) Looking just at the *notes and coin* component of M0 strengthens marginally the statistical leading indicator properties of narrow money over activity and prices. This again accords with the

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(19) Breedon and Fisher (1994) show that it is the unexplained component of M0 - the residuals from a money demand function - rather than the explained part - the predicted values - which accounts for M0's explanatory power over prices.

results of Breedon and Fisher (1994). It seems that there is a marginal loss of information by aggregating notes and coin together with the (much noisier) bankers' balance component of M0.

(b) *Broad Money Relations*

Table 3 shows the relation between M4 broad money (aggregate and disaggregated) and aggregate measures of activity, and Table 4 the relation between M4 (and disaggregations) and *dis*aggregated activity. Points to note are:

(i) *Aggregate M4* performs poorly in relation to aggregate measures of activity and prices. There is no evidence of Granger-causality or of cointegration. But *sectoral disaggregation* of broad money holdings improves matters greatly. This is in line with the findings of Dale and Haldane (1993a,b, 1995) and Fisher and Vega (1994).

(ii) In particular, there is strong evidence of *Industrial and Commercial Companies' (ICCs') M4 deposits* leading money GDP and prices (Table 3). As with narrow money, it appears to be the price component of money GDP with which ICCs' deposits are most strongly correlated. More impressive still, the impulse responses from the bivariate VAR reveal broadly systematic and plausible patterns in the relation between ICCs' deposits and nominal spending and prices (Chart 4). While the response of prices to a money innovation is "perverse" for the first year or so,[20] thereafter a well-defined and correctly signed positive response obtains. The peak response of prices, of around 0.3%, comes around two to three years out. This mirrors the results of Dale and Haldane (1995), who conclude that M4 deposits represent a preferred leading indicator of activity for the company sector. How might we explain this finding?

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(20) Dale and Haldane (1995) report similar short-run price perversities in an eight-dimensional VAR.

(iii) One story we might tell is of higher deposits serving as an indicator of incipient investment spending and thus, in time, inflation. Table 4 offers some support for this view. Companies' broad money holdings seem to contain information over both the *fixed and inventory components of investment.*[21] They are also useful as indicators of production industry output. Each of these relationships is statistically significant at 5% and in many cases also has a well-defined equilibrium (cointegrating relationship). The impulse responses are illustrated in Chart 5. The response of output and fixed investment is positive and relatively speedy, peaking at around 0.3% over the first nine to eighteen months; and it is systematically positive for at least the first two and a half years. This is consistent with the effect of higher ICCs' M4 holdings being felt, first, in higher output and investment - during the first 18 months - thence taking effect upon prices after two or so years. If companies used M4 deposits as a buffer-stock of liquidity held in anticipation of spending, and if the short-run Phillips curve were non-vertical, then this temporal sequence would be exactly as we might expect.

(iv) The results for *Other Financial Institutions' (OFIs') M4 deposits* are more surprising. OFIs' money holdings appear to Granger-cause both the activity and price components of money GDP, but not nominal GDP itself. Plotting the real GDP and price responses helps explain this (Chart 6). The two responses are the mirror-image of one another, netting out in their effect upon nominal spending.

(v) Looking at disaggregations of activity, OFIs' M4 deposits map into various of the activity measures, fixed investment in particular. Indeed, the impulse response pattern of fixed investment to a shock from OFIs' M4 deposits is qualitatively similar to that from ICCs' M4 deposits. Rationalising this pattern is rather harder. It is unclear why the behaviour of financial institutions switching funds between different types of asset - M4, equities, bonds, property *etc* - should serve as a

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(21) They also seem to contain statistical information over some of the consumption components. But looking at these relationships' impulse response functions suggested no systematic pattern - as we might expect.

harbinger of latent activity and price pressures. It could just be, of course, that ICCs' and OFIs' M4 holdings have some positive covariance because they behave similarly in their portfolio management activities, and that only ICCs' deposits have any true causal link with future activity. Spurious correlations are always possible using Granger-causality tests.

This problem notwithstanding, however, it is interesting to observe the number of significant relationships involving ICCs' and OFIs' M4 deposits. These deposits are typically much more volatile than personal sector M4 holdings, because asset substitution is more prevalent. But volatility per se need not of course deprive these assets of explanatory power, not least because many activity indicators - such as inventories - are themselves volatile quarter-on-quarter.

(iv) *Personal sector M4* does badly in relation to aggregate measures of activity or prices (Table 3). But within GDP, personal sector money holdings do appear to offer some information over (in particular) non-durable consumption trends. This result seems intuitive enough. It echoes that of Fisher and Vega (1994), who model personal sector M4 and consumption simultaneously and find them to have an important dynamic interaction. But the impulse responses suggest this M4-consumption interaction is relatively short-lived (Chart 7). A personal sector M4 innovation has a positive impact on spending for only around a year, thereafter remaining mainly negative.

(c) M4 Lending Relations

Tables 5 and 6 summarise the main results:

(i) Mirroring the results for aggregate M4, *aggregate M4 lending* performs fairly poorly in explaining aggregate measures of activity and prices (Table 5). If we were comparing aggregate bank money and bank credit as leading indicators - as many studies in the US have done (eg King (1986), Ramey (1993)) - then it would be a "no-score draw" on the basis of these results. At this level of aggregation, neither money nor credit add much by way of indicator information. Indeed, aggregate M4 lending possesses little by way of information over any of the *disaggregations* of activity either (Table 6).

(ii) But - as with M4 - sectoral disaggregation of M4 lending offers some information. In particular, *personal sector lending* looks to map into consumption reasonably closely. This mapping is strongest for durable goods (and retail sales) which intuitively are more likely to be credit than cash-financed. And it is M4 lending for consumption - rather than for house purchase - which does all of the work in explaining durables consumption. Perhaps surprisingly, lending for house purchase has very little indicator information over consumption. Intuitively, we might have expected house purchase lending and, in particular, second mortgages to be associated with big-ticket purchases. But this result is probably a small-sample phenomenon: equity withdrawal only became widespread in the 1980s. In fact, neither disaggregation of personal sector lending - consumption or house purchase - does as well as the aggregate. Chart 8 plots the personal sector lending-consumption relationship. It is short-lived and noisy. But it is broadly consistent with Dale and Haldane's (1995) VAR results, and with the widely-held view that bank lending is "special" for agents unable to substitute between financing sources. Since this view forms the basis of the credit channel, our leading indicator results can be interpreted as weakly supportive of it.

(iii) Other sectoral measures of lending - to *ICCs* and *OFIs* - generally do just as badly as aggregate M4 lending as an indicator. Any statistically significant results yielded non-systematic impulse response patterns. Given the alternative sources of financing these sectors are typically able to tap - for example, capital issues - these results are not surprising. Bank credit has no "specialness" for large firms and financial institutions.

(d) Divisia Money Relations

Again, Tables 7 and 8 summarise the main Granger-causality results:

(i) In general, *M4 Divisia* responses appear broadly corroborative of those from M4. *Aggregate* Divisia offers little as an indicator.

