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Inflation Targeting in the United Kingdom: Information Content of Financial and Monetary Variables

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Abstract

The main objective of this paper is to identify a set of leading indicators of inflation for the United Kingdom, and discuss the conceptual issues pertaining to inflation targeting. The main conclusions are that narrow money has strong leading indicator properties for inflation, while broad money does not. Long yields appear to have some information for the GDP deflator, and headline inflation, and short yields for underlying inflation. Spreads between commercial paper and gilts, and the yield curve, have very little predictive information on inflation. An interesting conclusion is that while the nominal effective exchange rate is not a good predictor of inflation, the sterling-deutsche mark exchange rate appears to have weak predictive information on the targeted measure of inflation.

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Contents

Summary

This paper identifies a set of leading indicators of inflation for the United Kingdom. Estimates are provided of the information that can be gleaned on future inflation from a variety of financial and monetary variables using nonstructural vector autoregressions. The paper also discusses the conceptual issues pertaining to inflation targeting as background to the empirical work. This includes a discussion of such issues as whether one should target inflation or nominal income, how broad the inflation target should be, and what are the precise mechanisms involved in targeting inflation.

The main conclusions are that narrow money has strong leading indicator properties for inflation, while broad money does not. Long yields appear to have some information for the GDP deflator and for headline inflation, and short yields have information for underlying inflation. The yield curve and spreads between commercial paper and gilts have very little predictive information on the different measures of inflation. One interesting conclusion is that while the nominal effective exchange rate is not a good predictor of inflation, the deutsche mark exchange rate appears to have weak predictive information on the targeted measure of inflation. The implications of these results for the actual conduct of monetary policy are discussed in the final section. In this context, the need for augmenting the information variable approach to the conduct of monetary policy with judgments gathered from "out of model" structural information is noted.

I. Introduction

Soon after sterling was forced off the Exchange Rate Mechanism (ERM) in September 1992, the United Kingdom adopted an explicit policy of targeting inflation as the framework for conducting monetary policy. The targeted measure of inflation is RPIX, defined as retail prices excluding mortgage interest payments. The targeted range, as established initially in October 1992, was for inflation to be in the 1 to 4 percent range, with the additional objective of being in the lower half of the range by the end of Parliament (i.e., by Spring 1997). In June 1995, the inflation target was reformulated as being 2 1/2 percent or less; setting interest rates to achieve this objective would, it was stated, keep actual inflation in the range of 1 to 4 percent most of the time. Inflation targeting has come into prominence in the 1990s. The United Kingdom thus joined New Zealand, which was the first to adopt an explicit inflation target in 1990, and Canada, which adopted it in 1991. Others such as Sweden and Finland have now joined the group whose monetary policy is conditioned by inflation targets.

While inflation targeting in the United Kingdom emerged initially as the immediate response to the aftermath of the ERM debacle, it can be perceived more broadly as an answer to the inadequacies of intermediate targeting strategies. The United Kingdom experimented with a number of intermediate targets for conducting monetary policy in the 1970s and 1980s. Following the abandonment of the fixed exchange rate system in the early 1970s, the United Kingdom adopted targets for broad money, which were expanded in the 1980s to include narrow money as well. Targeting monetary aggregates proved to be of limited success, as rapid financial innovation, just as in many other countries during the 1980s, rendered the relationship between monetary aggregates and various measures of activity tenuous. 1/ The exchange rate assumed greater importance as an indicator of monetary conditions from the later part of the 1980s onwards. Before sterling formally joined the ERM in October 1990, an implicit policy of targeting the exchange rate was carried out in the late 1980s, as in the episode of "shadowing" the deutsche mark at 3 to sterling. Exchange rate targeting, however, came to an end with the suspension of sterling's membership of the ERM in September 1992.

The main objective of this paper is to identify a set of leading indicators of inflation for the United Kingdom. Estimates are provided of the information that can be gleaned on future inflation and activity from a variety of financial and monetary variables using non-structural vector autoregressions. As background to this, the first part of the paper discusses inflation targeting in the context of the conceptual issues thrown up by the recent literature. This discussion also serves to provide the

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1/ See Temperton (1991), Artis and Lewis (1991), and Breeden and Fisher (1994) for detailed discussions on the behavior of monetary aggregates in the United Kingdom.

implicit justification for the econometric methodology used for deriving the leading indicators.

The main conclusions of this paper are that narrow money (M0) has a strong leading indicator property for inflation. Broad money, in contrast, does not appear to have much predictive content for inflation. Long yields appear to have some predictive information on the GDP deflator and RPI (headline inflation), but not for RPIX. Short rates have some information on RPI, and more so for RPIX. Both the spreads and the yield curve have very little predictive information on the different measures of inflation. The nominal effective exchange rate is not a good predictor of inflation, and the sterling-dollar exchange rate even less so; however, the sterling-deutsche mark exchange rate appears to contain weak predictive information on RPIX. The implications of these results for the actual conduct of monetary policy are also examined.

II. Inflation Targets: Conceptual Issues

Should one be targeting inflation at all in the first place? Or, does targeting nominal income, or the price level provide a better framework for conducting monetary policy? The answers to these questions are likely to vary, depending both on the model of the economic process that one uses, as well as the nature of the stochastic shocks that the economy is subject to.

The main conceptual argument for inflation targeting is based on the assessment that while monetary policy can affect real activity in the short run, it cannot do so over the long-run. If this indeed happens to be the case, then monetary policy is better off by targeting the nominal variables that it can influence in the long run. If, in addition, high inflation has costs in the form of more volatile output, it is obviously best to target low inflation. The implicit assumption behind this type of a conceptual framework is that hysteresis effects are not very important in practice. However, when hysteresis effects or path-dependency turns out to be an important feature of the economy, nominal income targeting may prove more advantageous by providing a greater control over the starting point of the long-run dynamics.

A second criterion for choosing between inflation and nominal income targeting can be based on the nature of the shocks that the economy is subject to. A demand shock raises both inflation and output, and the best response in this case is for monetary policy to target inflation. With supply shocks, however, inflation and output are likely to move in opposite directions, and nominal income targeting may prove to be a better strategy for monetary policy. The need for nominal income targeting can, of course, be mitigated to the extent that the inflation target makes special provisions for supply shocks. 1/ One possible way of choosing between inflation and nominal income targeting is to identify the relative importance in practice of supply and demand shocks. One could, for instance, use Blanchard-Quah decompositions 2/ to identify whether supply or demand shocks have predominated over a given history, and choose between inflation and nominal income targeting based on the past history of shocks. However, this still leaves open issues of whether supply and demand shocks can be truly identified, and even if identified correctly, whether past shocks provide information about the future pattern of stochastic shocks.

How broad or narrow should the inflation target be? There is very little that economic theory can offer in the way of precise guidance, other than to state that too wide a range may lack credibility. The desirable range for the inflation target also depends on the way that monetary policy is visualized--whether in the activist framework of being an effective strategy for controlling fluctuations, or in the Friedmanite tradition of avoiding being a cause of fluctuations. 3/ The implicit policy conclusion of the latter perspective is that too narrow a range requires monetary fine-tuning, which has the potential for destabilizing activity. From a practical point of view, however, it is possible to argue that a zero inflation rate may not be optimal, since negative real interest rates may be desirable under certain circumstances--such as in the case of a very deep recession. In addition, factors such as money illusion in the labor market may make the task of implementing a zero inflation target difficult. The United Kingdom has dealt with the problem of choosing a range in a practical way by relating it to forecast errors. The idea being, that if an inflation target of 2 1/2 percent is aimed for, the likely outcome is for inflation to be in the range of 1 to 4 percent. The range itself is seen as a prerequisite for providing a credibility band.

