ARTICLES

INTERPRETING MONETARY DEVELOPMENTS SINCE MID-2004

Monetary analysis constitutes one of the pillars of the ECB's monetary policy strategy. A thorough analysis of monetary trends helps to identify at an early stage shifts in underlying inflation dynamics and thereby provides relevant information for policy decisions aimed at the maintenance of price stability. While interpreting monetary developments, it is important to distinguish short-term "noise" in the monetary data from the policy-relevant "signal" embodied in the persistent monetary trends. To meet this challenge, the analytical framework underpinning the ECB's monetary analysis has been extended and deepened. This framework extends well beyond a comparison of annual M3 growth with the ECB's reference value for monetary growth, to embody an analysis of the components, counterparts and sectoral composition of M3, as well as developments in other monetary and credit aggregates. This article offers an insight into some of the tools and frameworks used to conduct monetary analysis at the ECB. It does not address the issue of how the policy-relevant signal from this analysis interacts with that from the economic analysis in the context of the ECB's monetary policy strategy.

From mid-2004 onwards, the underlying rate of monetary expansion in the euro area has trended upwards. This is reflected in the annual growth rate of the broad monetary aggregate M3, which rose from around 5% in early 2004 to more than 10% in the first quarter of 2007. While careful interpretation of the figures is required, other indicators also point to rapid monetary and credit expansion over this period: the annual growth rate of loans to the private sector rose significantly from early 2004 to attain double digit rates, while annual M1 growth remained close to 10% throughout 2004 and 2005 before moderating in 2006.[1]

By contrast with the previous experience of strong M3 growth in the euro area between 2001 and 2003 (which was viewed rather benignly in terms of the inflation outlook), the increasing pace of monetary expansion since mid-2004 has been interpreted as signalling progressively rising upside risks to price stability over the medium to longer term. In line with the ECB's monetary policy strategy, as this assessment became firmer during the course of 2005, monetary developments contributed to the Governing Council's decision in December 2005 to commence withdrawing monetary policy accommodation by raising the key ECB interest rates. Despite rising short-term interest rates since late 2005, annual M3 growth has strengthened over the past eighteen months, largely because of strong demand for the shorter-term marketable instruments included in M3, which itself was stimulated by higher short-term interest rates and the resulting flatter yield curve. However, other monetary indicators – notably the growth rates of M1 and household borrowing – have moderated as the impact of higher interest rates has taken hold.

This article reviews the key features of monetary developments in the euro area since mid-2004, offers various explanations for them – focusing on the impact of the historically low level of nominal interest rates seen in this period – and describes how an assessment of their implications for the outlook for price developments was made in real time by ECB staff.

1 INTRODUCTION

Since mid-2004, the rate of monetary expansion in the euro area has risen significantly. This is illustrated by developments in the annual growth rate of the broad monetary aggregate M3, which rose from slightly below 5% in March 2004 to more than 10% in March 2007. Broadly speaking, other monetary indicators – such as the growth of MFI loans to the private sector and M1 dynamics – support the picture of vigorous monetary expansion during most of this period.

In line with the ECB's monetary policy strategy, these monetary trends have been carefully analysed to extract the information they contain about the outlook for price developments over the medium to longer term. Such information is

1 The latest observation for monetary data in this article is the first quarter of 2007 and for real variables the fourth quarter of 2006.

relevant for the design and implementation of a monetary policy aimed at the maintenance of price stability. On the basis of its monetary analysis, since late 2004 the Governing Council has identified growing upside risks to price stability. As this interpretation firmed in the course of 2005 in a context of rapid and increasing rates of monetary expansion, monetary developments ultimately contributed to the Governing Council's decision in December 2005 to commence withdrawing monetary policy accommodation by raising key ECB interest rates.

More specifically, the monetary analysis helps to identify medium to longer-term trends in inflation that are used to cross-check the assessment of short to medium-term risks to price stability obtained from the ECB's economic analysis. Such an approach is based on the well-established empirical relationship between the underlying trends in monetary growth and inflation, which has been found to be robust across time, across countries and across different monetary policy regimes. Box 1 describes some aspects of how this key empirical relationship is exploited in practice in the ECB staff's regular monetary analysis.

Against this background, Section 2 describes recent monetary developments in depth, emphasising how superficially similar growth rates of the broad aggregate M3 may be associated with significant differences in the nature of monetary expansion. Section 3 offers an explanation of monetary developments between mid-2004 and the end of 2005, focusing on the impact of the historically low level of interest rates observed over this period. Section 4 discusses how this underlying analysis has been used to develop policy-relevant conclusions. In conclusion, Section 5 describes and explains the evolution of monetary developments since early 2006, discussing the impact of increases of key ECB interest rates over that period.

In addressing these questions, the article serves two purposes. First, it provides an opportunity to illustrate the breadth and depth of the tools and frameworks used by ECB staff when undertaking the real-time monetary analysis, thereby serving the goal of transparency. In particular, it demonstrates how existing tools have evolved and new tools have been developed to confront the practical challenges of monetary analysis over the past few years. Second, the article offers an opportunity to update the description of monetary developments and their analysis that was previously presented in the article entitled "Monetary analysis in real time", published in the October 2004 issue of the Monthly Bulletin.

Box 1

SHORT AND LONG-TERM CAUSALITY OF M3 TO INFLATION IN THE EURO AREA

There is widespread consensus that monetary growth and inflation are linked over the longer term. In recent literature, this link has been expressed as a relationship between the "low frequency component" of monetary growth and that of inflation.[1] In this context, the low frequency component should be understood as the more persistent or trend-like movements in these time series that remain once the short-term volatility is filtered out. A simple way to smooth out the series to recover these low frequency components is to take a moving average over several quarters. The question remains of whether this relationship can be made operational for monetary policy purposes. One aspect of this question is whether monetary developments

1 See, for example, K. Assenmacher-Wesche and S. Gerlach (2006), "Interpreting Euro area inflation at high and low frequencies", BIS working paper.

lead or cause inflation, in the sense that the low frequency component of money helps to predict future inflation by providing information beyond that already contained in lagged inflation (i.e. relative predictability). If this is the case, a number of corollary issues arise: what is the horizon at which monetary developments offer most information about inflation? How much "smoothing-out" of the time series is required (i.e. how long should a moving average be taken) to construct the trend series? These are empirical issues that can only be addressed by studying the data.

Reichlin and Lenza[2] (2007) address these empirical questions by employing a simple bivariate model that explains a moving average of inflation on the basis of its quarterly lags and those of quarterly M3 growth. This model encompasses those employed by ECB staff when constructing money-based inflation indicators. Relative predictability of M3 to inflation is assessed by comparing the (in and out-of-sample) fit of this model with that obtained by fitting inflation exclusively by its own lags (i.e. a benchmark autoregressive model). If the bivariate model fits inflation better than the autoregressive, then M3 is said to Granger-cause inflation in sample. The empirical analysis is based on euro area quarterly data on M3 and HICP inflation from 1971 to 2005.

Two in-sample exercises are carried out. First, the effect of different forecast horizons and degrees of smoothness of inflation on the causality of M3 to inflation is measured in isolation; then, the forecast horizon and the length of the moving averages of inflation being predicted are set equal and the evolution of causality of M3 to inflation is evaluated when both vary at the same time.

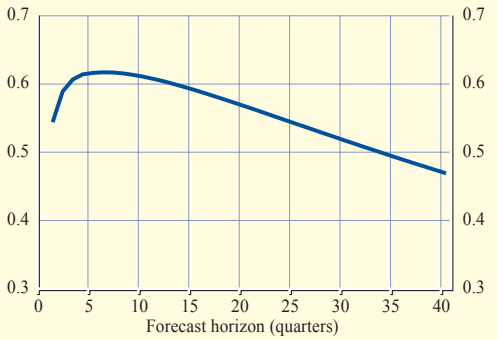
The first set of exercises shows that: (i) the longer the forecast horizon, the less M3 helps to predict inflation beyond an autoregressive model; and (ii) the longer the moving average of inflation being predicted (i.e. the greater extent to which inflation is smoothed), the more M3 provides information about future inflation beyond an autoregressive model.

The second set of exercises shows that the relative predictability of M3 growth for smoothed inflation displays an inverted U-shape (with a peak between four and ten quarters) (see Chart A). At shorter horizons/length of the moving average, the beneficial effect of increasing the degree of smoothness of inflation prevails over the cost of increasing the forecast horizon. However, as the horizon lengthens the latter eventually outweighs the benefits of increasing the degree of smoothness, thereby creating the inverted U-shape. Relative predictability is (approximately) maximal for the forecast horizons and the length of the moving averages chosen by the ECB in the context of the monetary analysis.

The evidence presented above is in-sample. However, for policy purposes it is desirable that M3-based indicators of future inflation provide a reliable signal out-of-sample since analysts, in real time, cannot rely on the information from the full sample. Reichlin and Lenza (2007) undertake an out-of-sample evaluation of twelve-quarter ahead M3-based indicators for the twelve-quarter moving average of inflation. At each period, such indicators are derived using only that portion of

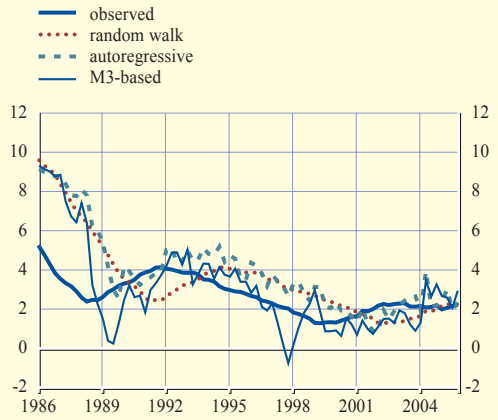
2 L. Reichlin and M. Lenza (2007), "On short-term and long-term causality of money to inflation: understanding the problem and clarifying some conceptual issues", available at www.ecare.ulb.ac.be/ecare/people/members/reichlin/reichlin.html

Chart A An in-sample measure of relative predictability of M3 to inflation



Source: ECB estimates.
Note: The vertical axis shows the value of the Granger-causality measure of monetary growth to inflation, i.e. a measure of the relative predictability. Higher values indicate a higher relative benefit from adding money growth to a model of inflation.