But the behaviour of *sectoral* Divisia has a direct mapping with sectoral M4.(22)

(ii) Both personal and corporate sector Divisia appear to map well into the real, rather than price, component of nominal GDP (Table 7). This seems plausible, since Divisia is meant to proxy transactions money. *Personal sector Divisia* exhibits the weakest patterns with activity. Its strongest relationship is with consumption (Table 8) - as with personal sector M4. But although largely statistically significant, the response of consumption is very volatile and short-lived (Chart 9). At best the results from personal sector Divisia are inferior to those from personal sector M4; and at worst they are behaviourally unimportant, despite their statistical significance.

(iii) Regarding *corporate Divisia*, it appears to map into investment activity and production industry output (Table 8) - as with ICCs' (and OFIs') M4 balances. And statistically the results using corporate Divisia are generally stronger than for simple-sum M4. The impulse responses - positive and reasonably systematic up to eighteen months out - show broadly sensible patterns (Chart 10) and they are less noisy than their simple-sum M4 counterparts. This is as we would expect if Divisia is a "cleaner" measure of the transactions services money offers.

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(22) The mapping is not exact in definitional terms. For Divisia, we combine ICCs and OFIs as the corporate sector: see Fisher *et al* (1993) for details of the construction of Divisia in the UK.

(e) Money-RPIX/RPIY Relations

We turn finally to the relation between various of the monetary aggregates (and disaggregations of them) and RPIX - the centrepiece of the UK's new monetary framework. We also consider RPIY, the underlying measure of retail price inflation which also strips out indirect tax effects.(23)

In general, RPIX's mapping with the monetary aggregates is - as we might expect - similar to that of the GDP deflator and producer prices. It is, however, notable that RPIX's link with the personal sector components of the aggregates is much stronger than was the case with other deflators. These results broadly carry across to RPIY. Table 9 summarises:

(i) Unsurprisingly, both *M0* and *notes and coin* show strong evidence of Granger-causing RPIX and have a well-defined equilibrium relationship with it.(24) Impulse responses offer further evidence of this (Chart 11). These are qualitatively similar to the responses from the GDP deflator, with a systematic positive response from the third quarter to around two and a half years out. Again, the responses are in the region of 0.2%-0.6%. Narrow money's leading indicator properties over RPIX are well-documented in the literature - see Henry and Pesaran (1993), Artis *et al* (1994); and Williams, Goodhart and Gowland (1976) for a much earlier discussion of the same finding. These narrow money-inflation links are also evident from RPIY and have, as we might expect, broadly similar dynamic profiles (Chart 11).

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(23) RPIY is only available from 1976Q2, and so the sample period in our estimation covers only the 1980s and 1990s. We use the Bank's RPIY measure, which differs only marginally from the series now published by the CSO. We use the same sample period for RPIX for comparability, though the data goes back further.

(24) RPIX and M0 marginally fail tests of cointegration over the sample from 1976, but pass this test when looked at over longer windows (back to 1974), which suggests the former result is a small sample problem.

(ii) None of the broader aggregates - M4, M4 lending and Divisia - offer very much by way of leading indicator information over RPIX and RPIY. Of them, however, aggregate Divisia appears to do best. This is particularly evident from the sectoral disaggregations, where both corporate and personal sector Divisia appear to contain (statistically significant) information about both RPIX and RPIY. Charts 12 and 13 plot these relationships.

(iii) The impulse responses from corporate Divisia (Chart 12) are the easier to interpret. They suggest an (almost) immediate systematic positive pattern, which persists for more than three years. The response is also fairly large, peaking above 0.5%. This may tie in with our earlier results suggesting a strong link between corporate Divisia and investment/output activity, with rising activity presumably then serving as a harbinger of retail inflationary pressures at a later stage.

(iv) Personal sector Divisia gives a smaller and more difficult to interpret response (Chart 13), which only becomes systematically positive after around two years. A similar - and also statistically significant - effect is evident from personal sector M4. In general, it seems to be the case that the personal sector components of the monetary aggregates map more accurately into retail prices than was the case with other deflators. This sounds intuitive enough. It is rather more difficult to explain the cause of this explantory power, however, given the reasonably weak link we observed between personal sector M4 (and Divisia) and consumption spending.

6 Out-of-Sample Performance

As a final check, we consider how the bivariate relationships (which we have identified as significant) perform out-of-sample. This also helps clarify the potential role of the monetary aggregates as a complement to structural forecasting in policy analysis.

As an arbiter of out-of-sample performance, we use Chow's (1960) test for predictive failure (Chow's second test). The resulting F-tests are shown in Table 10, for a selection of the bivariate relationships we have found to be significant in section 5.[25] The forecast period is 1990Q1-1993Q3. The predictive failure tests are satisfied for all of these relationships at the 1% level. The strongest relationships - as suggested earlier - are generally between narrow money and prices; between ICCs' (corporate) M4 deposits and measures of manufacturing output and investment; and between M4 lending to the personal sector and durable consumption. It is important to stress, however, that these out-of-sample tests tell us very little about our relationships' <u>absolute</u> forecasting performance. They tell us only how our equations compare in and out-of-sample - even if their performance over <u>both</u> samples is relatively poor.

So how might these results help inform policy analysis? Two pressing questions surrounding the current conjuncture are:

Whether the strength of narrow money growth during 1993 and 1994 is worrying for inflation? Or does it merely reflect a breakdown of the narrow money growth-inflation relationship? In answering the second question, it is interesting if we forecast annual RPIX inflation using observed M0 outturns. Chart 14 does this over the period 1992Q1-1994Q3. As the chart shows, the <u>actual</u> growth of RPIX and M0 diverged over the period from end-1991. Annual RPIX inflation fell from above 5% to around 2%; while annual M0 growth rose from around 3% to almost 7%. Prima facie, this might suggest their (positive) bivariate relationship may have collapsed over this period. But a <u>static</u> forecast of RPIX between 1992Q1 and 1994Q3, using actual M0 outturns, gives an inflation profile which tracks rather closely the actual path of RPIX. Indeed, if anything, the M0-conditional inflation projection *over*predicts the <u>fall</u> in RPIX inflation from 1992 onwards.

The explanation for this behaviour is a simple growth/levels one. In steady-state, there is an (approximate) unit *levels* - cointegrating -

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(25) We also experimented with some recursive Chow tests, but these yielded little additional information.

relationship between M0 and RPIX; that is, a well-defined equilibrium exists for *real* money balances.[26] This much was clear from our cointegration analysis. But beginning in 1992Q1, this levels equilibrium was initially out of kilter - perhaps because of the continuing effects of the earlier period of high interest rates, damping narrow money growth. The *level* of *real* money balances was thus below its equilibrium. Clearly, in the years which followed - 1993 and 1994 - M0 therefore had to grow more quickly than RPIX to restore this levels equilibrium. And this is indeed what occurred during 1993-94.

According to this interpretation, the rise in M0 during 1993-94 was neither a signal of incipient price pressures, nor was it an indication of the M0-RPIX relationship having become distorted. It was merely an indication of the well-defined steady-state relation between prices and narrow money reasserting itself. All of this story is neatly encapsulated within our simple bivariate M0-RPIX relationship. It shows up in the ability of our system to track the downward path of RPIX over the last two years, despite a seemingly perverse response from narrow money over the period.