III. Targeting Inflation: The Information Variable Approach

How does one go about the job of targeting inflation? The information variable approach lends itself most naturally as the appropriate framework for conducting monetary policy. The main features of the information variable approach are best understood by contrasting it with the intermediate targeting strategy. 4/ In the information variable approach, the search is for a set of variables that can forecast inflation well, whereas the intermediate targeting strategy calls for the choice of a variable that has a causal relationship with inflation, and which can also

1/ See Fischer (1995) and Hall and Mankiw (1994) for a comprehensive discussion of these issues.

2/ See Blanchard and Quah (1989)

3/ See, in this context, Feldstein and Stock (1994) and Mankiw (1994)

4/ Friedman (1990), Bernanke and Blinder (1992), Friedman and Kuttner (1992), and Woodford (1994) provide interesting discussions of the information variable approach.

be influenced by the instruments at the disposal of the monetary authority. Forecasting power is the most important criterion in the information variable approach, since the instruments under the direct control of the monetary authority impact on inflation only with considerable lags. While it is also necessary for a successful intermediate target to be able to forecast inflation, this is not in itself a sufficient condition, as is the case with the information variable approach. The intermediate targeting strategy is to a large extent conditional on the existence of a stable structural relationship between the intermediate target and the ultimate objective of monetary policy.

The same variable, depending upon the way it is used, can serve either as an intermediate target or as an information variable. The exchange rate, for instance, is an intermediate target under a fixed exchange rate regime, whereas it can serve as an information variable under a floating regime. Again, loosely speaking, monetary aggregates are information variables if the focus is not on the causal relationship between money and activity, but is mainly on whether changes in monetary aggregates predict changes in activity and inflation. To put it in the language of Friedman and Kuttner (1992), as long as movements in money do contain information about future movements in income beyond what is already contained in income itself, monetary policy can exploit that information by responding to observed money growth, regardless of whether the information it contains reflects true causation, reverse causation based on anticipations, or mutual causation caused by some independent but unobserved influence.

The main advantage with the information variable approach is that one can make use of a number of indicators, including non-financial ones, for implementing monetary policy. This is particularly useful when the economy is subject to large structural changes. Variables which cease to predict inflation well can be shed from the information set and, where possible, be replaced by other variables which predict better. The instability in the 1980s between broad monetary aggregates and nominal activity pointed out earlier, can be sorted out in the information variable approach by shifting the focus to a narrower monetary aggregate, if that happens to predict inflation better. It does not matter all that much that broad money should be the more important causal determinant of nominal activity. Similarly, under the information variable approach, one is not committed for credibility reasons to a particular nominal value of the exchange rate, if that rate starts having adverse consequences for the economy. 1/ More generally, given the lack of consensus on the structural properties of the monetary transmission mechanism, the information variable approach may,

1/ See Svensson (1993) and Obstfeld and Rogoff (1995) for interesting discussions of the recent experiences with having the exchange rate as an intermediate target.

paradoxically, provide stronger theoretical underpinnings for the conduct of monetary policy. 1/

At a deeper level, the relationship between the information variable approach and the intermediate targeting strategy is closely tied up to questions about rules versus discretion and the related issues of active versus passive orientation in monetary policy. Intermediate targets correspond most closely to the passive orientation in monetary policy, as for instance, is the case with Friedman's money supply rule. While there are definite feedback rules from indicators on to monetary policy action under the information variable approach, this does not constitute a "rule" in the strict sense of the term. Feedback rules, especially when there are a number of indicators, provide sufficient discretion in practice to the monetary authority in implementing monetary policy. The issue, then, is one of whether rules dominate discretion. The answer very much depends on the policy and institutional settings. As pointed out by Fischer (1990), the traditional argument against the superiority of rules was that any rule which stabilizes the economy, can be simulated by the appropriate discretionary policy. The dynamic inconsistency literature, originating with Kydland and Prescott (1977), resurrected the importance of rules by showing that precommitment could improve the behavior of the economy. However, recent extensions to the Kydland-Prescott model, by invoking the role of reputation in dynamic game theoretical settings, have essentially taken an eclectic position on whether rules dominate discretion in theory. 2/

Given the emphasis on forecasting in the information variable approach, time series techniques in the econometric tradition of Granger and Sims are particularly apt tools that can be utilized in implementing monetary policy. 3/ As pointed out earlier, a full understanding of the structural features of the transmission mechanism is not a necessary condition for targeting inflation successfully. Instead, the need is for identifying a set of indicators that contain information on future inflation. A good way of going about this is by conducting causality tests, variance decompositions, and impulse responses defined over a variety of indicators. Consequently, the empirical approach of this paper is to estimate a series of non-structural vector autoregressions for identifying the leading indicators of inflation.

A note of caution is, however, called for at this stage. There are effective limits on the extent to which one can rely solely on the results

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1/ Mishkin (1995), in his overview of the Journal of Economic Perspectives symposium on the monetary transmission mechanism, notes the large divergences in the literature about the precise channels and the mechanisms through which monetary policy impacts on activity.

2/ See Blinder (1995) for an interesting discussion of these issues.

3/ A useful methodological discussion of these issues can be found in Pagan (1987).

of non-structural vector autoregressions for conducting monetary policy. The first is related to the well known problem of Goodhart's law. A good predictor of inflation may cease to continue to be so if it becomes the explicit object of monetary policy actions. The second is related to the possibility of unstable feedbacks in situations where structural information is ignored altogether in implementing the information variable approach. 1/ For instance, suppose that the treasury bill predicts inflation well, and the operational intervention rate of the monetary authority is increased every time that higher than average treasury bill rates are observed. Then, there is a strong possibility of unstable feedbacks, due to the likely existence of a positive relationship between the intervention rate of the monetary authority and treasury bills. The approach, under these circumstances, is obviously not to ignore judgements gathered from "out of model" structural information in conducting monetary policy.

IV. Implementing the Tests

Following the case made for the use of non-structural vector autoregressions in the conduct of monetary policy, we now implement the empirical tests, in the form of Granger causality and variance decompositions, for deriving the information that financial and monetary variables have on future inflation. The strategy adopted is as follows. First, we start by estimating a series of bivariate Granger causality tests. While these tests do not tell us very much about the structural relationship between the variables tested, they nevertheless provide information on the leading indicator properties of the variables tested, which is really what we are looking for. The estimated equations are of the form:

$$\Delta X_t = \alpha(L)\Delta X_{t-1} + \beta(L)\Delta Y_{t-1} + \epsilon_t \qquad (1)$$

X is the vector of final target variables, which for this exercise are defined as real GDP (denoted as GDP_R in the tables), the GDP deflator (PGDP), the consumer price index (RPI) and the consumer price index, excluding mortgage payments (RPIX).

Y is a vector of indicator variables, which includes narrow money (M0), broad money (M4), M4 lending (M4L), the 25 year commercial paper rate (BI25), 20-year gilts (GB20), 10-year gilts (GB10), the 3-month treasury bill (TB91), the inter-bank rate (IB90), the base rate (LR), the spread between the 25 year commercial paper and the 20-year gilts (25_20), the spread between 10-year gilts and 3-month treasury bills (10_91), the nominal

1/ Woodford (1994) has been a strong proponent of not ignoring structural information in inflation targeting.

effective exchange rate (EE), the sterling-deutsche mark exchange rate (DM), and the sterling-US dollar exchange rate (USD). L is the lag operator. Table 1 provides a more detailed description of all the variables used. 1/

The following set of data transformations were carried out for the estimations. All variables were seasonally adjusted with the exception of the interest rates, the spreads (this refers throughout this paper to the difference between the 25 year commercial paper and 20 year gilts), the yield curve (refers to the difference between 10 year gilts and 3 month treasury bills), and the exchange rates. Except for the interest rate variables, the spread, and the yield curve, all variables are in logs. The sample period is from 1969:2 to 1994:4, except for the 25 year commercial paper which starts in 1970, and the nominal effective exchange rate and RPIX, for which the time series starts only in 1975. Augmented Dicky-Fuller tests, with the appropriate representation of the deterministic trend using the sequential procedure outlined in Holden and Perman (1994), have been used for selecting the order of integration. The results of the unit root tests are presented in Table 2. All variables except for the spreads and the yield curve have been first differenced to take care of stationarity considerations. Since, first differences on the spreads and yield curve are difficult to interpret intuitively, the estimations were carried out in levels; however, for these two variables, the results do not change significantly whether the estimations are conducted in levels or in differences. 2/

F- tests are first carried out for the null hypothesis of the non-Granger causality of the relevant monetary variable, and Table 3 presents the marginal significance levels (p-values) for the bivariate Granger causality tests for lag lengths of 1 to 8. The smaller these values, the stronger is the predictive content of the relevant financial or monetary variable for the particular target variable under consideration.