Chart B Out-of-sample forecasts of the twelve-quarter moving average of inflation, 12 quarters ahead



Source: ECB estimates.

the sample available at the time the indicator was produced and span the evaluation sample extending from the first quarter of 1986 to the fourth quarter of 2005.[3] Chart B portrays observed inflation (thick blue line), the bivariate M3-based inflation indicator (thin blue), a forecast of inflation only based on inflation lags (green dashed) and, finally, the random walk forecast of inflation (red dotted) predicting that inflation in the subsequent twelve quarters is equal to the last twelve-quarters moving average of inflation observed in sample. The latter is a benchmark of (relative) non-forecastability: if it turns out to outperform all the indicators based on more sophisticated models, one can conclude that inflation is hard to forecast.

Chart B reveals that M3 adds information to inflation lags, since M3-based inflation indicators are generally closer to observed inflation than the forecasts exclusively based on inflation lags. Also, on average, M3-based inflation indicators track observed inflation better than the random walk model. M3-based inflation indicators are affected by occasional but persistent episodes of volatility. Reducing this volatility through filtering the M3 series on the basis of off-model information derived from a detailed analysis of the monetary data is a key element of the real-time monetary analysis in practice, and leads to improved performance of the money-based indicator.[4] In the past few years M3-based indicators did not outperform the random walk model. In this respect, money-based indicators are no different from a broad variety of other economic and financial indicators of future inflation, since the predictability of inflation in many countries, including the euro area, has declined significantly in recent years due to the stability of inflation patterns.[5] To the extent that this low level of inflation as well as its low volatility

3 Notice, however, that data are revised as of the fourth quarter of 2005, hence the exercise is only pseudo-out-of-sample.
4 For the description of the methods to correct monetary series employed at the ECB and a real-time evaluation of the forecasting performance of the indicators of future inflation extracted by these methods, see B. Fischer, M. Lenza, H. Pill and L. Reichlin (2006), "Money and monetary policy: the ECB experience 1999-2006", forthcoming in A. Beyer and L. Reichlin (eds.), *The role of money: money and monetary policy in the 21st century*.
5 Fischer, Lenza, Pill and Reichlin (2006), B. Hofmann (2006), "Do monetary indicators (still) predict euro area inflation?", Deutsche Bundesbank Discussion papers, Series 1: Economic studies, No. 18/2006, and M. Lenza (2006), "Does money help to predict inflation in the euro area", available at http://student.ulb.ac.be/~mlenza/

are in part due to the improved effectiveness of monetary policy in maintaining price stability, it suggests that the results of these simple models should be referred to as money-based indicators rather than money-based forecasts.

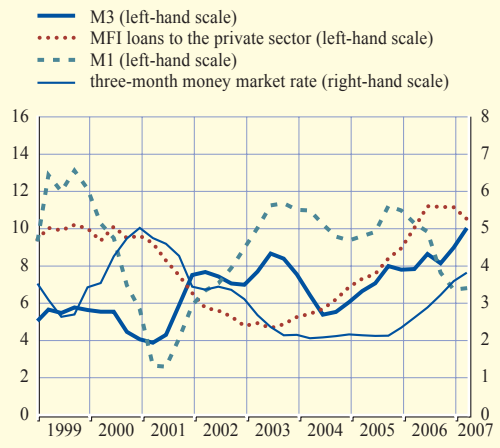
2 MONETARY DEVELOPMENTS SINCE MID-2004

Since mid-2004, monetary dynamics in the euro area have strengthened, reaching very vigorous rates by historical standards. This is illustrated by the annual growth rate of the broad monetary aggregate M3, which has followed an upward trend over the period (rising from just below 5% in early 2004 to more than 10% in early 2007). The March 2007 figure of 10.9% was the highest annual growth rate of M3 observed since the start of Stage Three (see Chart 1).

However, in forming a comprehensive view of monetary developments, it is crucial to adopt a broad-based approach rather than rely solely on the evolution of a single monetary aggregate or measure of liquidity. This implies making an assessment of developments in other monetary indicators, such as the components and counterparts of M3.

Chart 1 Monetary aggregates, MFI loans to the private sector and short-term interest rate

(annual percentage changes; adjusted for seasonal and calendar effects; percentages per annum)



Source: ECB.
Note: The quarterly figures are calculated on averaged monthly index series.

For example, the annual growth rate of the narrow aggregate M1 (which consists of currency in circulation and overnight deposits, the two most liquid components of M3) exhibits a somewhat different pattern, closely mirroring developments in short-term interest rates. In mid-2004, M1 was already growing at more than 10% on an annual basis and rates of broadly this magnitude persisted throughout the period of historically low interest rates in the euro area until end-2005. As short-term interest rates rose in 2006, the annual growth rate of M1 moderated, albeit still remaining at the robust rate of around 7% in early 2007.

As regards credit expansion, the strengthening of annual M3 growth since mid-2004 has been paralleled by an acceleration of the demand for MFI loans to the private sector (the main counterpart to M3 on the asset side of the MFI balance sheet).[2] Private sector borrowing trended upwards throughout 2004 and 2005, peaking at close to 12% in mid-2006. However, as the impact of higher short-term interest rates has taken hold, the growth of MFI loans to the private sector has moderated somewhat as from the second half of 2006, albeit still remaining at double-digit rates.

The constellation and explanation of monetary and credit dynamics between mid-2004 and late 2005 differ from those of the previous period of strong M3 growth in the euro area between mid-2001 and 2003.[3] In particular, the relationship between M3 growth and the evolution of MFI loans to the private sector is quite different. In the earlier episode, strong

2 Euro area MFIs are "monetary financial institutions", the money-creating sector in the Eurosystem's statistical framework. This sector consists of the ECB, national central banks, credit institutions and money market funds.

3 For an analysis of the differences between the two periods, see Box 1 entitled "The changing nature of strong monetary dynamics in recent years" in the ECB Annual Report 2005.

M3 growth was associated with weak private sector borrowing. Fragile business and household confidence in the aftermath of a sharp fall in equity prices and the terrorist attacks of 2001 led to caution in taking loans, but a greater desire for safe and liquid monetary assets. Money and credit growth therefore moved in opposite directions. By contrast, since 2004 the exceptionally low level of interest rates and latterly the strengthening of economic activity has led both to a renewed demand for money for transactions purposes and to an increased appetite to borrow to finance spending and investment. Therefore, as illustrated in Chart 1, monetary growth and credit expansion have increased in parallel.

The view that monetary dynamics since mid-2004 are different in nature from those seen between 2001 and 2003 is supported by a more detailed assessment of the components and counterparts of M3. Such an exercise is one of the main elements of the real-time analysis conducted by the ECB staff and underpins the interpretation of recent developments.

For example, between 2001 and 2003 the dynamism of M3 was driven by the very strong expansion of "marketable instruments" (see Chart 2).[4] This component of M3 includes instruments – such as money market fund shares/units – that are used to "park" savings in a safe and liquid form at times of heightened uncertainty, as the switching costs from alternative non-monetary instruments are relatively low. By contrast, between mid-2004 and end-2005, M3 growth was mainly driven by high M1 growth. Monetary expansion during the latter period was thus much more liquid in nature than during the former period.

With the increase in short-term interest rates since late 2005, M1 growth has moderated somewhat. At the same time, higher short rates have also led to a flattening of the euro area yield curve, which has increased the attractiveness of short-term time deposits included in M3 (whose remuneration closely follows short-term market rates) relative to longer-term assets outside M3. Moreover, the annual growth of short-term debt securities in M3 increased substantially in late 2006, as investors held these instruments for portfolio management reasons, so as to avoid the capital risk incurred in holding fixed-income securities of longer maturity at a time of possible further increases in interest rates. The increase in market interest rates has thus led to substitution within and into M3 during 2006 and early 2007, rather than to outflows into alternative assets outside M3.

The different forces driving M3 growth between 2001 and 2003 and since mid-2004 are also reflected in the pattern of sectoral money holdings (see Chart 3).[5] In the former period, heightened financial market volatility led to sharp increases in household money holdings, as small investors sought a safe haven from that volatility. At a later stage, non-financial and financial corporations increased their money holdings as well. By contrast, during the latter period households increased their money holdings more slowly, albeit steadily, suggesting the driving factors were not sudden shocks but rather underlying trend developments. Moreover, between mid-2004 and 2006, the M3 deposits of non-financial corporations and, in particular, non-monetary financial intermediaries other than insurance corporations and pension funds (i.e. other financial intermediaries or OFIs) grew strongly.