A second topical question is: at what stage in the cycle will companies begin investing? And can ICCs' M4 deposits help inform this debate? Chart 15 shows the results of a static forecast of manufacturers' fixed investment, conditioned upon observed outcomes of ICCs' M4 deposits. The forecast profile of fixed investment matches that of actual investment reasonably closely, at least in terms of first derivatives. In levels terms, there is a clear *over*prediction of investment, in particular during 1993. This suggests that investment spending during the current upturn is more sluggish than would be suggested by historic profiles of company deposits. Such a finding is probably related to the balance sheet restructuring which we know companies have undertaken during the most recent recovery. More optimistically,

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(26) When looked at over a sample going back to 1974.

however, were we to forecast *dynamically* from 1994Q3 onwards using our bivariate relationship, then this would suggest a fairly substantial take-off in investment during 1995. Chart 16 plots such a dynamic forecast up until the end of 1995. Manufacturers' fixed investment growth picks up from close to zero in 1994 to average 7%-8% during 1995. This is related to the significant accumulation of company deposits seen (in particular) during the second half of 1993 and the first half of 1994.

Most of the above analysis is concerned with the *relative* forecasting performance of various of the monetary aggregates. It would be useful, as a second strand of research, to consider the *absolute* forecasting performance of the monetary aggregates too - in particular, to set the performance of these against the Bank's inflation forecast, to determine what useful incremental or corroborative information money might have.

7 Conclusions

So does this analysis offer any crumbs of comfort for the policy-maker in search of monetary indicators able to inform policy choices? We would make three points:

First, the messages from narrow money appear to be both clear and informative with respect to future nominal spending and, in particular, price dynamics - provided equilibrium (levels) effects are accommodated. Indeed, of the monetary aggregates, perhaps *only* narrow money has in the past provided signals which are sufficiently reliable and timely to have helped steer policy choices with any accuracy.

Second, the broader aggregates - M4, M4 lending and Divisia - have in the past provided signals which are, in the main, either too weak to be reliable, or too noisy to be useful on a month-by-month basis. Clearly, however, this does not preclude a role for the broader aggregates as guides to medium-term price level trends - which is precisely the role the monitoring ranges play in the UK's new monetary framework. Our analysis has very little to say about steady-state money-income linkages, in the absence of a well-articulated behavioural model of velocity trends. Nor does our analysis preclude a role for these aggregates as leading indicators in the future, if the on-going process of financial liberalisation slows or becomes more predictable.

Third, sectoral disaggregation of money and credit gives us a much firmer feel for incipient spending and price developments. On the *deposits* side, corporate M4 and Divisia appear to have a systematic and reliable mapping with investment activity and production industry output. Personal sector M4 has some relation - albeit a short-lived one - with consumption. On *lending*, only the personal sector side offers any information; this is over the durables component of spending and is weak. The broad picture here is of sectoral measures of money and credit mapping into some of the disaggregated components of activity -

in line with the results of, *inter alia*, Dale and Haldane (1995) and Fisher and Vega (1994). Out-of-sample analysis helped to clarify the potential usefulness of sectoral money and credit as an add-on to formal structural forecasting. And later research will look to clarify further these links.

It is interesting to set our conclusions against those of Crockett (1970, page 468):

"(i)..the money stock, *narrowly defined* (M1), seems to be positively related to subsequent changes in expenditure...

(ii)..there appears to be little to choose between (aggregate) *money and credit*...

(iii)..*investment* appears to be more strongly related to changes in financial conditions than are the other components of expenditure" (italics and parantheses added).

The correspondence is indeed striking.

And so too is the correspondence between our bottom-line conclusion: that we would be cautious about trawling too exhaustively the (in particular broad) monetary indicators, especially when the components of activity are themselves observable with little more of a lag. Certainly, none of the monetary aggregates offer sufficiently robust early warning signals to justify intermediate target status. Rather, the message is that, when used alongside other information variables such as the Bank's inflation projection, <u>some</u> of the monetary aggregates offer useful <u>corroborative</u> information about incipient activity and price developments.

Appendix: The Data

Table 1 provides a description of each variable, together with CSO/Bank codes, data sources and availability. The activity variables are all official CSO series, covering both the consumption and production/investment components of GDP. Disaggregations are considered where available. On a quarterly basis, many of the activity variables date back to 1955. However, several series - notably retail sales and RPIX - are only available from the 1970s. The retail sales series were extended back using data supplied by the CSO.

The money variables are all taken from the Bank's break-adjusted series directory. A backward-looking break-adjustment methodology was used, such that each series is consistent with the current reporting "population". Narrow money, both sides of the M4 institutions' balance sheets and Divisia were all investigated, including sectoral disaggregations where available. On a quarterly basis, many of the series were available from the 1960s. However, the Divisia series and several M4 lending disaggregations were only available from the mid-1970s. Flows data were used to extend the sectoral M4 deposits series back fourteen years. Wholesale/retail M4 disaggregations were not investigated because they were only available from 1982.

The main estimation period is 1969Q1 to 1993Q3. Most of both the activity and money series are available over this period. The main text highlights the occasions when a different estimation period is used.

TABLE 1 - DATA DESCRIPTIONS, SOURCES & AVAILABILITY

ACTIVITY VARIABLES

CODE	DESCRIPTION	SOURCE	PERIOD
DJAE.q	GDP(E) at current factor cost, NSA, £mn	ETAS 3	55q1-93q3
DJCW.q	GDP(E) at FC, Constant 1990 prices, NSA, £mn	ETAS 3 NA A27	55q1-93q3
**DEFF.q	Implied GDP deflator, Expenditure Based, At Factor cost, Index, 1990=100, NSA	ETAS 1 ET 2, MD 1.1, NA A	55q1-93q3
*FHBJ.q	Retail Sales Value Index, All retailers, 1990=100, NSA.	MD 14.2	71q1-93q3
*FHBK.q	Retail Sales Volume Index, All retailers, 1990=100, NSA.	MD 14.2	71q1-93q3
CHMK.q	Retail Price Index Excluding Mortgage Interest Payments, 1990=100		74q1-93q3
RPIY.q	Retail Price Index Excluding Mortgage Interest Payments and Indirect Taxes		76q2-93q3
AIIK.q	Consumers' Expenditure, Current prices, £mn, NSA	ETAS 3, MDS 1.6, FS 9.1 MD 1.2, NA A18	55q1-93q3
CCBH.q	Consumers' Expenditure, Constant 1990 prices £mn, NSA	ETAS 3 ET 3, MD 1.2, NA A2	55q1-93q3
AIIL.q	Consumers' Expenditure on Durable Goods Current prices, £mn, NSA	ETAS 6 FS 9.1, MD 1.6, NA A6	55q1-93q3
CCBI.q	Consumers' Expenditure on Durable Goods Constant 1990 prices, £mn, NSA	ETAS 6 MD 1.6, NA A6	55q1-93q3
CDGM.q	Consumers' Expenditure On Non-Durable Goods Current Prices, £mn, NSA	NA A5,	55q1-93q3