1/ All tables are provided at the end of the text.

2/ Granger causality tests on first differences, when the levels are co-integrated, is known to result in non-standard limiting distributions (see Dolado and Luetkepohl (1994) and Toda and Phillips (1993)). Toda and Phillips (1994) made a comparative simulation study of the small sample properties of Granger causality tests in levels, differences, and in an error correction model for co-integrated systems. Their findings indicate that in small samples (less than 100), Granger causality tests that explicitly take co-integration into account, could not outperform the conventional tests in levels and first differences, despite the absence of the usual asymptotic distributions. Moreover, there is the additional problem of the arbitrariness involved in choosing between multiple co-integrating vectors for multi-variable Granger causality tests defined over numerous equations. Consequently, the strategy adopted in this paper is to test the robustness of the tests estimated in first differences on the basis of a decision rule outlined later on.

The second set of tests involve the forecast error variance decompositions for bivariate vector autoregressions defined on the target variables and the financial and monetary indicators. The forecast error variance decompositions are calculated using the Choleski procedure for orthogonalizing the VAR innovations, and identification is achieved through Sims' triangular ordering. The VAR is structured such that the financial or monetary indicators are last in order. The results are computed with 6 lags for the bi-variate VAR (the results were not significantly different when the calculations were repeated with 4 and 8 lags). The forecast error variance decompositions for different forecast horizons are presented in Table 4. It follows that the higher these values, the stronger is the predictive content of the relevant financial or monetary variable for the particular target variable under consideration.

The results of the bi-variate Granger causality tests reported in Table 3 indicate that M0 contains a high degree of information on both GDP, and all the different measures of inflation. Both M4 and M4 lending, in contrast, turn out to have very little predictive content for all measures of inflation. All the different long yields--25 year commercial paper, 20 year gilts, and 10 year gilts--have predictive information for the GDP deflator and RPI, but not for RPIX. The short rates, which in this case, includes the base rate, the inter-bank rate, and the 3 month treasury bill, appear to contain some predictive information for RPI, and over longer lags for RPIX. The spread between commercial paper and long gilts has information over longer lag lengths for RPI, but not for RPIX. The surprising finding of the Granger causality tests is that the yield curve (given by the spread between 10 year gilts and 3 month treasury bills) does not have predictive information for all measures of inflation. All three exchange rates--the nominal effective, the deutsche mark, and the dollar--also do not have predictive information for all the different measures of inflation. To sum up, the bi-variate Granger causality tests indicate that M0 has by far the greatest predictive information on inflation.

The bi-variate variance decompositions reported in Table 4 reinforce the findings of the bi-variate Granger causality tests; M0 explains the forecast variance of all measures of inflation well. Again, both M4 and M4 lending have very little predictive information on inflation. As in the case of the bi-variate Granger causality tests, long yields contain predictive information on both the GDP deflator and RPI, but much less so for RPIX. The short rates have some predictive information on the GDP deflator and RPI, and more so for RPIX over longer lag lengths, as in the case of the Granger causality tests. The bi-variate variance decompositions indicate that the spreads and the nominal exchange rates have very little predictive information for all measures of inflation, but the yield curve now has some predictive information on RPIX over longer lag lengths.

The next stage of the exercise is to test the robustness of the bi-variate tests in a multi-variable set up. For the Granger causality tests, this involves estimating the following VARs:

$$\Delta X_t = \alpha(L)\Delta X_{t-1} + \beta(L)\Delta Z_{t-1} + \phi(L)\Delta Y_{t-1} + \epsilon_t \tag{2}$$

Again, X and Y are the vectors of the target and monetary variables respectively. Z is a vector of control variables which are likely to contain information on the target variables. Z is defined as follows. For real GDP it includes the GDP deflator and the terms of trade. For all price variables, it includes real GDP and the terms of trade. In both cases, the terms of trade variable serves to capture the effects of possible real external disturbances. The results of the four variable forecast equations are given in Table 5. The same multi-variable set-up used for the Granger causality tests is also extended for calculating the forecast error variance decompositions. The ordering of these 4 variable VAR's for the multi-variate variance decompositions always places the financial or monetary indicator as the last of the VAR variables in order to preclude biasing the results in favor of these indicators. The exercise is repeated for different lag lengths and the results are presented in Table 6.

The four variable Granger causality tests reported in Table 5 continue to show the strong predictive content of M0 for inflation. However, M4 now has some predictive information for the RPIX over the longer lag lengths, but none for either the GDP deflator or RPI. Long yields once again have information on the GDP deflator and RPI, but not RPIX. Short yields appear to have some predictive information on both RPI and RPIX over some lag lengths. Both the spreads and the yield curve have no predictive information on inflation. The information content of the exchange rates, however, starts to change once real external disturbances are controlled for through the terms of trade variable. While the nominal effective exchange rate has no predictive information for both the GDP deflator and RPI, it appears to have some information on RPIX over some lag lengths. The deutsche mark exchange rate now also has predictive information on RPIX. However, the dollar exchange rate continues to have no information on any of the inflation measures in the multi-variable set-up.

The multi-variate variance decompositions reported in Table 6 pretty much replicate the results of the bi-variate variance decompositions. M0 continues to be a strong predictor of all measures of inflation. Both M4 and M4 lending have very little predictive information on inflation. Again, long yields have predictive information on the GDP deflator and RPI, but not for RPIX. Short yields have relatively strong explanatory power for the forecast error variance of RPI, but less so for RPIX. Both the spreads and the yield curve have very little information on any of the measures of inflation. Both the dollar exchange rate and the nominal effective exchange rate do not appear to contain much predictive information on the different measures of inflation; the deutsche mark exchange rate, however, contains predictive information on RPIX over the longer lag lengths.

We conducted a further set of robustness checks to test the stability of the results reported above. The first is essentially a further extension of the type of exercise already carried out. The multivariate analysis is extended to encompass "blocks" or groups of the financial and monetary indicators; that is, for the Granger causality tests and forecast error variance decompositions, Equation 2 is now estimated by taking each element of the vector Y as a block of variables rather than as a single one. We experimented, for instance, by taking M0, M4 and M4 lending as Block 1; the 25-year commercial paper rate, 20-year government gilts and 10-year gilts as Block 2; the inter-bank rate, the base rate and the 3-month treasury bill as Block 3; and the spread between 25 year commercial paper and 20 year gilts, the spread between 10-year gilts and 3-month treasury bills as Block 4. The results of this exercise largely replicate the earlier ones on the leading indicator properties of financial and monetary variables. In addition, since the results of the forecast error variance decompositions are useful, to the extent to which they do not change when the ordering of the variables in the VAR model are changed, we also experimented by changing the ordering of the financial and monetary variables within the blocks. Again, the results reported earlier appear to be stable. 1/

The second, is a stability test of the Granger causality tests in differences. For the reasons discussed earlier, rather than use an error correction model for co-integrated systems, our approach for testing the robustness of the Granger causality tests in differences is by adopting the following decision rule. The null hypothesis of non-Granger causality is now rejected only if both the first differences and levels reject it for at least half of the calculated lag orders. 2/ The results from this exercise once again indicate that the findings reported in the text are fairly robust; the predictive content of the deutsche mark exchange rate, however, appears weaker than what the tests in first differences alone indicate. 3/

The exercise so far has identified a set of variables that contain information in a statistical sense about future inflation. However, for these variables to be operationally useful as leading indicators, the time dimension matters. That is, we are interested in knowing whether movements in these financial and monetary indicators contain information about inflation sufficiently far into the future, so that policy makers can operationally react to this information in a meaningful way.