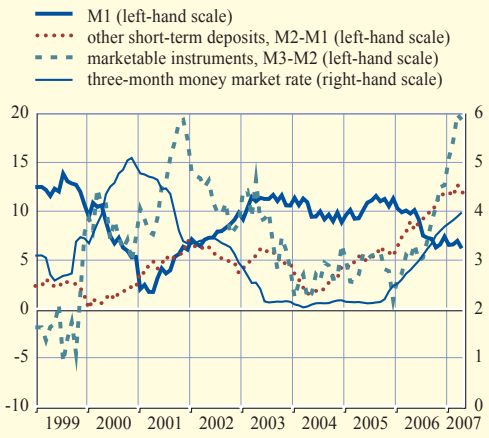
Indeed, the increase in OFI deposits made a particularly substantial contribution to the strong rise in M3 growth between 2005 and 2006. In general, this money-holding sector is characterised by a volatile and very strong cyclical money-holding pattern, which makes it more difficult to extract the underlying trend in real time. The analysis of OFI deposits is further complicated by the fact that the money holdings of this sector are often not directly linked to

4 These consist of: debt securities issued by MFIs with an initial maturity of up to two years; money market fund shares/units and repurchase agreements of MFIs with the money holding sector.

5 Chart 3 shows developments by sector in M3 deposits plus repurchase agreements, the largest aggregate for which official information on holding sectors is available.

Chart 2 M3 components and short-term interest rate

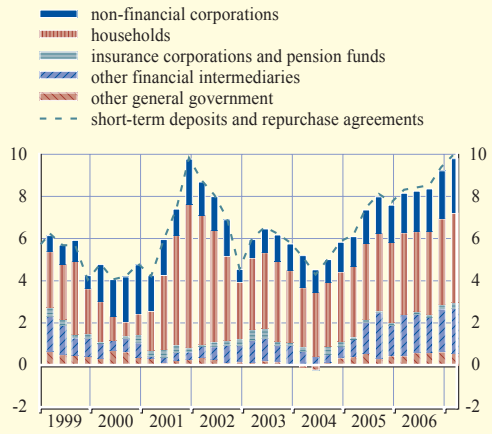
(annual percentage changes; percentages per annum)



Source: ECB.

Chart 3 Contributions to the annual rate of growth of short-term deposits and repurchase agreements

(percentage points; annual percentage changes; not adjusted for seasonal and calendar effects)



Source: ECB.
Note: Data by reporting sector before 2004 are estimates.

output and consumer prices, but rather to financial transactions that are likely to have their first impact on asset prices.

A detailed analysis of the composition of loans to the private sector also confirms and strengthens the view that the two recent periods of strong money growth are different in nature. Increases in money holdings between 2001 and 2003 took place in a context of declining growth in loans to households and non-financial corporations. By contrast, the broad-based nature of increases in M3 growth since mid-2004 is reflected in increases in loan growth for all purposes and across all maturities.

The breakdown of MFI loans to households shows that the growth of consumer loans declined between 2001 and 2003, reflecting declining consumer confidence, rising unemployment and weaker income growth. At the same time, the expansion of loans for house purchase moderated (see Chart 4). Between 2004 and mid-2006, the annual growth rate of consumer credit quadrupled, mirroring increases in confidence and spending. Loans for house purchase also increased steadily, reaching very high levels in 2006. Following the increases in interest rates from December 2005, loan demand for households slowed somewhat, while nonetheless remaining at vigorous rates through early 2007.

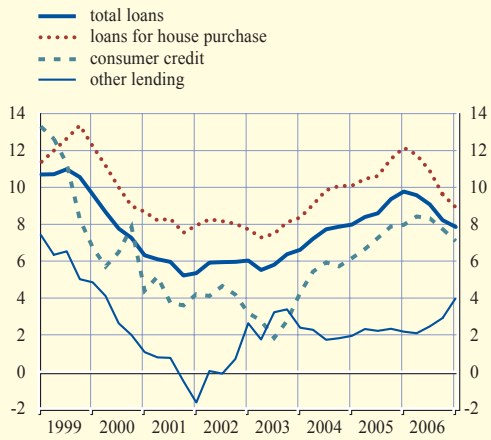
A similar picture is obtained when looking at the demand for MFI loans by non-financial corporations broken down by maturity. During the first period of strong money growth, credit expansion declined at all maturities. By contrast, since 2004 corporate borrowing has strengthened steadily, with the largest increases occurring at shorter maturities (see Chart 5). Only in the most recent data has corporate borrowing shown some signs of moderation in the face of higher short-term interest rates. The slower response of corporate borrowing to higher rates is in line with historical regularities, which suggest that turning points in the demand for loans by non-financial corporations lag those observed in household borrowing.[6]

As the preceding discussion demonstrates, the similarity of headline M3 dynamics during the two recent episodes of strong M3 growth

6 See Box 6 entitled "The cyclical pattern of loans to households and non-financial corporations in the euro area" in the June 2007 issue of the Monthly Bulletin.

Chart 4 MFI loans to households

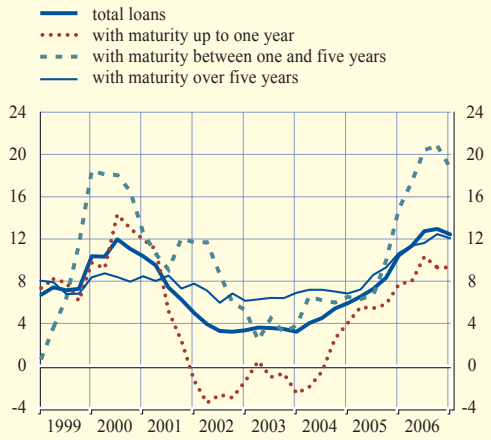
(annual percentage changes; not adjusted for seasonal and calendar effects)



Source: ECB.

Chart 5 MFI loans to non-financial corporations

(annual percentage changes; not adjusted for seasonal and calendar effects)



Source: ECB.

obscures divergent developments in the evolution of components, counterparts and sectoral holdings. The real-time analysis of monetary developments conducted by ECB staff has identified these differences and thus offered distinct explanations for M3 growth, with potentially different monetary policy implications.

With the benefit of hindsight, various econometric models have been developed at the ECB which serve to deepen and extend this analysis. Box 2 describes one such analysis based on a dynamic stochastic general equilibrium (DSGE) model of the euro area. This model is used to decompose developments in M1 and M3 into the contributions stemming from the evolution of a number of economic shocks which are identified by the model.

In line with the conclusions drawn from the real-time analysis, this model-based decomposition suggests that quite different forces underlay strong monetary growth between 2001 and 2003, and have done so since 2004. In particular, the former episode was associated with increases in the liquidity preference of money holders, whereas the latter episode has been driven, inter alia, by the low level of short-term interest rates (reflecting the accommodative stance of monetary policy).

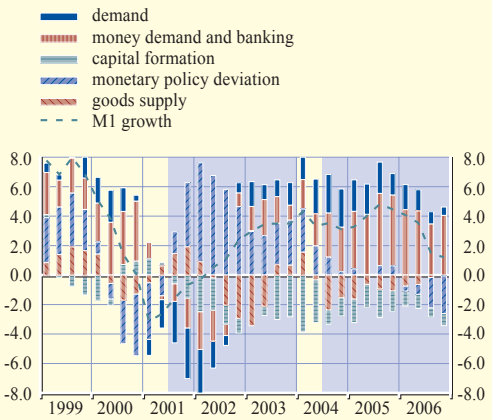
Box 2

A STRUCTURAL DECOMPOSITION OF MONEY GROWTH

As is the case for all macroeconomic variables, monetary aggregates vary over time as a consequence of a host of fundamental forces. Some of these originate in the financial system, such as changes in the way monetary transactions are conducted and innovations in banking services. Others exert an indirect impact on money through the effect that they have on macroeconomic variables, such as income, consumption and inflation, which are important determinants of money demand. Shocks to productivity or consumer confidence are a case in point. Changes in the preference for liquidity by money holders represent another driving force.

Chart A Decomposition of real M1 growth

(annual percentage changes; percentage points)



Source: ECB calculations.
Note: Annual (year-on-year) per capita real M1 growth rates in deviation from the model's mean, which is 3.5%. The deflator used is the GDP deflator.

In order to measure the contribution of each of these forces to the observed developments in money, one needs to use a structural model where the impact of shocks of different nature and source can be identified and quantified. These shocks influence consumption, investment and financial decisions. This box employs a structural dynamic stochastic general equilibrium (DSGE) model with financial frictions and an explicit banking sector to conduct such an exercise, recognising that the results obtained are specific to this modelling framework.[1] While rich in structure, such models remain stylised and cannot fully capture all factors behind money growth. For example, the model employed omits the external dimension of monetary developments. Nonetheless, the exercise serves to complement the real-time monetary analysis described in the main text.[2]

In a DSGE model, the response of monetary policy to economic and monetary developments needs to be spelled out explicitly in the form of a simple estimated "reaction function", which links short-term interest rates to a number of endogenous variables, notably inflation, output and money growth. In reality, such a rule cannot account for the complexity of the monetary policy-making process. "Shocks to monetary policy" thus are introduced, which close the gap between the prediction for the policy rate implied by the reaction function and the observed rate. If interest rates are lower than predicted on the basis of the simple rule embedded in the model, this will show up as a negative monetary policy shock, i.e. a deviation of the actual rate below the prediction of the rule that is embedded in the model.

Bearing this in mind, Chart A reports a decomposition of real M1 growth from the first quarter of 1999 to the fourth quarter of 2006 on the basis of the DSGE model. The green dashed line shows the deviation of the year-on-year growth rate from its in-sample average. M1 growth is decomposed into contributions of five categories of shocks, each represented by a separate bar. Some of these shocks are persistent and the effect of most shocks is propagated over time through the economic structure captured by the model itself. The lags in the transmission of monetary policy shocks through the economy represent a well-known example of such propagation. A shock can thus in principle continue to be an important driver of money growth even if the shock itself occurred in a previous period.