CCYV.q	Consumers' Expenditure On Non-Durable Goods Constant 1990 Prices, £mn, NSA	NA A5	55q1-93q3
DUDK.q	Index of Real Output of Production Industries, DIV 1-4, 1990=100, NSA	MDS 7.1	48q1-93q3
PLLU.q	Producer Price Index, Output of Manufactured Products, 1990=100, NSA	ET 26 MDS 18.6	63q1-93q3
DUDM.q	Index of Real Output of Manufacturing Industries DIV 2-4, 1990=100, NSA	MDS 7.1	48q1-93q3
DFDC.q	Gross Domestic Fixed Capital Formation, Current prices £mn, NSA	ETAS 3,9 MD 1.2, NA T A14	55q1-93q3
DFDM.q	Gross Domestic Fixed capital Formation, Constant 1990 prices, £mn, NSA	ETAS 3,9 ET 3,MD 1.2, NA A15	55q1-93q3
DFDG.q	Private Sector Gross Domestic Fixed K. Form Current Prices, £mn, NSA	ETAS 9 MD 1.8, NA A15	55q1-93q3
DFDQ.q	Private Sector Gross Domestic Fixed K. Form Constant 1990 Prices, £mn, NSA	ETAS 9 MD 1.8, NA A15	62q1-93q3
DFDD.q	Total Gross Fixed Investment In Manufacturing Industry, current Prices, £mn, NSA	ETAS 10 MD 1.8, NA A16	55q1-93q3
DFDN.q	Total Gross Fixed Investment In Manufacturing Industry, Constant 1990 Prices, £mn, NSA	ETAS 10 MD 1.8, NA A16	55q1-93q3
DHBF.q	Value of Physical Increase in Stocks and WIP At Current Market Prices, £mn, NSA	ETAS 3 MD 1.2, NA A17	55q1-93q3
DHBK.q	Value of Physical Increase in Stocks and WIP At Constant 1990 Prices, £mn, NSA	ETAS 3 ET 3, MD 1.2, NA A17	48q1-93q3

<u>Key</u>

ET	=	Economic Trends
ETAS	=	Economic Trends Annual Supplement
MDS	=	Monthly Digest of Statistics
NA	=	UK National Accounts
FS	=	Financial Statistics
*	=	Database updated using CSO supplied data
**	=	Calculated from nominal and real GDP data

MONETARY DATA

CODE	DESCRIPTION	PERIOD
M0UA.q	M0 level, break-adjusted (BA), NSA	69q3-93q3
NCUA.q	Notes & Coins level, BA, NSA	69q3-93q3
M4Ua.q	M4 level, BA, NSA	63q3-93q3
*M4OUA.q	M4 Deposits: OFI's, BA, NSA	63q1-93q3
*M4IUA.q	M4 Deposits: ICC's, BA, NSA	63q1-93q3
*M4PUA.q	M4 Deposits: Persons, BA, NSA	63q1-93q3
M4LUA.q	M4 Lending, BA, NSA	63q2-93q3
M4LPUA.q	M4 Lending: Personal Sector, BA, NSA	63q2-93q3
M4LCUA.q	M4 Lending: Personal sector for Consumption BA, NSA	75q3-93q3
M4LHUA.q	M4 Lending: Personal Sector for House Purchase, BA, NSA	75q1-93q3
M4LOUA.q	M4 lending: OFI's, BA, NSA	63q2-93q2
M4LIUA.q	M4 Lending: ICC's, BA, NSA	63q2-93q3
I3.q	Divisia	77q1-93q3
I15.q	Divisia: Personal Sector	77q1-93q3
I17.q	Divisia: Corporate Sector	77q1-93q3

Chart 1
M0 - nominal GDP, GDP deflator & Producer Prices

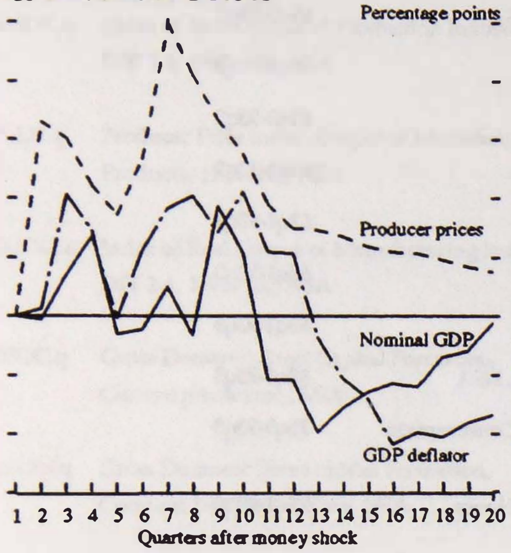

Chart 2
M0 - real GDP

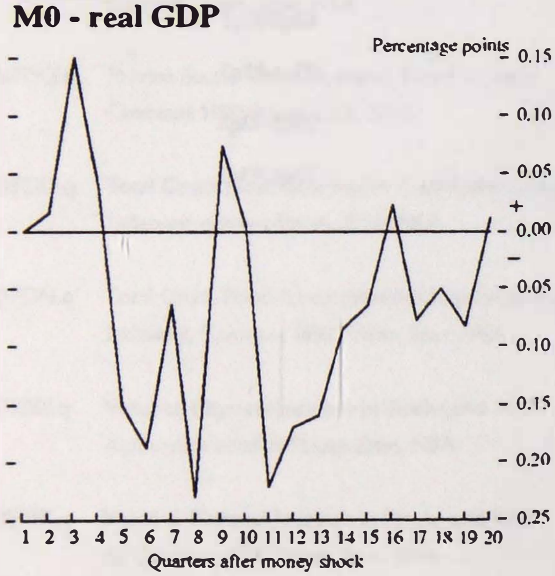

Chart 3
M0 - Retail sales Volume

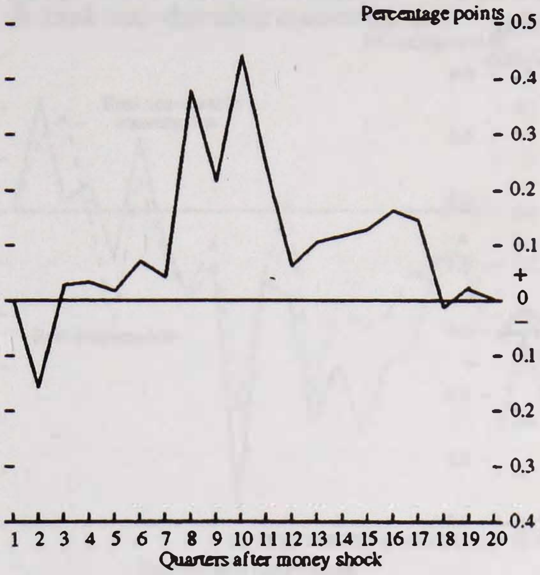

Chart 4
M4 ICCs - GDP deflator & nominal GDP

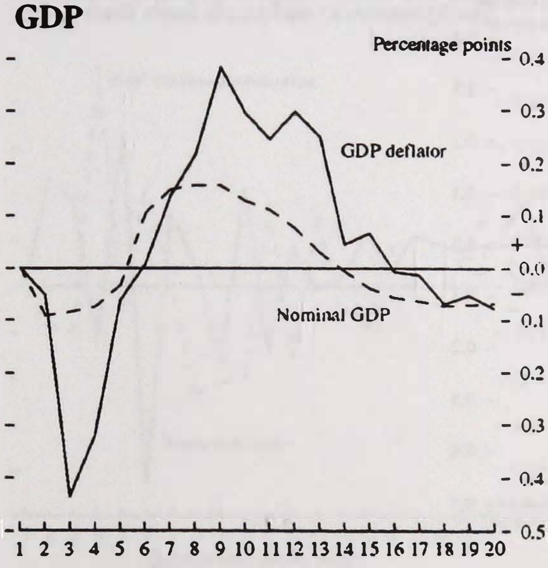

Chart 5
M4 ICCs - production output, real GDFKF & real fixed investment in manufacturing