1/ Interested readers can obtain detailed tables of the robustness tests from the authors on request.

2/ This strategy is based on our interpretation of the simulation results reported in Toda and Phillips (1994). It appears that combining the results of the tests in first differences and levels as described in the text could reduce the distortions when the tests are carried out sequentially.

3/ Interested readers can obtain detailed tables of this set of tests from the authors.

One way of arriving at judgements about the time dimension of the leading indicators is by estimating impulse-responses, which trace out the time path of the target variable in response to an unit shock to the monetary or financial variables. We take the horizons at which the impulse-response function is statistically significant as providing an approximate measure of the time dimension of the leading indicator.

Charts 1 and 2 1/ show the impulse-response functions for variables which have been pre-selected as leading indicators on the basis of the Granger causality and variance decomposition exercises. Chart 1 shows that the impulse-response function for M0 is statistically significant between 6 and 10 quarters. This in turn can be taken as an indication that movements in M0 contain information on inflation (both RPI and RPIX in this case) between 6 and 10 quarters ahead. This judgement is corroborated independently by cross correlations that we estimated between lagged M0 and inflation (both RPI and RPIX), which shows that the cross correlation coefficient is maximized when the lag on M0 is about 7 quarters. That is, we can infer that M0 contains information about inflation sufficiently far into the future for the policy maker to respond to movements in M0 in a useful way.

The impulse-response functions for long yields are not as statistically robust as in the case of M0. However, the peak of the impulse-response occurs between the 5th and the 6th quarters, and it is statistically significant for RPIX (Chart 1). The maximum of the independently estimated cross correlations between inflation and the long yields is around the 6th quarter. That is, movements in long yields could also provide useful information on future inflation from an operational point of view.

The impulse-responses on short yields are statistically significant in the first three quarters (Chart 2). This implies that the information on future inflation contained in short yields is of too short a horizon for constructing effective feedback rules for policy action, given the considerably longer lags between shifts in monetary policy and subsequent effects on inflation. As will be argued below, there are other reasons as well for not relying very much on short yields as leading indicators of inflation. The impulse-response functions for the deutsche mark exchange rate are not statistically significant over any horizon (Chart 2). This suggests that despite the deutsche mark exchange rate containing some information on future inflation on the basis of the Granger causality and variance decomposition tests, it is not of a form that can provide a systematic feedback rule for policy action.

1/ Charts are found at the end of the paper

V. Summary and Conclusions

All things considered, M0 appears to be the best predictor of inflation in the United Kingdom. In contrast, both M4 and M4 lending do not have much predictive content for any of the measures of inflation. Long yields appear to have some predictive information on the GDP deflator and RPI, but not for RPIX. Short rates have some information on RPI, and more so for RPIX. Both the spreads and the yield curve have very little predictive information on the different measures of inflation. The nominal effective exchange rate is not a good predictor of inflation, and the dollar exchange rate even less so; however, the deutsche mark exchange rate appears to have weak predictive information on RPIX. The strong leading indicator property of the narrow monetary aggregate, in particular, is consistent with previous findings on the U.K. 1/ The impulse-response exercises indicate that both M0 and the long yields contain information on future inflation sufficiently far into the future, so that policy makers can operationally react to this information in a meaningful way. Short yields, in contrast, contain information on inflation in the near future, and the time horizon of the deutsche mark exchange rate is not clearly defined; hence, these indicators are less useful from an operational point of view.

This, then, brings us to the difficult questions: what are the concrete policy implications of these findings? The straightforward one is simply that these results offer the policy maker additional information for the conduct of monetary policy. But how exactly ought the policy maker to make use of this information? Here, as argued in the introductory sections of the paper, one is treading the complex borderline between the purely theoretical implications of the information variable approach, and the practical consequences of pushing it to its logical limits. For instance, the purely logical approach would be to weight the predictive information of the different indicators on the basis of the strength of the Granger causality and variance decomposition results, taking into account the lag structures implied by the impulse-responses, and condition monetary policy actions on this information set. This strategy, however, may give rise to unstable feedbacks in the absence of implicit weightings given to the plausible structural features of the transmission mechanism.

For instance, our results show that the short rates contain predictive information on inflation. However, in addition to the fact that the impulse-responses indicate a short time horizon, this indicator needs to be assigned a lower weight in practice than what the Granger causality and variance decompositions indicate, since the structural information that we know from the term-structure argument tells us that conducting open market operations in response to every change in the treasury bill would be a poor way of targeting inflation. The information content of long yields, in

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1/ A number of studies in the Bank of England (see, for instance, Henry and Pesaran (1993), Breedon and Fisher (1994), and Astley and Haldane (1995)), have all established the strong leading indicator properties of M0.

contrast, is not constrained in the same way. The powerful leading indicator property of the narrow monetary aggregate can also be given plausible structural justifications. While M0 should, on a priori causal considerations, have much less of an impact on inflation than M4, it is possible to conceive of structural stories that justify M0's role as a leading indicator. Breeden and Fisher (1994), for instance, point out that M0's predictive power may arise simply because of its close association with spending. If prices respond slowly to demand shocks, and M0 more quickly, then M0 should be a good leading indicator of inflation.

The exchange rate story emerging from this paper is an interesting one. The first is that, contrary to popular perceptions, exchange rates are not particularly good leading indicators of inflation in the United Kingdom. In this sense, the results on exchange rates are consistent with that of other expectations driven variables such as the yield curve and spreads. Movements in all these variables appear to be dominated by their volatility as asset prices, and consequently, their forecasting power for the real economy appears to be tenuous. Nevertheless, disaggregated estimations show that the deutsche mark exchange rate does contain weak predictive information on inflation. While the deutsche mark exchange rate may be a worthwhile variable to monitor on the basis of this information, it is difficult to derive precise feedback rules for policy action as the inflation forecasting horizon of the deutsche mark exchange rate is neither uniquely nor clearly defined.

Table 1. Variable Definitions and Transformations

GDP_R	Real GDP, expenditure estimate (statistical discrepancy is excluded) in 1990 prices seasonally adjusted by UK authorities	in logs
PGDP	Implicit GDP deflator, 1990 = 100 seasonally adjusted by UK authorities	in logs
RPI	Consumer price index, defined as retail price index (RPI), 1987=100 seasonally adjusted by the authors with Census-X11	in logs
RPIX	RPI excluding mortgage interest payments, 1987=100 seasonally adjusted by the authors with Census-X11	in logs
M0	Sterling notes and coins in circulation outside the Bank of England (BoE) plus Banker's operational deposits with the Banking Department of the BoE, Source: CSO FS table 3.1C, series AVAE. seasonally adjusted by UK authorities	in logs
M4	Sterling notes and coins plus all types of sterling deposits with UK Banks and Buildings Societies, Source: CSO FS table 3.1D, series AUYN seasonally adjusted by UK authorities	in logs
M4L	Sterling lending to the UK private sector, total, Source: CSO FS table 3.1F, series AVBR seasonally adjusted by UK authorities	in logs
BI25	Industrial bond yield - secondary market, 25 years (average of weekly series), Source: WEFA, Intline Data Base, W112RibBCL.W	
GB20	British government securities, long dated bond yield, 20 years, Source: CSO FS table 7.10, series AJLX	
GB10	British government securities, medium dated bond yield, 10 years, Source: CSO FS table 7.10, series AJLW	
TB91	91-day Treasury Bills yield (period average) Source: CSO FS table AJNC, series AUYN	
IB90	Three month interbank interest rate, (period average) Source: CSO FS table 7.10, series AMIJ	
BR	London Clearing Banks Base Rate Source: CSO FS table 7.10, series AMIH	
25_20	BI25 minus GB20	
10_91	GB10 minus TB91	
EE	Nominal effective exchange rate UK, index 1990 = 100 Source: IFS	
DM	Bilateral nominal Deutschmark/British Pound exchange rate	
USD	Bilateral nominal US dollar/British Pound exchange rate	
TOT	Terms of trade (export price deflator (in logs, OECD MEI:112"74__D"Q) minus import price deflator (in logs, OECD MEI: 112"75__D"Q)) Source: WIFO Database	

The series are quarterly time series and the sample ranges from 1969:2 to 1994:4. For IB25 and 25_20 the sample starts 1970:1 and for RPIX and EE the first observations are available 1975:1.