According to the model, from mid-2001 to 2005 nominal interest rates were significantly below the levels that one would have predicted on the basis of the estimated interest rate

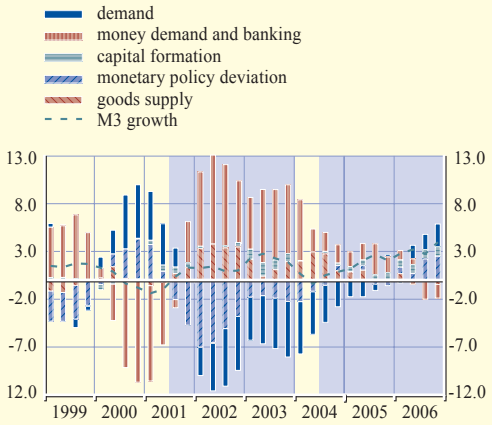
1 The model is described in Christiano L., R. Motto and M. Rostagno (2003): "The Great Depression and the Friedman-Schwartz Hypothesis," *Journal of Money, Credit and Banking* 35(6), December. A recent analysis is presented in Christiano, L., R. Motto and M. Rostagno (2007): "Shocks, Structures or Policies? The EA and the US after 2001", forthcoming in the *Journal of Economic Dynamics and Control*.

2 The model that is used in this box is a model of a closed economy. International linkages are therefore omitted. As a consequence, it is impossible to account – on the basis of the model – for factors that, e.g., influence money through a change in the net asset position of monetary financial intermediaries in the euro area.

reaction rule embedded in the model. The resulting low short-term interest rates contributed significantly to real M1 growth throughout the period from mid-2001 to early 2004 (see the "monetary policy deviation" bars in Chart A). In the first part of this period, this stimulative effect was partially offset by a negative impact stemming from demand shocks (e.g. declines in consumer confidence, leading to a reluctance to spend out of income and thus lower demand for money held for transactions – see "demand" bars). However, as the economy recovered in 2004, this offsetting effect dissipated, leading to a strengthening of real M1 growth.

Chart B Decomposition of real M3 growth

(annual percentage changes; percentage points)



Source: ECB calculations.
Note: Annual (year-on-year) per capita real M3 growth rates in deviation from the model's mean, which is 2.8%. The deflator used is the GDP deflator.

The period from 2004 to 2006 is marked by a positive contribution of stronger consumer confidence ("demand" bars), reflecting a revival of the transactions motive as economic activity recovered. Moreover, significant positive shocks to the preference for holding more liquid forms of monetary assets within the consumers' wealth portfolios (the main component underlying the "money demand and banking" bars in Chart A) increased the holding of M1 vis-à-vis the holding of M3-M1. It was only in the course of 2006 that the gradual removal of monetary policy accommodation started to exert a downward impact on M1 growth, reflected in the negative contribution from the "monetary policy deviation" bars.

Similarly, Chart B decomposes the deviation of the growth rate of real M3 from its historical mean into its driving forces. Over the period between 2001 and 2003, the strength of M3 growth is largely explained by increases in liquidity preference on the part of money holders ("money demand and banking" bars), which may be viewed as arising from the increased demand for safe and liquid monetary assets on the part of euro area residents at a time of heightened economic and financial market uncertainty (as referred to in the main text). This stimulative effect was partially offset by the weakness of aggregate demand and spending, as reflected in the negative contribution stemming from the "demand" bars.

By contrast, the evolution of M3 growth in the period from mid-2004 onwards can be explained to a large extent by real forces. A gradual improvement in the propensity to consume ("demand" bars) has supported demand for the transactions instruments included in M3. Further, the model associates M3 growth in this phase also with a more favourable valuation of financial (stock market) wealth, which in the model eases collateral constraints and thus creates an incentive for firms to build capital. These forces in this period are the main component underlying the "capital formation" bars. They also reflect banks' increased propensity to supply both short-term loans to finance firms' working capital, and longer-term loans to fund gross fixed capital.

Finally (and anticipating the discussion in Section 5 of the main text), the positive contribution of monetary policy shocks to M3 growth in the last quarters of 2006 may reflect the gradual removal of monetary accommodation which, to the extent it results in some flattening of the

yield curve, leads to an initial substitution of short-term assets within M3 for longer-term assets outside M3 (as is also documented in Box 4).

This box illustrates how model-based analysis can complement the real-time analysis discussed in the main text. Lower than average levels of key ECB interest rates have, on average, led to higher M1 growth while encouraging investors to diversify away from M3-M1 into instruments with a higher remuneration. Over the period from mid-2001 to 2003 this mechanism contributed positively to M1 growth, while the dampening effect on M3 growth was more than compensated for by a strong upsurge in liquidity preference due to "safe haven" flows into monetary assets. Third, in the more recent period, the gradual withdrawal of monetary accommodation has started to restrain M1 growth, while driving forces which have caused a strong economic and financial recovery have kept M3 growth at elevated levels.

3 THE IMPACT OF THE LOW LEVEL OF INTEREST RATES ON MONETARY DEVELOPMENTS SINCE MID-2004

A distinctive feature of recent years has been the historically low level of short-term interest rates in the euro area. Prima facie, it is reasonable to believe that a reduction in interest rates would – other things being equal – lead to more rapid monetary expansion, as the attractiveness of holding money rather than alternative financial assets remunerated at market rates increases. Such a relationship is embedded in standard theoretical and empirical models of monetary growth. Against this background, the low level of interest rates is thus a natural leading candidate to explain the strength of monetary growth in the euro area since 2004.

One simple way to investigate the power of this explanation is to study the relationship between the income velocity of money (i.e. the ratio between nominal income and nominal money) and the evolution of interest rates (or, more specifically, movements in the opportunity cost of holding money relative to alternative financial assets). By studying velocity rather than money itself, one normalises for the volume of spending (which obviously also influences the demand for money for transaction purposes) and focuses attention on the role played by interest rates in influencing money holdings.

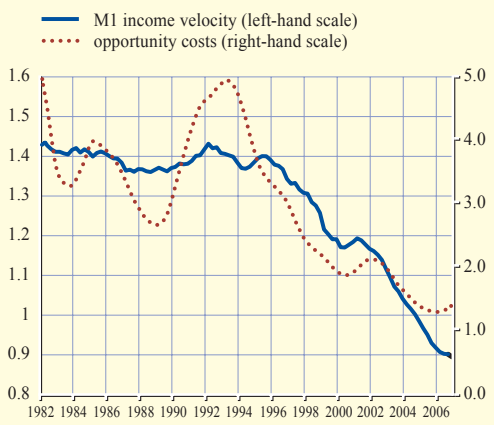
Charts 6 and 7 show the income velocities of M1 and M3 plotted against the respective opportunity cost of holding these assets. For M1, the opportunity cost is defined as the difference between the own rate of return on M3-M1 and the own rate of return on M1. Given the low remuneration of instruments included in M1 (currency – which offers a zero financial return – and overnight deposits), the opportunity costs of M1 are, in practice, very similar to the level of short-term interest rates. For M3, the opportunity cost is defined as the difference between the long-term interest rate and the own rate of return on M3. Thus, the opportunity cost of holding M3 may potentially behave quite differently from the level of short-term rates.

The two charts demonstrate that, in recent years, velocity has decreased more strongly than can be accounted for by developments in interest rates and opportunity costs (at least when measured in the simple manner described above). Albeit in a simplified manner, this is equivalent to showing that monetary growth since 2001 has been stronger than would have been anticipated on the basis of developments in the conventional determinants of money demand as, for example, incorporated in a money demand equation.

Two broad explanations for this development are possible. On the one hand, monetary

Chart 6 M1 income velocity against opportunity costs

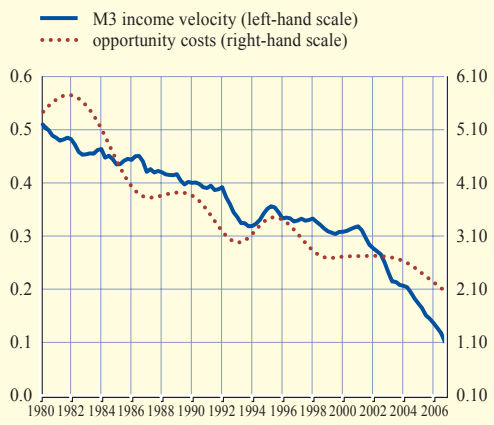
(log levels; percentage points)



Source: ECB estimates.
Note: Opportunity costs are defined as the difference between the own rate of M3-M1 and the own rate of return of M1. The opportunity costs have been smoothed with an eight-quarter moving average.

Chart 7 M3 income velocity against opportunity costs

(log levels; percentage points)



Source: ECB estimates.
Note: The opportunity costs are derived as the difference between the long-term interest rate and the own rate of return of M3. It has been smoothed with a Hodrick-Prescott filter (λ=400).

developments may have been strongly influenced by factors that are not captured in conventional money demand specifications. This is the likely explanation of the strong decline in M3 velocity between 2001 and 2003, where heightened financial and economic uncertainty played a significant role in raising the demand for safe and liquid monetary assets.[7] On the other hand, the relationship between monetary developments and their conventional determinants may have changed. For example, the sensitivity of monetary growth to interest rate changes – in more technical terms, the interest rate semi-elasticity of money demand, which is typically held constant in standard money demand models – may have risen in recent years, possibly because this sensitivity rises as the level of interest rates falls. The remainder of this section evaluates this latter hypothesis in greater detail.