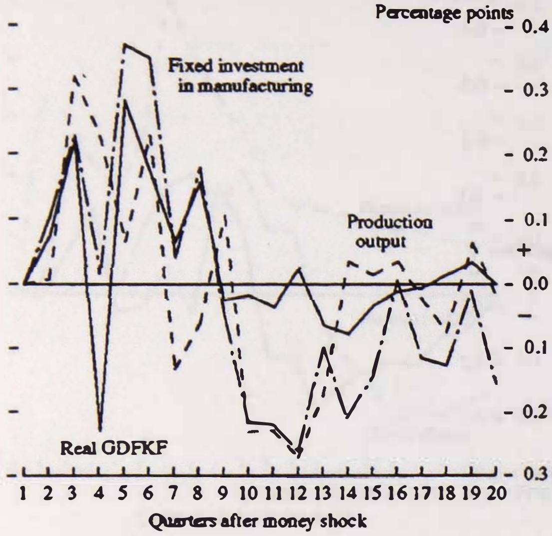

Chart 6
M4 OFIs - real GDP & GDP deflator

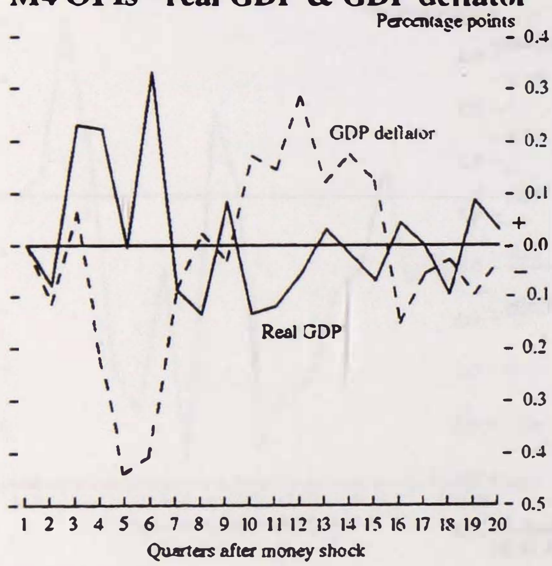

Chart 7
M4 personal sector - real consumption & real non-durable consumption

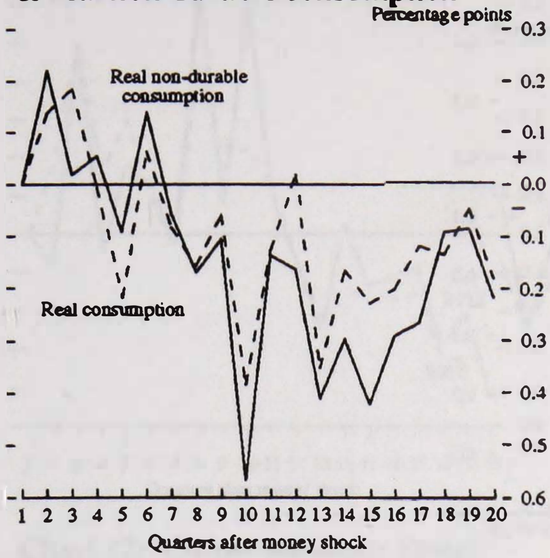

Chart 8
M4 lending to persons - real retail sales and real durable consumption

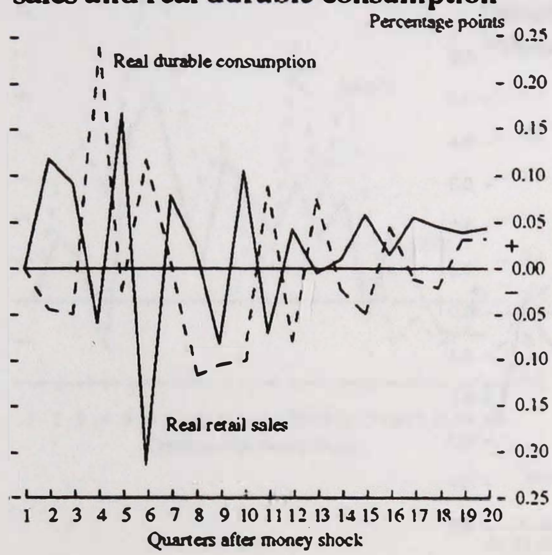

Chart 9
Personal Divisia - real retail sales & real durable consumption

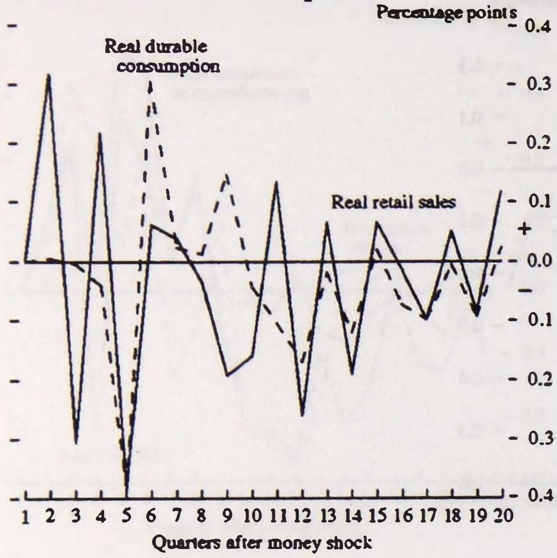

Chart 10
Corporate Divisia - production output & real fixed investment in manufacturing