Table 2. Augmented Dickey/Fuller Unit Root Tests

Levels

		trend included					no trend			no constant	
		(-20.7)	(-3.45)	(4.88)	(6.49)		(-13.7)	(-2.89)		(-7.9)	(-1.95)
	k	ρ_τ	τ_τ	Φ_2	Φ_3	k	ρ_μ	τ_μ	k	ρ	τ
GDP_R	7	-15.47	-3.52	8.86	4.82	9	-0.25	-0.27	9	0.03	2.25
PGDP	28	-1.14	-0.81	161.36	55.22	28	-1.09	-2.57	9	0.03	0.57
RPI	31	-0.98	-0.53	150.66	57.39	31	-1.68	-3.32	13	0.02	0.40
RPIX	3	-1.53	-1.81	165.18	51.29	3	-0.74	-2.68	3	0.04	1.52
M0	18	-2.37	-2.84	248.97	83.97	10	-0.66	-3.46	10	0.02	1.39
M4	14	5.28	1.08	289.91	34.45	14	-0.18	-1.41	8	0.04	1.57
M4L	1	-1.52	-1.23	408.74	92.36	1	-0.17	-1.67	1	0.05	2.39
BI25	12	-24.25	-4.08	7.45	11.30	3	-7.55	-2.20	12	-0.16	-0.29
GB20	3	-8.96	-2.46	1.57	2.38	1	-6.09	-1.86	1	-0.29	-0.45
GB10	3	-9.11	-2.34	2.58	3.92	2	-6.78	-1.81	2	-0.26	-0.36
TB91	8	-19.12	-2.93	1.50	2.28	8	-19.22	-3.20	9	-0.55	-0.45
IB90	1	-9.85	-2.41	2.51	3.80	1	-9.95	-2.52	6	-0.77	-0.66
BR	6	-10.28	-1.26	0.25	0.37	16	-12.69	-1.94	16	-0.17	-0.17
25_20	0	-13.02	-2.69	1.41	2.12	0	-11.53	-2.49	0	-2.11	-1.14
10_91	1	-14.18	-2.74	1.68	2.53	1	-11.85	-2.59	1	-9.72	-2.31
EE	7	-14.05	-3.09	2.84	4.28	7	-4.60	-1.25	7	-0.02	-0.26
DM	21	-23.20	-3.86	10.43	12.12	19	-2.63	-1.63	19	-0.93	-2.05
USD	6	-11.14	-2.72	3.18	4.48	6	-5.45	-2.02	7	-0.90	-1.12
TOT	6	-7.27	-2.65	15.40	23.34	6	-5.57	-2.16	6	-4.90	-2.05

1. Differences

		trend included					no trend			no constant	
		(-20.7)	(-3.45)	(4.88)	(6.49)		(-13.7)	(-2.89)		(-7.9)	(-1.95)
	k	ρ_τ	τ_τ	Φ_2	Φ_3	k	ρ_μ	τ_μ	k	ρ	τ
GDP_R	8	-80.29	-3.06	33.31	50.52	8	-80.52	-3.11	9	-36.31	-2.03
PGDP	14	-64.94	-4.35	14.66	22.25	8	-13.69	-1.45	14	-2.84	-0.67
RPI	11	-39.83	-3.55	17.07	25.88	12	-9.79	-1.23	12	-2.90	-0.85
RPIX	2	-30.26	-3.40	7.36	11.08	2	-15.99	-2.59	2	-6.64	-2.03
M0	8	-37.93	-3.46	27.20	41.24	14	-10.67	-1.31	14	-3.93	-1.23
M4	13	-44.71	-2.60	9.87	14.91	14	-24.92	-1.49	7	-3.16	-1.09
M4L	0	-22.91	-3.64	3.42	5.18	0	-19.20	-3.21	0	-4.12	-1.45
BI25	11	-116.30	-3.74	14.28	21.67	11	-96.78	-3.41	11	-96.72	-3.43
GB20	4	-108.96	-5.08	21.31	32.31	0	-84.49	-8.47	0	-84.49	-8.51
GB10	2	-93.54	-5.54	23.42	35.50	1	-100.38	-7.81	1	-100.38	-7.85
TB91	8	-122.85	-4.37	20.83	31.59	8	-108.80	-4.04	8	-108.86	-4.07
IB90	8	-115.58	-4.37	18.34	27.81	5	-80.89	-3.82	5	-80.87	-3.85
BR	17	-182.21	-3.30	21.01	31.90	15	-132.09	-3.21	15	-131.77	-3.23
25_20	0	-107.66	-10.79	36.64	55.53	0	-107.63	-10.84	0	-107.60	-10.90
10_91	6	-119.09	-4.81	22.32	33.85	6	-116.97	-4.77	6	-116.91	-4.79
EE	6	-78.47	-3.71	18.34	27.87	6	-73.97	-3.51	6	-72.76	-3.59
DM	17	-103.08	-2.77	21.39	32.49	17	-85.32	-2.64	17	-41.60	-1.93
USD	6	-66.00	-2.96	18.42	27.93	6	-65.66	-2.96	5	-66.25	-3.25
TOT	4	-59.51	-4.41	14.50	21.97	4	-58.02	-4.35	4	-58.01	-4.37

Lag order selection is based on the Ljung/Box (1979)autocorrelation test. Numbers in parenthesis are 5% critical values for 100 observations.

Table 3. Information Content of Monetary Indicators for Real GDP Growth and Inflation
(Granger Causality Tests of Variables in 1. DIFFERENCES)

Bivariate Prediction Equations for Different Lag Length. Sample: 1973:03 - 1994:04

GDP_R

Lags	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.747	0.452	0.296	0.816	0.764	0.768	0.992	0.815	0.797	0.890	0.069	0.838	0.733	0.552
2	0.854	0.766	0.198	0.519	0.593	0.773	0.999	0.966	0.830	0.770	0.152	0.720	0.928	0.294
3	0.923	0.950	0.297	0.394	0.421	0.554	0.657	0.574	0.436	0.819	0.192	0.667	0.995	0.333
4	0.012	0.961	0.283	0.541	0.613	0.760	0.797	0.772	0.475	0.872	0.289	0.261	0.341	0.502
5	0.026	0.967	0.066	0.458	0.497	0.533	0.199	0.238	0.079	0.393	0.268	0.277	0.294	0.484
6	0.010	0.105	0.065	0.074	0.080	0.080	0.080	0.048	0.134	0.615	0.122	0.350	0.476	0.721
7	0.012	0.030	0.015	0.036	0.091	0.064	0.023	0.024	0.085	0.767	0.121	0.330	0.517	0.600
8	0.018	0.059	0.044	0.066	0.113	0.135	0.046	0.047	0.075	0.178	0.144	0.433	0.630	0.703