In the academic literature, a number of reasons have been advanced as to why the sensitivity of monetary developments to interest rates may rise as the level of interest rates falls. First, it has been argued that the move from a high inflation and interest rate regime to a low and well-anchored inflation regime with lower nominal interest rates creates a one-off increase in money holdings.[8] Such an effect would thus create relatively higher money holdings during the period of disinflation, with the level of interest rates falling in parallel.

Another explanation for the higher sensitivity of monetary developments to interest rate changes in periods of low interest rates is the presence of fixed costs for switching between monetary and non-monetary assets.[9] Those fixed switching costs would be of relatively low importance when interest rates are high (i.e. they would constitute a small fraction of the overall difference in remuneration between monetary and non-monetary assets), but would be a important factor determining whether a switch from monetary to non-monetary assets is made when interest rates are low. The existence

7 A more detailed assessment is offered in the article entitled "Money demand and uncertainty" in the October 2005 issue of the Monthly Bulletin.

8 See, for example, R. Lucas, 2000, "Inflation and welfare", *Econometrica*, Vol. 68, No 2, pp. 247-274.

9 See, for example, C.B. Mulligan and X. Sala-I-Martin, 1992, "U.S. Money Demand: Surprising Cross-sectional Estimates", *Brooking Papers on Economic Activity*, No 2, pp. 285-343.

of fixed switching costs may thus create a situation in which money holdings increase more strongly for a given fall in the interest rate when the overall level of interest rates is low.

(I) ANALYSING M1

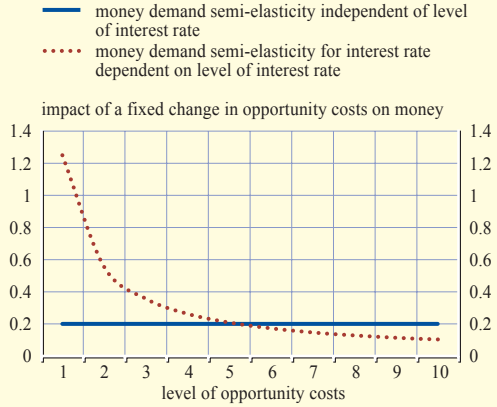
Since there is no major difference between the level of short-term interest rates and the opportunity cost of holding M1 rather than alternative assets, in studying the link between the level of the interest rate and monetary growth it is natural to start with M1. To address the issues raised above, one needs to adopt a framework that allows the sensitivity of monetary growth to vary with the level of interest rates. One such approach used by ECB staff is based on a specification where monetary developments are related to the inverse of opportunity costs. As reflected in Chart 8, under such a specification the hypothetical reaction of money to a 25 basis point decrease in the opportunity cost increases as the level of the opportunity cost declines.

Chart 9 plots M1 income velocity against a measure of the opportunity cost of M1 based on the specification which allows for a rising sensitivity of money to interest rate changes at low levels of interest rates. As demonstrated by the closer fit between the two lines evident in Chart 9 (compared with Chart 6), this exercise suggests that, allowing for a non-constant interest rate, semi-elasticity can help to explain recent strong M1 growth.

This approach to analysing M1 can be incorporated into a money demand model. Such a specification has been regularly used in the ECB's analysis since 2001 (e.g. see Box 1 entitled "Factors explaining the robust growth of M1" in the April 2006 issue of the Monthly Bulletin). Within such a framework, the underlying long-run relationship between real M1 and its main determinants remains intact throughout the estimation period 1980 to 2006. On the basis of this equation, the annual rate of growth of M1 can be decomposed into the contributions stemming from its main determinants, as shown in Chart 10. As the chart demonstrates, the strength of M1 growth up to late 2005 can be explained by the low and declining level of opportunity costs. By the same token, the moderation in M1 growth seen since mid-2006 is mainly explained by a

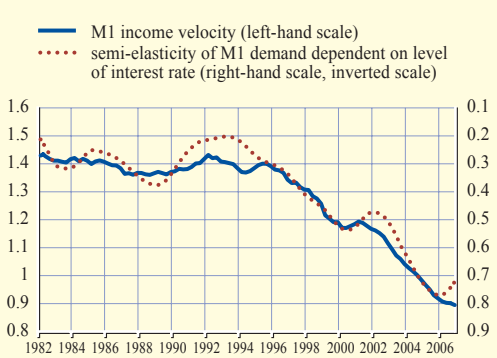
Chart 8 The hypothetical impact of a decline in the opportunity costs at different levels of the opportunity costs on monetary growth

(annual percentage changes; not adjusted for seasonal and calendar effect)



Source: ECB estimates.

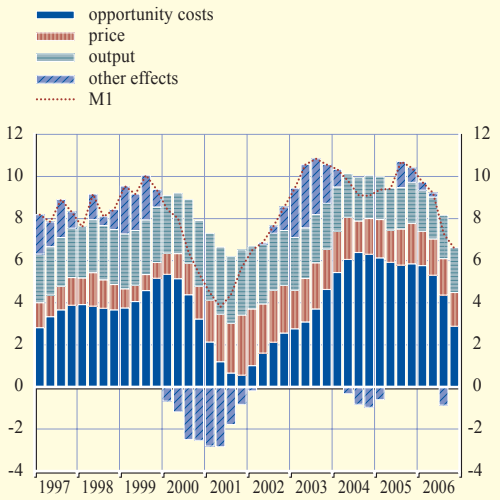
Chart 9 M1 income velocity against opportunity costs



Source: ECB estimates.
Note: Opportunity costs have been smoothed with an eight-quarter moving average. Specification assuming non-constant semi-elasticity of M1 demand to the opportunity costs.

Chart 10 Decomposition of the annual rate of growth of M1 into its contributions

(annual percentage changes; percentage points)



Source: ECB estimates.
Note: Other effects include deterministic effects linked to the Y2K phenomenon, distortions in 1999 due to the introduction of a harmonised reporting scheme, and residuals.

reduced impact of the opportunity cost variable (i.e. rising short-term interest rates).

(2) ANALYSING M3

Since M1 represents roughly half of the total outstanding stock of M3, factors explaining the dynamics of M1 will naturally play an important role in accounting for the evolution of M3 growth. One can thus conclude that the strength of M3 growth can also be explained, in large part, by the low level of interest rates in recent years, via the significant contribution made by M1 to the expansion of M3 (see Chart 3).

However, it is also important to recognise that M3 is a broader aggregate than M1 and is thus likely to be influenced by a broader range of factors, notably wider portfolio considerations. While M1 can make a claim to represent a measure of transactions balances and therefore be determined by conventional money demand determinants that are intended to explain such balances, M3 also includes assets that are held for saving and portfolio reasons and therefore are influenced by a richer set of variables. One important example of this is the period of portfolio shifts between 2001 and 2003, during which the decline in M3 income velocity was considerably stronger than could be linked to developments in the opportunity costs variable, as demand for monetary assets increased as investors sought a safe haven from financial market volatility largely independent of the opportunity cost involved.

This episode is one example of the need to make a thorough assessment of developments in the monetary sector in order to understand broad money dynamics in real time. In the context of such an assessment, a number of specific factors have recently come to the fore that have informed the ECB staff's assessment and interpretation of the strong monetary growth observed over the past few years. Several of these factors can also be linked to the low level of interest rates that has prevailed since 2003. In the interests of brevity, only a small number of issues can be discussed here. The five issues presented below should be thus seen as illustrative rather than exhaustive, providing a flavour of the real-time analysis conducted. Overall, it is important to note that the factors described below mainly reflect continuous processes that exert an influence on monetary growth over a prolonged period, while at the same time often intensify the amplitude of the cyclical patterns observed in the data.

A) An example of financial innovation: The emergence of "retail derivatives"

In an environment of low interest rates and opportunity costs – and especially in the aftermath of the sharp stock market correction in 2000-03, which left euro area households reluctant to expose themselves to significant downside risks to equity prices – euro area MFIs have issued retail products that combine traditional debt securities with derivative instruments. The latter imply that the composite instrument embodies an element of risk, such as participation in the upside returns from equity markets, which is combined with option features

that protect against capital losses caused by stock price falls.

The creation of such so-called "retail derivatives" – which, in statistical terms, are typically included within M3 as short-term MFI debt securities – was supported by the introduction of new information technology, which allowed the customisation of new products at short notice and at low cost, thereby serving retail investors' specific demands with regard to risk and return profiles.

There is clear evidence that in some euro area Member States demand for these structured products has exerted a significant impact in recent years on the evolution of the short-term debt securities component of M3, which has grown very rapidly. At the same time, the share of short-term debt securities within M3 is still small (in April 2007, short-term debt securities contributed just 3% to the outstanding stock of M3), so that currently the impact on M3 growth remains limited.

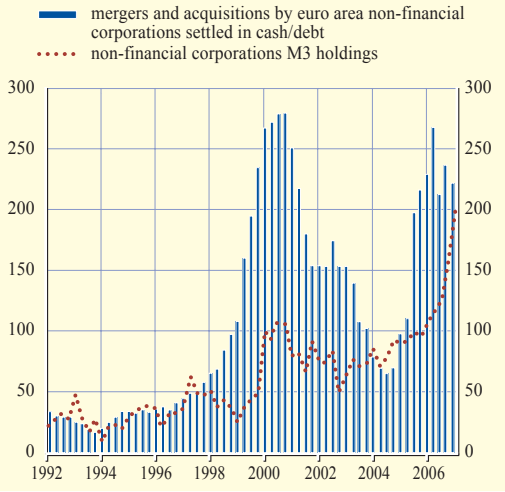
From a conceptual point of view there remain some doubts as to whether structured products should be part of monetary aggregates or whether they should be classified as non-monetary investment products, given that those products often do not offer capital certainty. When having to extract the underlying signal of monetary aggregates, the ability to single out such structured products and their impact on M3 growth remains important.