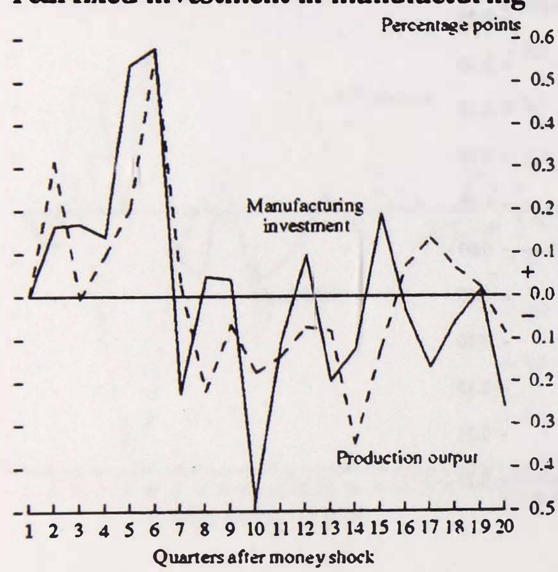

Chart 11: Notes & coin - RPIX, RPIY

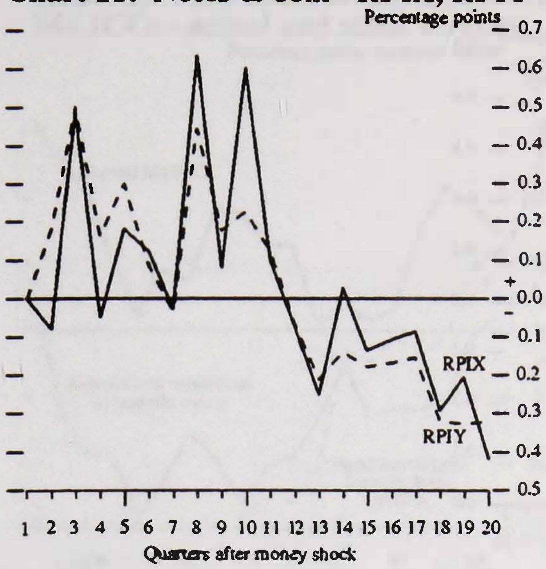

Chart 12: Corporate sector Divisia - RPIX, RPIY

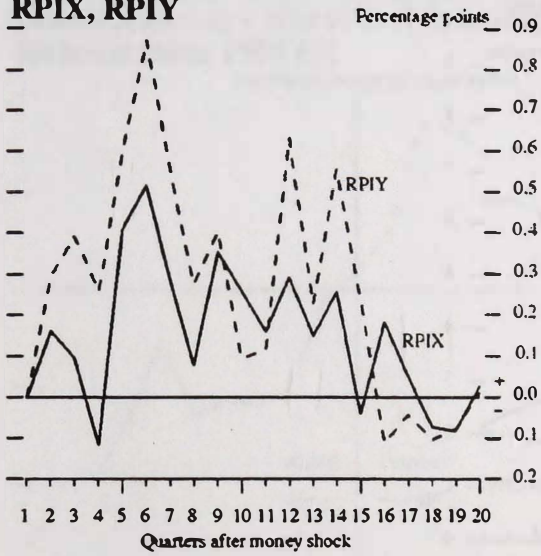

Chart 13: Personal sector Divisia - RPIX, RPIY

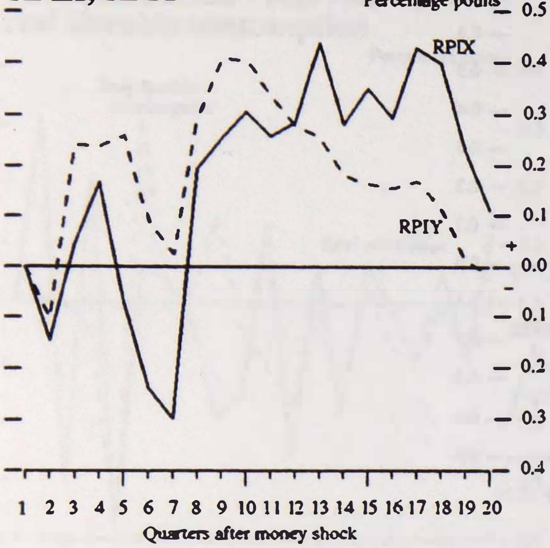

Chart 14: RPIX and M0 - actual and static forecast

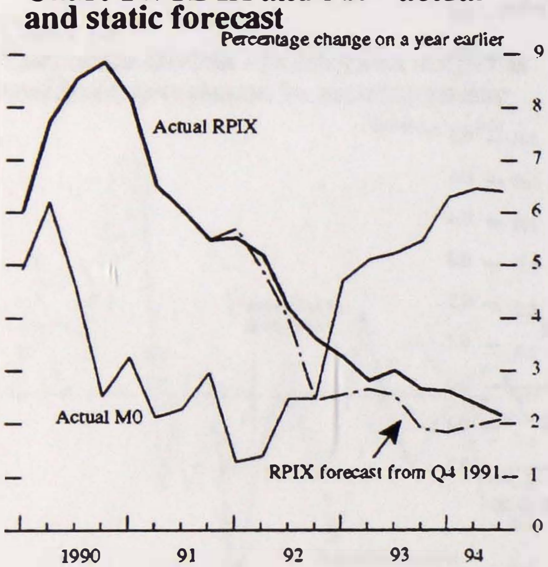

Chart 15: Real fixed investment and M4 ICCs - actual and static forecast

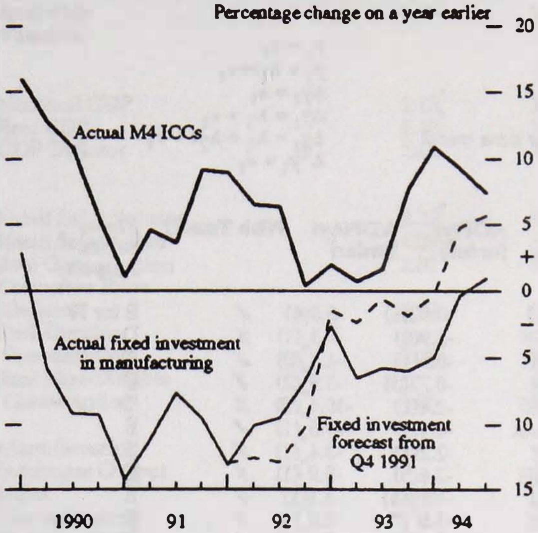

Chart 16: Real fixed investment in manufacturing - actual and dynamically forecast from 1994 Q3

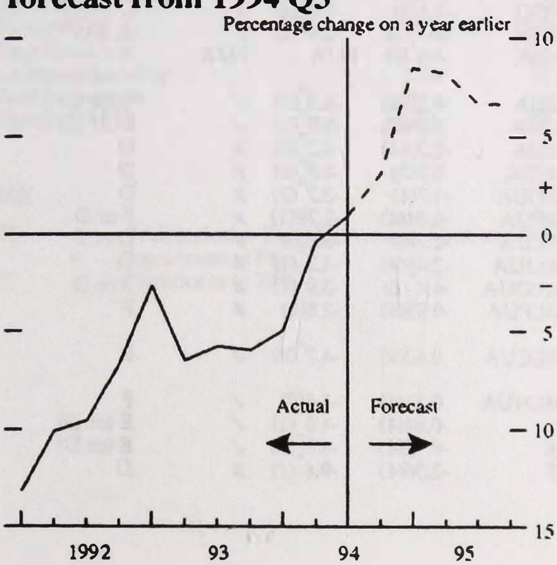

Table 1: Time Series Properties of Data

A	=	Stationary, without trend	$y_t = \epsilon_t$
B	=	Stationary series, with trend	$y_t = \lambda_1 t + \epsilon_t$
C	=	Unit root (I(1)), no drift, no trend	$\Delta y_t = \epsilon_t$
D	=	Unit root (I(1)), with drift, no trend	$\Delta y_t = \lambda_1 + \epsilon_t$
E	=	Unit root (I(1)) with drift around a linear time trend	$\Delta y_t = \lambda_1 + \lambda_2 t + \epsilon_t$
F	=	Integrated of order 2 (I(2))	$\Delta^2 y_t = \epsilon_t$

where ϵ_t = mean zero stationary process.