PGDP

Lags	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.001	0.778	0.560	0.128	0.332	0.403	0.516	0.548	0.255	0.867	0.316	0.270	0.746	0.540
2	0.010	0.938	0.563	0.001	0.005	0.015	0.509	0.549	0.293	0.066	0.514	0.334	0.740	0.917
3	0.028	0.909	0.224	0.001	0.003	0.012	0.240	0.284	0.142	0.012	0.390	0.478	0.660	0.947
4	0.057	0.792	0.273	0.003	0.008	0.025	0.440	0.504	0.267	0.035	0.295	0.614	0.820	0.976
5	0.017	0.859	0.426	0.002	0.004	0.005	0.045	0.056	0.130	0.071	0.425	0.710	0.595	0.938
6	0.006	0.255	0.281	0.005	0.008	0.009	0.055	0.088	0.114	0.120	0.096	0.797	0.625	0.876
7	0.010	0.122	0.286	0.003	0.010	0.017	0.088	0.129	0.130	0.117	0.082	0.680	0.718	0.672
8	0.007	0.197	0.354	0.005	0.018	0.022	0.118	0.171	0.066	0.115	0.100	0.267	0.729	0.502

RPI

Lags	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.000	0.454	0.247	0.882	0.909	0.866	0.394	0.592	0.039	0.962	0.349	0.255	0.880	0.684
2	0.000	0.278	0.248	0.003	0.022	0.079	0.456	0.657	0.201	0.446	0.249	0.395	0.119	0.844
3	0.000	0.316	0.346	0.005	0.046	0.115	0.376	0.556	0.227	0.066	0.328	0.687	0.212	0.858
4	0.000	0.367	0.515	0.004	0.078	0.158	0.523	0.658	0.274	0.134	0.471	0.548	0.264	0.911
5	0.003	0.667	0.444	0.000	0.003	0.006	0.025	0.025	0.086	0.027	0.751	0.673	0.196	0.788
6	0.000	0.017	0.368	0.000	0.001	0.002	0.013	0.014	0.069	0.022	0.172	0.671	0.402	0.649
7	0.000	0.011	0.382	0.000	0.005	0.006	0.016	0.028	0.124	0.002	0.222	0.780	0.108	0.870
8	0.001	0.024	0.411	0.000	0.006	0.011	0.015	0.022	0.140	0.001	0.005	0.861	0.139	0.840

RPIX

Lags	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.135	0.541	0.075	0.815	0.791	0.696	0.481	0.467	0.199	0.040	0.481	0.212	0.091	0.967
2	0.004	0.109	0.208	0.282	0.379	0.370	0.243	0.228	0.414	0.331	0.374	0.149	0.155	0.979
3	0.015	0.202	0.367	0.375	0.510	0.483	0.145	0.196	0.189	0.433	0.438	0.301	0.318	0.844
4	0.016	0.215	0.477	0.595	0.735	0.718	0.298	0.348	0.363	0.466	0.218	0.186	0.247	0.655
5	0.036	0.229	0.608	0.434	0.359	0.396	0.108	0.106	0.060	0.191	0.245	0.255	0.378	0.784
6	0.001	0.212	0.628	0.380	0.300	0.236	0.039	0.037	0.068	0.187	0.202	0.200	0.416	0.487
7	0.000	0.167	0.415	0.123	0.110	0.188	0.016	0.017	0.042	0.262	0.148	0.062	0.391	0.366
8	0.001	0.284	0.571	0.126	0.147	0.292	0.071	0.073	0.035	0.298	0.204	0.197	0.515	0.607

All series except 25_20 and 10_91 are in first differences. The numbers in the table are marginal significance levels (p-values) of F-tests for the Ho of non-Granger causality of a monetary indicator. For regressions including the series IB25 and 25_20 the sample starts 1972:01 and with RPIX and EE the sample starts 1977:01

Table 4. Forecast Error Variance Explained through Different Monetary Indicators

Bivariate VAR Model in 1. DIFFERENCES of Order 6. Sample: 1973:03 - 1994:04

GDP_R

Steps	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
2	1.62	1.80	4.17	0.14	0.96	1.57	0.11	0.28	0.48	0.44	0.04	0.15	0.11	0.36
4	6.63	2.01	5.70	3.96	4.90	4.56	3.50	4.92	2.76	1.15	1.93	3.18	0.74	2.99
8	11.39	8.25	9.27	9.79	10.84	10.44	9.58	10.72	7.57	3.39	8.84	9.25	5.46	3.18
12	12.04	8.58	11.01	9.83	11.01	10.75	9.83	10.99	8.26	3.74	9.68	9.53	5.68	3.41
24	13.81	9.37	11.63	10.22	11.47	11.10	9.93	11.17	8.39	4.46	9.73	9.57	5.74	3.43

PGDP

Steps	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1.05	0.29	0.07	1.39	1.31	1.30	1.86	1.09	0.57	4.16	0.46	1.20	0.43	0.11
4	8.20	1.45	3.11	22.11	19.69	17.31	6.76	5.53	5.22	6.14	1.84	1.32	2.45	0.10
8	32.70	3.72	6.00	38.09	37.10	36.61	24.86	21.56	12.32	6.48	3.08	1.40	9.36	0.87
12	46.88	8.37	11.52	40.84	39.64	38.59	28.58	24.93	13.69	9.96	8.77	1.28	12.40	1.06
24	51.39	21.41	20.07	41.73	40.72	39.72	29.45	25.78	14.10	11.55	18.53	1.13	13.86	1.16

RPI

Steps	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1.12	0.20	0.01	0.00	0.16	0.45	2.03	0.95	5.42	2.65	1.20	2.61	0.37	0.32
4	22.45	1.20	0.64	22.51	17.87	14.62	6.24	4.57	16.67	9.89	1.90	3.09	1.65	0.63
8	39.46	4.94	4.30	34.56	30.58	29.87	22.57	21.13	26.12	14.15	2.88	4.90	3.71	2.98
12	56.35	8.86	12.77	37.92	33.24	31.41	24.61	23.14	31.53	13.47	7.50	5.34	3.95	3.55
24	64.96	21.11	28.03	39.82	35.54	33.93	27.10	25.56	36.76	12.51	14.72	5.86	4.21	4.36

RPIX

Steps	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	3.12	1.55	2.31	1.36	2.42	3.66	6.79	6.23	3.08	0.27	2.87	0.77	1.66	0.05
4	6.10	2.41	8.43	8.85	0.49	13.37	25.58	24.28	17.87	0.89	12.79	2.53	1.53	0.32
8	23.59	4.45	4.26	15.75	19.86	23.71	42.29	41.21	33.01	5.20	18.67	4.33	2.54	4.46
12	38.22	7.00	16.34	17.05	21.07	24.29	44.92	43.99	37.95	7.05	18.68	4.85	2.48	5.25
24	48.77	16.60	21.99	18.41	22.55	25.57	45.94	45.15	39.55	9.34	21.09	5.31	2.50	6.84

All series except 25_20 and 10_91 are in first differences. The orthogonalization method is Choleski decomposition with the monetary indicator last in the ordering.

Table 5. Information Content of Monetary Indicators for Real GDP Growth and Inflation
(Granger Causality Tests of Variables in 1.DIFFERENCES)

Four Variable Prediction Equations for Different Lag Length. Sample: 1973:03 - 1994:04

GDP_R

Lags	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.200	0.329	0.359	0.588	0.456	0.464	0.905	0.744	0.818	0.845	0.024	0.356	0.894	0.828
2	0.348	0.625	0.266	0.559	0.482	0.590	0.953	0.894	0.565	0.666	0.040	0.900	0.919	0.230
3	0.277	0.860	0.377	0.705	0.612	0.697	0.818	0.750	0.724	0.784	0.039	0.891	0.962	0.373
4	0.028	0.863	0.296	0.835	0.789	0.872	0.871	0.896	0.523	0.837	0.061	0.704	0.124	0.549
5	0.046	0.692	0.245	0.755	0.774	0.775	0.473	0.481	0.189	0.851	0.031	0.611	0.322	0.502
6	0.031	0.075	0.118	0.211	0.143	0.203	0.539	0.362	0.295	0.793	0.077	0.762	0.585	0.748
7	0.022	0.030	0.021	0.231	0.259	0.262	0.394	0.359	0.274	0.961	0.040	0.902	0.757	0.598
8	0.169	0.076	0.003	0.316	0.208	0.397	0.652	0.611	0.140	0.096	0.124	0.832	0.633	0.702