B) Borrowing to finance M&A activity[10]

Another factor has been the build-up of capital for financial purposes, facilitated by the low level of interest rates. In particular, since late 2004 non-financial corporations have channelled part of their increased borrowing into intensified M&A activity (see Chart 11). Contrary to the M&A boom in the period 1999 to 2000 (which was focused on technology sectors, often located outside the euro area), M&A activity in recent years has been broadly based across industries and driven by domestic and intra-euro area deals. Higher borrowing for M&A activity cannot simply be excluded when gauging the underlying money and credit dynamics that embed the relevant signals for price developments. A comprehensive monetary analysis needs to take into account that, through its impact on asset prices and the liquidity situation, borrowing for such purposes may have implications for price stability, even though it may have little immediate or direct impact on fixed investment and aggregate demand.

Chart 11 M3 and M&A activity of non-financial corporations

(annual flows; EUR billions)



Sources: ECB, Thomson Financial, Bureau van Dijk (Zephyr database).
Note: Figures on M&A activity refer to transactions in which euro area non-financial corporations act as acquirers.

C) The growing importance of the OFI sector for monetary developments

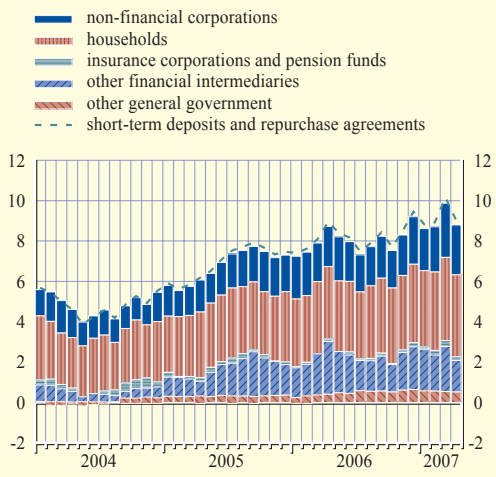
As noted in Section 2, in recent years the OFI sector has become of increasing importance in explaining monetary developments.[11] In part, this is a consequence of "loan securitisation", a process whereby bank assets such as mortgage and corporate loans (or the risks associated with them) are pooled and repackaged as

10 See Box 2 entitled "Factors underlying the strong acceleration of loans to euro area non-financial corporations" in the January 2007 issue of the Monthly Bulletin and Box 4 entitled "Recent trends in merger and acquisition activity in the euro area" in the July 2006 issue of the Monthly Bulletin for details.

11 See Box 1 entitled "The role of other financial intermediaries in monetary dynamics" in the ECB Annual Report 2006.

Chart 12 Contributions to annual M3 deposit growth by sector

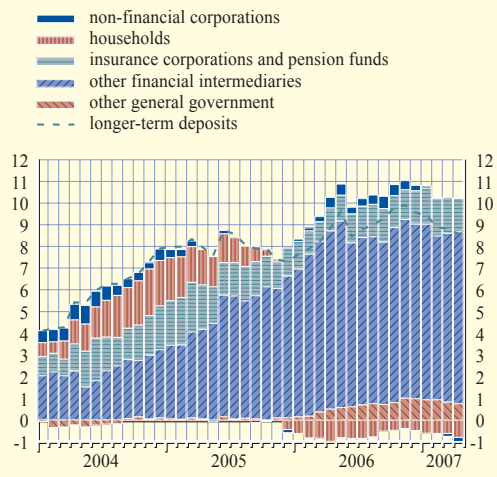
(percentage points; annual percentage changes)



Source: ECB estimates.
Note: MFI sector excluding Eurosystem.

Chart 13 Contributions to annual long-term deposit growth by sector

(percentage points; annual percentage changes)



Source: ECB estimates.
Note: MFI sector excluding Eurosystem.

marketable securities that are sold to investors – typically via so-called financial vehicle corporations (FVCs), which are part of the OFI sector.

There are two main types of loan securitisation: true-sale securitisation and synthetic securitisation.[12] True-sale securitisation typically involves the actual transfer of the loan off the MFI balance sheet and on to the FVC balance sheet, while synthetic securitisation only involves the transfer of the associated credit risk, with the loan itself remaining on the originator's balance sheet.

The direct impact of loan securitisation on monetary developments is complicated, and depends on the financing strategies of the FVC and the identity and behaviour of the purchaser of the securitised asset. Indirectly, however, both types of securitisation are likely to increase the capacity of MFIs to issue loans and might thus finally positively contribute to M3 dynamics. At the very least, such innovations lead to a shift in the holding structure of deposits towards a higher importance of non-monetary financial intermediaries (OFI). Indeed, this is confirmed by the MFI deposit data by sector. Charts 12 and 13 show the contribution of the OFI sector to the growth of M3 deposits[13] and that of long-term deposits (outside M3). Since long-term deposits are a natural way for FVCs to hold the proceeds from the sale of securitised assets, the OFI sector has been the predominant sector contributing to long-term deposit growth in recent years. Yet OFIs have also made considerable contributions to M3 deposit growth since late 2004, especially when taking account of their relatively modest share in the stock of outstanding M3 deposits (12% in April 2007). Nonetheless, developments in money holdings by the OFI sector do not change significantly the assessment of the overall liquidity situation.

12 For details, see Box 1 entitled "The impact of MFI loan securitisation on monetary analysis in the euro area" in the September 2005 issue of the Monthly Bulletin.

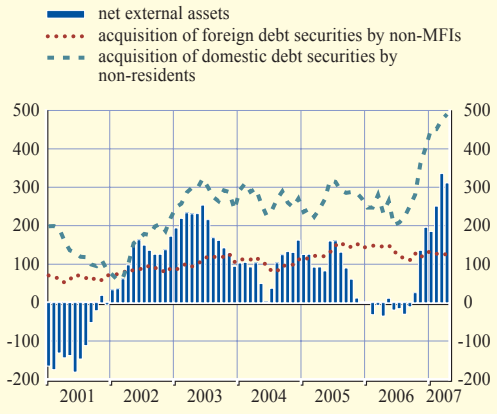
13 M3 deposits are defined as repurchase agreements and short-term deposits, which represent the largest combination of M3 components for which official information on holding sectors is available.

D) Global liquidity in an environment of globally low interest rates[14]

Strong money and credit growth has recently been observed in all of the major currency areas, following the extended period of low short and long-term interest rates since the turn of the century and the more recent strengthening of economic activity. This has created a situation of ample global liquidity that is looking for a home. At present, given the relative outlook for economic growth and returns, investment in euro area assets is attractive by comparison with other major currency areas. It is thus not surprising that global investors are purchasing significant volumes of euro area assets, thus leading to strong capital inflows to the euro area, while at the same time euro area investors have little increased incentive to invest abroad.[15]

Chart 14 Net portfolio investment in debt securities by residents and non-residents

(annual flows as reflected in the monetary presentation of the euro area balance of payments, EUR billions)



Source: ECB.

The international influence on monetary developments is reflected in the MFI net external asset position, which captures (almost) all transactions of the money holding sector with counterparties outside the euro area. This position has recently increased strongly, reaching an annual flow of €335 billion in the year to end-March 2007, after hovering below zero between late 2005 and summer 2006 (see Chart 14).

At the same time, there is no mechanical link between MFIs' net external assets and monetary developments. Indeed, developments in net external assets often find their counterparts in balance sheet positions other than monetary assets, like credit (e.g. during the M&A boom in 1999 and 2000) and longer-term financial liabilities. Currently, sales of government bonds by MFIs to euro area non-residents are one important counterpart to MFI net external assets. Such transactions imply a reduction in credit granted to the general government sector rather than an increase in M3. Only part of the increase in net external assets is thus likely to impact on M3. However, this fraction is likely to have been responsible for the bulk of the increase in the dynamics of the annual rate of growth of M3 from 8.5% in October 2006 to 10.9% in March 2007.

When assessing what could happen with the monetary assets created by the transactions with the rest of the world, the factors that have been responsible for its build-up should be borne in mind. Since 2004, two broad factors can be identified – one structural and one cyclical – which may, in turn, have different implications for the liquidity situation and, accordingly, imply different degrees of risk to price stability.

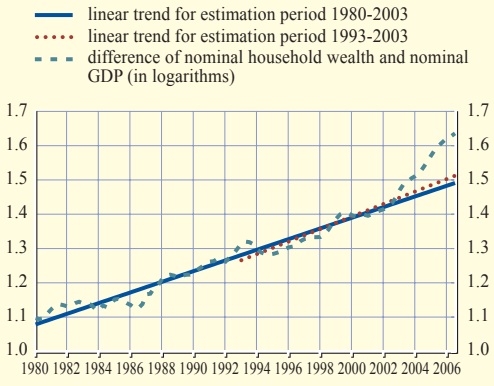
As regards the structural factor, changes in the funding patterns of MFIs since 2004 may lead to permanently higher transactions with the rest of the world (as already discussed in the context of securitisation activity under the previous point on OFIs). At the same time, one cannot exclude that a significant part of the portfolio investment from outside the euro area is driven by short-term and cyclical considerations that will ultimately reverse (possibly rapidly), and thus may be of less relevance to the underlying or trend rate of monetary expansion.