Variable	CSO Bank Code	ADF(y) [order]	ADF(Δy) [order]	With Trend?	Times Series Property
<u>Activity Variables</u>					
Nominal GDP at Factor Cost	DJAE	-0.92(6)	-3.3*(4)	✓	E (or F)
Real GDP at Factor Cost	DJCW	-1.9(0)	-7.3*(1)	✗	D
GDP Deflator at Factor Cost	DEFF	-0.5(1)	-4.3*(0)	✓	E
Retail Sales Value	FHBJ	-0.77(3)	-3.9*(2)	✓	E
Retail Sales Volume	FHBK	-1.4(1)	-10.4*(0)	✗	D
RPIX	CHMK	-3.1(1)	-3.5*(1)	✓	E
RPIY	RPIY	-2.2(1)	-3.4*(1)	✓	E
Real Consumption	CCBH	-2.6(5)	-5.9*(1)	✗	D
Consumer Price Index	CPRI	-0.76*(4)	-3.1*(1)	✓	E
Real Durable Consumption	CCBI	-3.8 (7)	-8.8*(1)	✗	B
Real Non-Durable Consumption	CCYV	-3.0(5)	-5.2*(1)	✗	D
Real Production Output	DUDK	-3.1(5)	-6.2*(1)	✗	D
Producer Price Index	PLLU	-0.66(1)	-3.6*(0)	✓	E
Real Manufacturing Output	DUDM	-1.8(4)	-5.6*(1)	✗	D
Real GDFKF	DFDM	-2.1(3)	-7.2*(1)	✗	D
Real Private FKF	DFDQ	-2.1*(3)	-8.0*(1)	✗	D
Real Fixed Inv in Manufacturing	DFDN	-3.7*(3)	-5.4*(1)	✗	A, B or C
Real Increase in Stocks and WIP	DHBK	-4.6*(0)	N/A	N/A	A
<u>Money Variables</u>					
M0	M0UA	0.27(0)	-5.9*(1)	✓	E (or D)
Notes & Coins	NCUA	0.21(0)	-5.5*(1)	✓	E (or D)
M4	M4UA	-2.35(4)	-4.2*(0)	✗	D
M4 ICCs	M4IUA	-3.2(2)	-4.7*(1)	✗	D
M4 OFIs	M4OUA	-1.7(4)	-3.7*(2)	✗	D
M4 Persons	M4PUA	-0.84(4)	-2.79(1)	✗	F or D
M4 Lending	M4LUA	-2.7(4)	-3.0*(0)	✗	D or F
M4 Lending ICCs	M4LIUA	-2.48*(4)	-4.3*(1)	✗	D
M4 Lending OFIs	M4LOUA	-4.4 (8)	-3.9*(1)	✗	B or D
M4 Lending to Persons	M4LPUA	-0.95(4)	-2.8(4)	✗	F
M4 Lending to Persons for Consumption	M4LCUA	0.42(4)	-4.7*(0)	✓	E
M4 Lending to Persons for House Purchase	M4LHUA	0.21(4)	-1.6*(0)	✓	F
Divisia	I3	-0.84(4)	-4.6*(1)	✓	E (or D)
Divisia, Personal	I15	-0.12(4)	-4.9*(1)	✓	E (or D)
Divisia, Corporate	I17	-2.36(4)	-9.4*(1)	✗	D

<u>Key</u>

* = sig at 95% level.

Table 2: Narrow Money and Aggregate and Disaggregated Activity

Real-Side Variable	M0	Lag	Notes & Coin	Lag
Nominal GDP	2.13*	12CI*	2.99*	12CI*
Real GDP	2.12*	12	2.14*	12
GDP Deflator	2.25*	12CI*	2.68*	12CI*
Retail Sales Volume	3.29*	14	2.58*	12
Retail Sales Value	4.29*	12CI*	3.72*	12CI*
Real Consumption	2.02*	10	2.64*	10
Consumer Price Deflator	1.41	12	1.54	12
Real Durable Consumption	2.19*	9	3.60*	10
Real Non-Durable Consumption	1.20	12	2.82*	8
Manufacturing Industries Output Index	1.64	12	1.29	12
Manufacturing Producer Price Index	3.76*	6	2.89*	7
Production Industries Output	1.41	12	1.00	12
Real GDFKF	1.51	12	1.82**	11
Real Private Sector FKF	1.52	12	1.53	11
Real Fixed Inv in Manufacturing	1.38	12	1.06	12
Real Increase in Stocks & WIP	2.01*	12	1.87**	12

Key

CI = VAR includes Error Correction Term to allow for Cointegrating Relationship.
* = Significant at 5%.
** = Significant at 10%.

Table 3: Broad Money and Aggregate Activity

	M4	Lag	M4 Deposits of ICCs	Lag	M4 Deposits of OFIs	Lag	M4 Deposits of Persons	Lag
Nominal GDP	0.90	12	3.17*	6CI	1.13	11	0.61	12
Real GDP	0.96	12	1.05	12	1.87**	12	1.02	12
GDP Deflator	1.65	11	2.14*	12	2.32*	12	0.43	12

Key

CI = VAR includes Error Correction Term to allow for Cointegrating Relationship.
* = Significant at 5%.
** = Significant at 10%.

Table 4: Broad Money and Disaggregated Activity

Real-Side Variable	M4	Lag	M4s ICCs	Lag	M4 OFIs	Lag	M4 Persons	Lag
Retail Sales Volumes	1.43	12	0.93	12	3.11*	12CI*	1.42	12
Retail Sales Value	1.51	12	1.86*	12	0.92	12	1.68**	12
Real Consumption	1.85**	12	0.58	12	3.02*	12CI*	1.76**	12
Consumer Price Deflator	2.80*	12	2.08*	13	2.02*	11	1.27	12
Real Durable Consumption	1.62	12	1.81**	7CI*	2.31*	9CI**	1.32	12
Real Non-Durable Consumption	2.29*	12	1.47	9	3.85*	10CI*	2.65*	12
Manufacturing Industries Output Index	1.63	12	1.49	12	0.66	12		
Manufacturing Producer Price Index	1.41	12	1.18	12	1.58	10		
Production Industries Output	2.19*	12	2.34*	12CI*	1.13	12		
Real GDFKF	0.83	12	2.34*	8	1.94*	11		
Real Private Sector FKF	1.84**	12	1.72**	13CI*	4.15*	10CI*		
Real Fixed Inv in Manufacturing	0.91	13	2.08*	13CI*	0.81	12		
Real Increase in Stocks & WIP	2.28*	8	2.45*	12	0.88	12		

Key

CI = VAR includes Error Correction Term to allow for Cointegrating Relationship.
* = Significant at 5%.
** = Significant at 10%.