PGDP

Lags	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.002	0.902	0.758	0.276	0.653	0.723	0.802	0.839	0.389	0.945	0.289	0.135	0.826	0.814
2	0.007	0.852	0.739	0.005	0.028	0.066	0.591	0.706	0.414	0.115	0.320	0.245	0.961	0.737
3	0.026	0.965	0.630	0.011	0.017	0.056	0.566	0.608	0.304	0.013	0.408	0.480	0.672	0.361
4	0.018	0.989	0.429	0.054	0.065	0.160	0.335	0.389	0.313	0.114	0.300	0.593	0.604	0.208
5	0.009	0.991	0.536	0.035	0.047	0.076	0.130	0.117	0.136	0.307	0.531	0.745	0.680	0.483
6	0.007	0.831	0.684	0.066	0.053	0.120	0.314	0.332	0.404	0.518	0.474	0.779	0.639	0.560
7	0.001	0.588	0.759	0.054	0.078	0.189	0.459	0.459	0.351	0.513	0.546	0.884	0.690	0.509
8	0.002	0.582	0.674	0.122	0.197	0.299	0.498	0.454	0.315	0.282	0.544	0.614	0.524	0.333

RPI

Lags	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.000	0.555	0.371	0.789	0.900	0.884	0.514	0.715	0.067	0.859	0.560	0.138	0.643	0.611
2	0.000	0.293	0.273	0.013	0.046	0.120	0.425	0.637	0.201	0.443	0.224	0.129	0.163	0.975
3	0.000	0.409	0.499	0.004	0.019	0.036	0.157	0.202	0.422	0.134	0.393	0.226	0.032	0.378
4	0.001	0.168	0.586	0.004	0.060	0.090	0.287	0.344	0.367	0.253	0.523	0.198	0.041	0.468
5	0.011	0.596	0.930	0.000	0.001	0.003	0.090	0.081	0.036	0.229	0.830	0.419	0.058	0.789
6	0.002	0.166	0.846	0.000	0.001	0.002	0.036	0.039	0.004	0.229	0.571	0.549	0.100	0.485
7	0.000	0.090	0.868	0.000	0.002	0.002	0.009	0.013	0.001	0.035	0.583	0.626	0.067	0.652
8	0.004	0.099	0.883	0.001	0.018	0.014	0.031	0.053	0.008	0.150	0.090	0.599	0.024	0.885

RPIX

Lags	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.841	0.673	0.515	0.513	0.581	0.648	0.980	0.707	0.735	0.217	0.154	0.045	0.016	0.965
2	0.001	0.106	0.559	0.192	0.209	0.196	0.142	0.115	0.626	0.442	0.426	0.016	0.006	0.744
3	0.008	0.178	0.686	0.247	0.296	0.275	0.099	0.111	0.446	0.891	0.302	0.047	0.015	0.816
4	0.198	0.034	0.144	0.311	0.343	0.192	0.148	0.064	0.493	0.661	0.330	0.061	0.015	0.852
5	0.130	0.042	0.143	0.329	0.338	0.239	0.165	0.066	0.336	0.742	0.351	0.065	0.024	0.797
6	0.037	0.053	0.186	0.111	0.098	0.042	0.017	0.020	0.197	0.873	0.216	0.005	0.002	0.576
7	0.291	0.021	0.063	0.238	0.369	0.289	0.130	0.208	0.360	0.618	0.465	0.026	0.020	0.369
8	0.593	0.064	0.274	0.403	0.631	0.559	0.379	0.522	0.423	0.528	0.753	0.096	0.035	0.811

All series except 25_20 and 10_91 are in first differences. The numbers in the table are marginal significance levels (p-values) of F-tests for the Ho of non-Granger causality of a monetary indicator. For regressions including the series IB25 and 25_20 the sample starts 1972:01 and with RPIX and EE the sample starts 1977:01 . Each estimated equation contain GDP_R, a price index, the terms of trade and a monetary indicator.

Table 6. Forecast Error Variance Explained through Different Monetary Indicators

Four variables VAR model in 1. DIFFERENCES of order 6. Sample: 1973:03 - 1994:04

GDP_R

Steps	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1.81	2.77	2.36	1.46	3.07	3.48	0.67	1.09	1.15	0.54	0.04	3.19	0.00	0.00
4	5.52	3.13	4.81	2.57	4.57	4.31	2.16	3.21	1.94	0.74	1.77	4.29	0.37	2.05
8	11.45	9.55	8.47	10.75	10.26	9.10	4.32	5.68	4.19	2.98	4.98	5.75	3.54	2.06
12	12.72	10.25	9.28	10.33	9.90	9.04	4.21	5.54	4.08	2.95	5.40	6.00	3.55	2.59
24	13.73	0.83	10.31	10.61	10.12	9.22	4.44	5.98	4.30	3.23	5.83	6.30	3.67	2.61

PGDP

Steps	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.55	0.02	0.08	0.59	0.74	1.09	3.32	2.35	1.63	0.99	1.67	0.00	0.00	0.52
4	10.58	0.14	4.09	9.79	9.61	8.66	7.66	5.78	6.86	1.52	1.71	0.92	0.10	1.52
8	28.92	3.80	3.62	9.18	10.17	11.95	17.14	14.20	9.53	4.10	2.77	2.55	0.90	9.93
12	40.99	10.67	7.61	10.80	12.02	14.48	21.87	18.61	11.83	6.64	4.65	5.83	0.92	11.94
24	43.37	25.86	23.35	11.82	12.76	15.45	23.21	19.96	12.79	7.96	8.32	5.70	0.84	11.69

RPI

Steps	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.42	0.17	0.78	0.08	0.15	1.01	8.47	5.03	17.42	0.06	5.66	0.21	0.11	0.39
4	20.14	4.02	3.07	14.98	13.07	14.02	14.89	10.26	23.11	0.59	4.71	0.19	1.08	0.74
8	35.85	6.19	3.56	12.24	10.90	13.17	20.29	15.79	21.06	3.10	4.48	0.54	1.66	6.87
12	48.90	13.61	9.88	13.09	12.49	15.89	24.48	19.49	23.98	4.22	5.94	2.59	1.47	8.83
24	51.16	29.08	29.53	12.55	12.74	16.66	26.54	21.54	25.42	5.96	8.92	2.56	1.22	8.93