14 See Box 2 entitled "Recent developments in MFI net external assets" in the July 2005 issue of the Monthly Bulletin and Box 3 entitled "Worldwide trends in monetary aggregates" in the November 2006 issue of the Monthly Bulletin for details.

15 These capital inflows are thus of a completely different nature to those observed during the period 2001 to 2003, when euro area investors repatriated funds from abroad into liquid assets driven by a high level of risk aversion.

Chart 15 Relation between gross household wealth and GDP

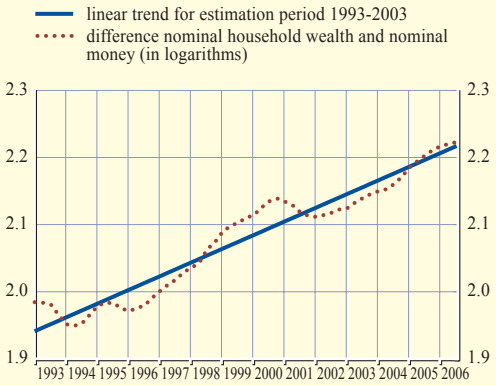
(differences of logarithms of nominal household wealth and GDP)



Source: ECB internal estimates.

Chart 16 Relation between gross household wealth and household M3

(differences of logarithms of nominal household wealth and M3 holdings of households)



Source: ECB internal estimates.

E) Money and wealth

Money is part of the wealth portfolio of households, which also includes bonds, equities and residential property. Increases in total wealth will typically induce households to hold a larger stock of money. Since wealth may rise in a low interest rate environment (as bond, stock and house prices increase), low interest rates may increase monetary growth through a wealth channel.

As shown in Chart 15, in recent years nominal household wealth[16] has grown more quickly than nominal GDP in the euro area. To the extent that wealth rather than nominal GDP is the driver of monetary dynamics, this development could explain the observed more rapid than anticipated decline in M3 income velocity. Indeed, in recent years the ratio of household wealth to household M3 deposits has fluctuated around the rather steady upward trend that it has exhibited since the early 1990s (see Chart 16), suggesting that the recent strength of monetary growth is broadly linked to stronger growth in wealth, that may in turn be rooted in lower levels of interest rates.

4 EXTRACTING POLICY-RELEVANT INFORMATION FROM MONETARY DEVELOPMENTS

The exercises presented above suggest that the strength of monetary growth since 2004 can be explained, at least in part, by the increased sensitivity of monetary developments to opportunity costs when interest rates are at low levels. Several channels exist through which monetary developments are influenced by low interest rates and – especially for the broad aggregate M3 – these can involve complex processes such as product innovation and the evolution of asset prices and wealth.

However, developing an explanation of why monetary developments have evolved in a particular manner is only the first step in the ECB's monetary analysis. Providing such explanations does not, of itself, reveal whether monetary developments imply risks to price stability. While some factors driving the

16 As described in Box 5 entitled "Estimates of housing wealth for households in the euro area" in the December 2006 issue of the Monthly Bulletin, these data recently became available on the basis of an ECB estimate for housing wealth. Quarterly data are interpolated.

stronger reaction of money to low interest rates might imply higher equilibrium money holdings (and thus few implications for the inflation outlook), others may imply the accumulation of excess liquidity with clear upside risks to price stability, either directly or possibly indirectly via asset price dynamics.

Against this background, it is crucial to seek as full an explanation as possible of monetary dynamics in order to form an assessment of their implications for price developments and thus extract the information relevant for monetary policy. Furthermore, this assessment has to be made in the context of other macroeconomic and structural analysis, including developments in asset prices and institutional changes in the financial system.

To illustrate this important point, it is instructive to focus on the final example discussed in the previous section, namely the relationship between wealth and money holdings. It is important to recognise that simply being able to explain monetary developments on the basis of the evolution of wealth – as Chart 16 suggests is possible – does not imply that these developments are benign in terms of the outlook for price stability.

For example, one might argue that the growth of household wealth may lead to the emergence of additional demand and ultimately inflationary pressures. Alternatively, one might take the view that higher wealth is a reflection of asset price misalignments, which could unwind in the future in a manner threatening macroeconomic, and ultimately price, stability. Moreover, the direction of causality may be reversed, i.e. strong monetary and credit growth could be causing or fuelling asset price rises and thus wealth dynamics with potential inflationary consequences. In each of these cases, increases in monetary growth would thus reflect increases in risks to price stability. A detailed analysis would help to better pin down the types of risk and potential transmission channels, and thus allow any policy action to be calibrated appropriately.

Similarly, one may take the view that holdings of retail derivatives and/or easier credit supply conditions resulting from increased securitisation of bank loans represent financial innovations that change the structure of the monetary sector and thus their impact should be discounted in assessing monetary developments. However, such an approach would ignore how these innovations have increased the aggregate liquidity of the domestic private sector and eased overall financing conditions, both of which may lead to stronger aggregate spending and thus ultimately inflationary pressures. Borrowing by corporates for M&A activity also creates liquidity and the ultimate holders of that liquidity (e.g. the seller of the equity stake in the company taken over) may increase spending and/or alter the structure of their overall asset portfolio in a manner that leads to upward pressures on asset or consumer prices.

On the basis of considerations such as these, the strengthening of monetary growth between 2004 and 2005 – although explicable in broad terms – was viewed as signalling upside risks to price stability. Box 3 describes how the results of simple money-based indicator models of inflation, which are derived on the basis of the analytical results presented in Box 1 and have been used in the staff analysis, are consistent with this overall assessment.

Box 3

THE EVOLUTION OF MONEY-BASED INDICATORS OF INFLATION OVER RECENT YEARS

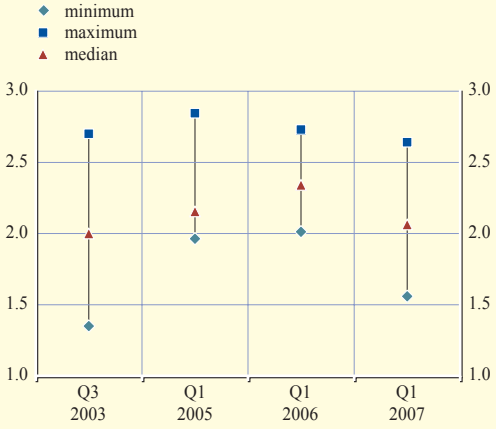
This box illustrates the evolution of various money-based indicators of inflation developed by ECB staff which have been constructed using the methodology described in Box 1.

The chart below shows the range and the median of a set of real-time money-based indicators of inflation at four different points in time. Such a representation of inflation risks was previously shown in the March 2005 and June 2006 issues of the Monthly Bulletin. When interpreting the results of this particular tool of the monetary analysis, the simplicity of the underlying indicator models needs to be kept in mind.

At the end of the portfolio shift period in mid-2003, risks to price stability were slightly skewed to the upside, but the uncertainty derived from monetary indicators was large, so that the overall quality of the signal was blurred. The blurring of the signal arose from uncertainty regarding how to interpret such portfolio shifts: while the modal view was that they were rather benign in terms of the inflation outlook, over the longer term the danger existed that such holdings could be converted into transactions balances which, especially in the context of an economic recovery, could create inflationary pressures.

The range of money-based inflation risk indicators based on a set of bivariate leading indicator models

(annualised growth rates over the next six quarters; real-time results of the various vintages)



Source: ECB estimates.
Note: The chart shows the range of indicators derived from seven bivariate leading indicator models of inflation (M1, M2, M3, M3 corrected for the estimated impact of portfolio shifts, MFI loans to the private sector and measures of excess liquidity for M3 and M3 corrected). Each indicator is based on information available at the time the indicator was derived. For example, the result for the individual indicators for the first quarter of 2006 contains information on money and inflation up to and including the first quarter of 2006.

This assessment changed from mid-2004 onwards. By the first quarter of 2005, the clarity of the signal stemming from this particular tool of the monetary analysis had improved, as captured by the narrowing of the range of the set of money-based inflation indicators shown in the chart. Moreover, the upward shift of the range pointed to higher risks to price stability. These developments intensified through the first quarter of 2006, as further upward shifts of the median shown in the chart illustrate. Even though important structural changes in the financial system were taking place, the rapid and increasing rate of monetary expansion observed during this period was thus seen as implying growing risks to price stability.

Given the overall strength of money and credit dynamics, as well as the rather mixed signals emanating from the broad set of indicators considered (e.g. higher M3 growth but some stabilisation of M1 credit expansion), the summary representation of monetary developments in early 2007 points to continued risks to price stability, but at the same time to greater uncertainty given the broadening of the range of signals offered by various components and counterparts.

5 EXPLAINING MONETARY DEVELOPMENTS AS SHORT-TERM INTEREST RATES HAVE RISEN

Since the Governing Council decided to commence removing monetary policy accommodation in December 2005, the resulting sequence of short-term interest rate increases has had divergent effects on various monetary and credit indicators. M1 growth started to moderate in the autumn of 2005, with loan growth easing from summer 2006. By contrast, the growth rate of M3 has increased further.

Box 4 suggests that the continued strengthening of M3 growth in the face of increases in short-term interest rates is in line with historical regularities, at least as captured in a simple empirical model of the euro area since the early 1990s. Such behaviour is therefore not surprising and has been taken into account in assessing recent monetary developments.