Table 5: M4 Lending and Aggregate Activity

	Nominal GDP	Lag	Real GDP	Lag	GDP Deflator	Lag
M4 lending	1.35	11	1.55	12CI	2.43*	12
M4 lending to ICCs	0.95	12	1.03	12	2.10*	12
M4 lending to OFIs	2.71*	11	1.81**	11	1.12	11
M4 lending to Persons	1.65	12	1.50	12	2.50*	11
M4 lending to Persons for Consumption	1.57	12	1.60	12	1.99**	9
M4 lending to Persons for House Purchase	0.59	12	0.71	12	0.50	12

Key

CI = VAR includes Error Correction Term to allow for Cointegrating Relationship.
* = Significant at 5%.
** = Significant at 10%.

Table 6: M4 Lending and Disaggregations and Disaggregated Activity

Real-Side Variable	M4 Lending	Lag	M4 Lending ICCs	Lag	M4 Lending OFIs	Lag	M4 Lending Persons	Lag	M4 Lending Persons Consumption	Lag	M4 Lending Persons House Purchase	Lag
Retail Sales Volume	0.62	12	1.89**	13CI*	1.10	12	2.91*	8CT*	3.28*	13	0.88	11
Retail Sales Value	1.51	14	1.57	13CI*	1.19	14	1.99*	12	3.31*	12	1.29	11
Real Consumption	1.50	12	1.63	12CI*	3.39*	8	2.23*	8	2.18*	14	1.09	8
Consumer Price Deflator	0.71	12	0.91	12	1.19	11	1.69**	12	3.10*	14	0.71	9
Real Durable Consumption	1.69**	12	1.61	12CI*	2.15*	10	2.29*	11CI*	3.82*	13	1.68	8
Real Non-Durable Consumption	1.42	12	1.10	12	1.61	11	1.56	10	2.15*	14	0.79	10
Manufacturing Industries Output Index	0.96	12	0.41	12	1.48	12						
Manufacturing Producer Price Index	1.59	10	1.37	12	2.86*	10						
Production Industries Output	1.44	12	0.50	12	2.06*	12						
Real GDFKF	0.50	12	0.43	12	1.44	12						
Real Private Sector FKF	0.71	8	1.03	12	1.05	11						
Real Fixed Inv in Manufacturing	0.50	12	0.58	8	0.97	13						
Real Increase in Stocks & WIP	1.28	12	1.49	9	1.95*	13						

Key

CI = VAR includes Error Correction Term to allow for Cointegrating Relationship.
* = Significant at 5%.
** = Significant at 10%.

Table 7: M4 Divisia and Aggregate Activity

	Divisia	Lag	Personal Sector Divisia	Lag	Corporate Sector Divisia	Lag
Nominal GDP	1.42	12	3.37*	12	3.36*	10
Real GDP	1.58	12	3.01*	12	2.92*	13CI*
GDP Deflator	0.90	10	1.04	12	0.89	12CI*

Key

CI = VAR includes Error Correction Term to allow for Cointegrating Relationship.
* = Significant at 5%.
** = Significant at 10%.

Table 8: M4 Divisia and Disaggregated Activity

Real-Side Variable	Divisia	Lag	Personal Sector Divisia	Lag	Corporate Sector Divisia	Lag
Retail Sales Volume	2.22*	13	3.33*	8	1.57	13
Retail Sales Value	0.88	12	2.25*	12	0.90	12
Real Consumption	2.18*	12CI*	0.89	12	1.90**	13
Consumer Price Deflator	1.24	11	1.29	10	0.61	12
Real Durable Consumption	1.83*	11CI*	1.98*	10CI*	1.91*	14
Real Non-Durable Consumption	1.02	11	0.62	12	1.47	12CI*
Manufacturing Industries Output Index	2.85*	8	0.65	12	1.79**	12
Manufacturing Producer Price Index	1.12	7	1.67	12	1.95*	13
Production Industries Output	1.62	10			3.03*	12
Real GDFKF	2.50*	10			2.09**	10
Real Private Sector FKF	1.68	11			1.92**	8
Real Fixed Inv in Manufacturing	1.59	13			3.57*	12
Real Increase in Stocks & WIP	0.83	12			2.72*	9

Key

CI = VAR includes Error Correction Term to allow for Cointegrating Relationship.
* = Significant at 5%.
** = Significant at 10%.

Table 9: RPIX and RPIY Relationships

	RPIX	Lag	RPIY	Lag
M0	3.29*	13	4.75*	10CI**
Notes & Coins	5.20*	13CI*	4.02*	12CI*
M4	1.12	13	0.81	12
M4 OFIs	2.67*	10	0.51	12
M4 ICCs	0.59	12	0.47	12
M4 Persons	2.93*	13	2.29*	11
M4 Lending	1.98**	12	1.00	10
M4 Lending OFIs	2.85*	12	3.38*	13
M4 Lending ICCs	1.70	12	1.10	12
M4 Lending to Persons	1.55	12	0.68	12
M4 Lending to Persons for Consumption	2.30*	12	1.67	12
M4 Lending to Persons for House Purchase	0.75	12	0.92	12
Divisia	1.62	12	2.44*	8
Personal Sector Divisia	2.06*	12	1.98**	8
Corporate Sector Divisia	1.91**	13	3.09*	13

Key

CI = VAR includes Error Correction Term to allow for Cointegrating Relationship.
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Table 10: Selected Out-of-Sample Predictive Failure Tests(1)

Bivariate Relationship	F-Statistic
M0 - Nominal GDP	0.46
M0 - Real GDP	0.76
M0 - GDP Deflator	0.46
M0 - Real Retail Sales	0.77
M0 - Real Consumption	0.21
M4 ICCs - Nominal GDP	0.90
M4 ICCs - GDP Deflator	0.65
M4 ICCs - Production Industries Output	0.20
M4 ICCs - Real Fixed Investment in Manufacturing	0.56
M4 OFIs - GDP Deflator	0.83
M4 OFIs - Real GDP	0.41
M4 Persons - Real Non-Durable Consumption	0.76
M4 Lending to Persons - Real Retail Sales	0.36
M4 Lending to Persons - Real Consumption	0.29
M4 Lending to Persons - Real Durable Consumption	0.27
M4 Lending to Persons for Consumption - Real Durable Consumption	0.82
Personal Sector Divisia - Real GDP	0.38
Personal Sector Divisia - Real Retail Sales	0.39
Corporate Sector Divisia - Real GDP	0.55
Corporate Sector Divisia - Production Industries Output	0.07
Corporate Sector Divisia - Real Fixed Investment in Manufacturing	1.10
M0 - RPIX	0.94
Notes and Coin - RPIX	0.95
M4 Persons - RPIX	1.48
Personal Sector Divisia - RPIX	1.01
M0 - RPIY	0.96
Notes & Coin - RPIY	1.18
M4 Persons - RPIY	0.70
Divisia - RPIY	0.54
Corporate Sector Divisia - RPIY	1.49

(1) Forecast period: 1990 Q1 - 1993 Q3.

Key

* = Significant at 5%.
** = Significant at 10%.

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