RPIX

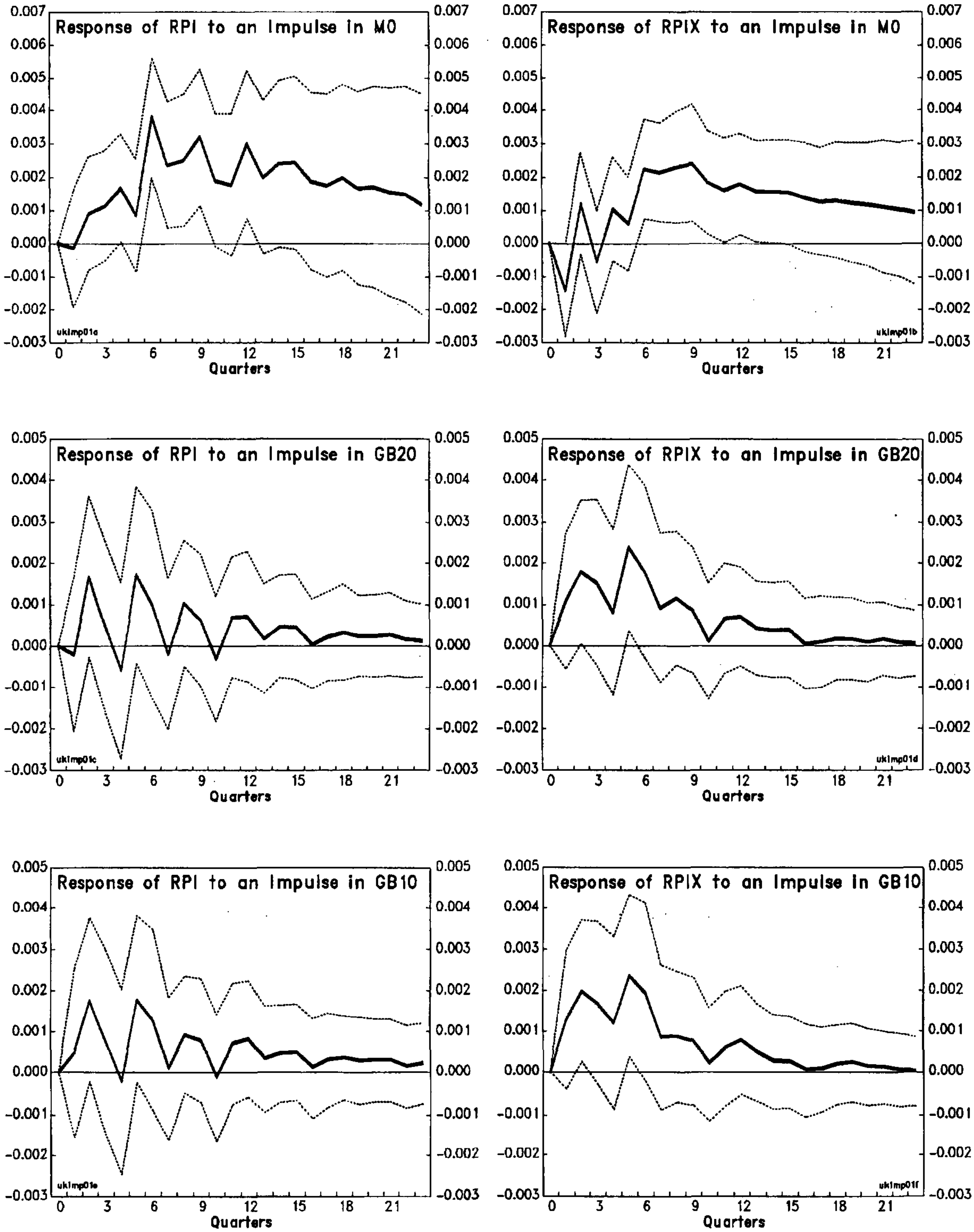
Steps	M0	M4	M4L	BI25	GB20	GB10	TB91	IB90	BR	25_20	10_91	EE	DM	USD
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.68	4.17	1.01	0.39	0.92	0.89	3.82	3.11	2.54	0.89	0.85	0.05	1.16	0.89
4	4.76	3.43	3.48	3.00	3.15	3.68	9.14	7.93	6.13	0.76	4.12	1.24	2.48	0.87
8	13.72	4.11	12.74	3.73	5.23	6.47	13.62	12.19	13.76	2.51	6.15	2.63	6.65	0.81
12	30.68	3.80	15.48	3.34	4.45	5.31	11.67	10.33	15.96	3.10	8.32	3.66	12.19	0.87
24	38.42	5.34	17.79	3.30	4.69	5.57	11.29	9.87	16.49	4.08	13.47	4.67	16.23	1.32

All series except 25_20 and 10_91 are in first differences. The orthogonalization method is Choleski decomposition with the ordering: GDP_R, price index, TOT and a monetary indicator variable. For regressions including the series IB25 and 25_20 the sample starts 1971:03 and with RPIX and EE the sample starts 1976:03 .

CHART 1
UNITED KINGDOM

IMPULSE RESPONSES 1/

(Bivariate VAR model with lag order 6)



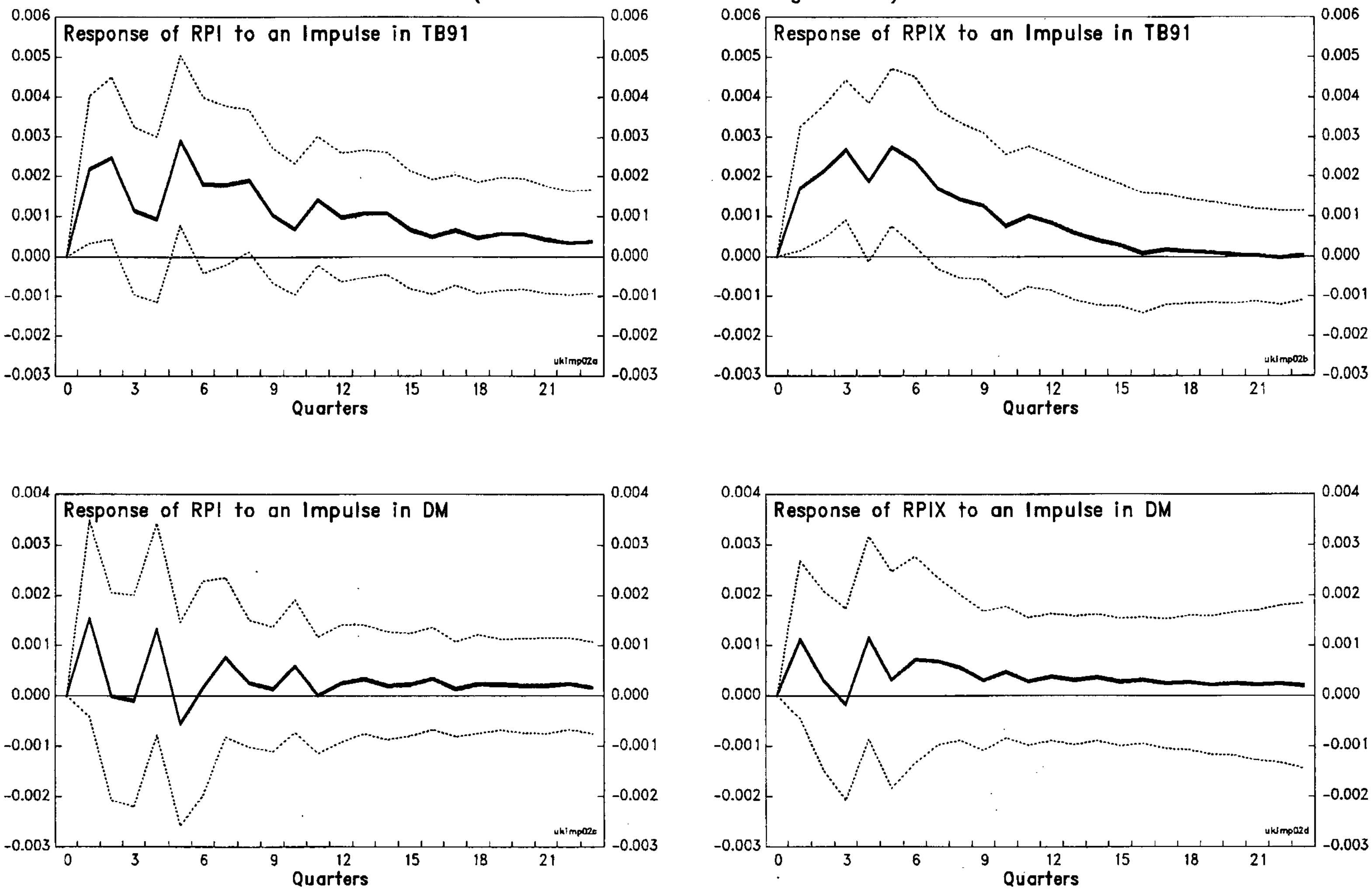
Source: Staff calculations.

1/ Dotted lines denote standard errors.

CHART 2
UNITED KINGDOM

IMPULSE RESPONSES 1/

(Bivariate VAR model with lag order 6)



Source: Staff calculations.

1/ Dotted lines denote standard errors.

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