There are a number of reasons why M3 growth may rise in the context of rising short-term interest rates. First, a higher demand for money may emerge for portfolio management reasons, as investors seek capital-certain assets such as bank deposits at a time when holding fixed income securities entails risks, since higher interest rates imply capital losses on bonds. Such a portfolio demand is likely to manifest itself in holdings of time deposits, money market funds and/or short-term MFI debt securities (especially if they are remunerated at floating rates). Second, higher short-term interest rates have led to a flattening of the euro area yield curve, thereby increasing the attractiveness of short-term time deposits relative to longer-dated assets. The former offer the same yield as the latter, while having more liquid characteristics. Third, the withdrawal of monetary policy accommodation and the improved economic outlook may encourage inflows of capital into the euro area and an increase in the net external asset position on the MFI balance sheet, which may also serve to raise M3 growth. Each of these three elements has played some role in explaining the strengthening of M3 growth since December 2005, when key ECB interest rates started to rise.

Box 4

THE REACTION OF EURO AREA M3, M1 AND LOANS TO CHANGES IN INTEREST RATES

This box presents quantitative euro area evidence derived from vector autoregressive models (VAR) on the reaction of monetary and credit dynamics to interest rate changes. VARs – by contrast with the models underlying the analysis shown in Box 2 – impose very little theoretical structure on the data and can be used to establish the "stylised facts" about the correlations among various macroeconomic variables.

VAR models and impulse responses

A standard exercise in the VAR literature is to introduce a transitory increase in the level of one variable and to investigate the dynamic effects of this so-called "shock" on all variables in the system (i.e. so-called "impulse response analysis"). If this exercise is performed for a shock to the short-term interest rate, it can be regarded as offering an empirical assessment of the implications of a change in the stance of monetary policy on other macroeconomic variables.

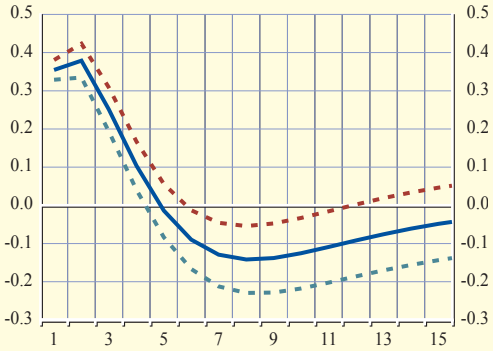
The following charts are based on the estimation of two systems, both of which include a linear trend, a commodity price index[1] and an oil price index as (pre-determined) explanatory

1 The use of a commodity price index as a leading indicator for domestic inflation in the policy reaction function could eliminate the positive response of prices to a contractionary monetary policy shock. See Sims, C. A. (1992), "Interpreting the Macroeconomic Time Series Facts: The Effects of Monetary Policy", *European Economic Review*, Vol. 36 (5), pp. 975-1000.

Impulse response functions following a transitory increase in the short-term interest rate by one standard deviation

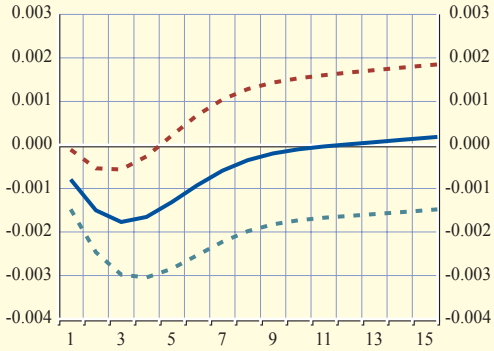
Response of short-term interest rates

x-axis: quarters after shock
y-axis: percentage deviation from baseline



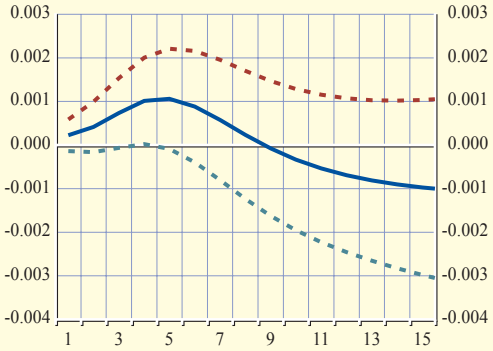
Response of M1

x-axis: quarters after shock
y-axis: percentage deviation from baseline



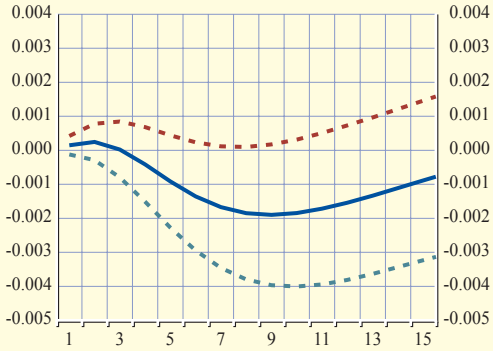
Response of M3

x-axis: quarters after shock
y-axis: percentage deviation from baseline



Response of loans

x-axis: quarters after shock
y-axis: percentage deviation from baseline



Source: ECB calculations.
Note: All variables, except for interest rates, are in logarithms. The sample period is from the first quarter of 1981 to the fourth quarter of 2004, with solid lines showing percentage deviations from the baseline and dashed lines the respective one standard deviation confidence band.

variables. The first system is intended to capture the behaviour of the components of M3 and consequently includes: the HICP; real GDP; M3; M1, and a long-term and a short-term nominal interest rate. The second system models the counterpart side of M3 and (relative to the first model) excludes M1 but includes loans to the private sector and MFI longer-term financial liabilities.

Since the focus of this box is on the long-run relationships between the variables, a VAR in the level of the variables is estimated and solved for its dynamic responses.[2] As is quite common in the literature, the three-month interest rate is chosen as the short-term interest rate and is seen as the policy instrument. The chart above then illustrates the reaction of the short-term

2 The impulse response analysis is carried out using generalised impulse response functions. The purpose of generalised impulse response functions is to circumvent the problem of the dependence of the orthogonalised impulse responses on the ordering of the variables in the VAR. See Pesaran, M.H. and Shin, Y. (1998), "Generalized Impulse Response Functions in Linear Multivariate Models", Economic Letters, Vol. 58, pp. 17-29.

interest rate, M1, M3 and loans to the private sector to a transitory (i.e. one-off) shock in the "policy rate" of one standard deviation. It also shows the respective 68% confidence interval which corresponds to one standard deviation of the response.[3] The estimations cover a period from the first quarter of 1980 to the fourth quarter of 2004. The reactions of the variables included in the system are shown for a time horizon of 24 quarters.

Results

According to the results, the response pattern of the short-term interest rate shows a peak after two quarters, followed by a steady decline reaching a trough between eight and ten quarters before returning to the zero line (see the chart). This could be interpreted as suggesting that, following the initial restrictive interest rate policy, the monetary authorities subsequently lower interest rates in response to a decline in real activity and lower prices.

The increase in the short-term interest rate is followed by a prompt decline in euro area M1, a result that confirms the rather high interest rate sensitivity of this aggregate. After the interest rate effect has faded out over time, the effect of a decrease and subsequent recovery in GDP comes to the fore. A similar pattern can be observed for the dynamic response of nominal loans. At the same time, the reaction of loans compared with that of M1 is somewhat delayed. These features mimic the behaviour observed since December 2005 that is reported in the main text.

Contrary to this, the rise in the short-term interest rate triggers a significant and permanent decline in the stock of euro area M3, which starts to materialise after around ten quarters. The permanent decrease, however, is preceded by a positive reaction of M3 to a rise in interest rates, which may be linked to the speculative demand for money materialising in the M3 components outside M1 (M3-M1). This positive initial response of M3 to the unanticipated increase in short-term interest rates can be relatively persistent, and is consistent in direction with what has been observed in the euro area over the past year as key ECB rates have risen.

3 It is common in the VAR literature to use a one standard deviation confidence interval (although this is narrower than for other statistical exercises). See, e.g. Bagliano, F. C. and Favero, C. A. (1999), "Information from Financial Markets and VAR Measures of Monetary Policy", European Economic Review, Vol. 43, pp. 825-837.

6 CONCLUDING REMARKS

Between mid-2004 and late 2005, the underlying trend rate of monetary expansion strengthened. A variety of tools have been used to analyse this development. Broadly speaking, the historically low level of nominal short-term interest rates in the euro area during this period has been an important driver of strong money growth. Although institutional changes in the monetary and financial sector have influenced broad money dynamics, by mid-2005 the comprehensive monetary analysis conducted by the ECB staff concluded that the strengthening of monetary growth signalled clear medium to longer-term risks to price stability.

After the start of the increases in interest rates in December 2005, developments in various monetary indicators have diverged. M1 growth moderated almost immediately, while the dynamics of loans to the private sector stabilised somewhat later. Nonetheless, these indicators continue to grow at vigorous rates. By contrast, M3 growth continued to trend upwards after December 2005, in part owing to financial innovation, developments in non-monetary financial institutions' money holdings related

to loan securitisation and, in particular, a heightened demand for marketable instruments in M3 for portfolio management purposes. The ECB's monetary analysis employs a broad set of tools and frameworks to assess these developments. On this basis, it has been concluded that the underlying rate of monetary expansion in the euro area – which remains robustly correlated with inflation dynamics over longer horizons – remains strong, although over the course of 2006 and in early 2007 developments in the annual growth rate of the broad aggregate M3 may overstate the dynamism of the underlying rate of monetary expansion.