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ORIGINAL PAPER

Wealth effects on money demand in the euro area

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Abstract We investigate the determinants of money demand (M3) in the euro area, considering that this variable remains an important co-determinant of monetary policy making by the European Central Bank. Regressing the real stock of M3 on real GDP, interest rates and wealth variables (real housing and stock prices) within an error-correction framework provides evidence of positive wealth effects on money demand in the long run. Correcting for this wealth effect, money demand in the euro area has grown almost exactly in line with the official reference value of 4 1/2% per annum.

Keywords Money demand · Inflation · Wealth

JEL Classifications E41 · E52

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1 Introduction

Since the advent of the single currency on 1st January 1999, the year-on-year growth rate of broad money (M3) in the euro area has persistently exceeded the "reference value" of 4½ per cent which the European Central Bank (ECB) uses as the benchmark for a prudent, non-inflationary expansion of the money stock (Fig. 1). Aside from a short spell between mid-2000 to mid-2001, when growth of M3 fell short of the reference value, M3 growth has been in a range of 2 to 4 percentage points per annum in excess of the reference value. This has raised concerns that the "monetary overhang" could at some point boost inflation (ECB 2004).

Many observers, as well as the ECB, initially explained the "monetary overhang" that built up since the advent of the euro by a combination of two temporary factors: (i) a flight into liquidity in response to heightened uncertainty in the wake of the stock market slump in 2000/2001; and (ii) the historically low level of interest rates and hence low opportunity cost of holding liquidity. If this assessment is correct, growth in M3 should return to (and perhaps initially undershoot) the reference value once uncertainty surrounding the stock market has diminished and interest rates return to their equilibrium level.

However, even though stock markets have by now recovered to a large extent their earlier losses, growth in money aggregates remains uncomfortably high. This suggests that other factors are contributing to the surge in money demand, which may not be identified in the standard money demand models. More than three decades ago, Friedman (1970) suggested that if the demand for money was viewed in a portfolio framework, wealth may be a determinant. Financial market liberalisation may have accelerated such wealth gains and these gains may have contributed to an increase in liquidity preference. This paper seeks to examine this possibility.

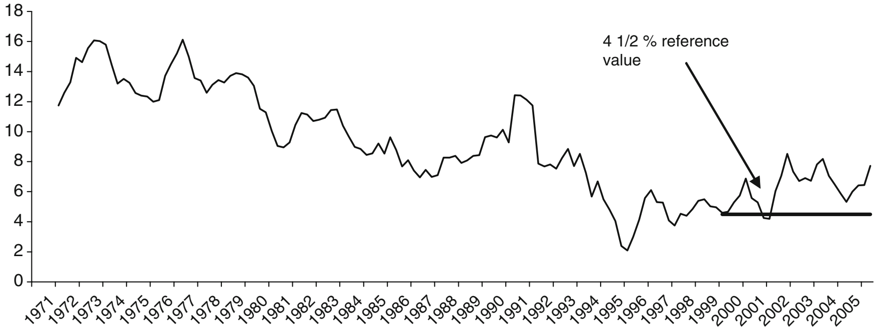

Fig. 1 Growth of M3 in the euro area, per cent, compared to the same quarter in the previous year

2 The state of play

Developments in M3 may contain information about opportunity cost variables for holding money beside its “own rate of interest on money”, including a range of yields on financial and real assets that may be considered as substitutes for money and other liquid assets (Nelson 2003). However, the standard specification for money demand equations comprises a rather narrow range of opportunity cost variables. It reads:

$$M = M(\overset{+}{P}, \overset{+}{Y}, \overset{?}{irs}, \overset{-}{irl}) \tag{1}$$

In this standard specification money demand (M) varies with the volume of activity or transactions (Y) and the price level (P) in line with the quantity theory of money. In addition, money demand is assumed to decrease if the long-term interest rate or bond yield (*irl*) rises, because the opportunity cost of holding liquidity as opposed to bonds increases. A rise in the short-term interest rate (*irs*) has an ambiguous effect. It will raise money demand to the extent it results in a higher return on short-term deposits (the “own” rate of return on liquid assets), but reduce it to the extent yields on fixed-term deposits and fixed-income securities with longer maturities are affected.

It is this specification, or variants thereof, that is frequently used as a starting point for estimating money demand equations for the euro area. Variants include Fase and Winder (1998) and Coenen and Vega (2001) who suggest entering the difference between *irs* and *irl* (i.e. the yield curve) in the equation, thus restricting the coefficients of *irs* and *irl* to be the same. Brand and Cassola (2004) remove *irs* and only retain *irl*, whereas Avouyi-Dovi et al. (2003) and Bruggeman et al. (2003) emphasise the importance of *irs* as a measure of the ”own rate of money”, i.e. the yield on near-money included in M3. Artis and Beyer (2004) remove *irs* and retain *irl* as well, but argue that *irl* should represent the German bond rate, this being the relevant benchmark rate in the euro area. Inflation is sometimes introduced in the equation as a proxy of the capital loss of holding money and to capture the impact of inflation on real interest rates.

We propose to augment the standard money demand equation with explanatory variables that capture the possible impact of wealth (W) on money demand. The basic idea is that a gain in wealth will exert an influence on the demand for money through two channels. One channel is the substitution effect (Friedman 1988): a rise in asset prices makes these assets more attractive alternative investment vehicles in comparison with money. The other channel is the income effect: as wealth increases, part of the additional wealth may be stored in liquid instruments. Moreover, as the turnover of financial transactions increases with the higher level of asset prices, the demand for money for transaction purposes will rise. The substitution effect of wealth on money demand is negative and the income effect is positive, hence a priori the sign of the net impact of wealth on money demand is undetermined. This leads to the following specification:

$$M = M(\overset{+}{Y}, \overset{+}{P}, \overset{?}{irs}, \overset{-}{irl}, \overset{?}{W}) \tag{2}$$

Fase and Winder (1998) have found empirical evidence for a positive sign on the wealth variable in this relationship for the European Union prior to the adoption of the euro in 1999, with net financial wealth derived from balance sheet data as an explanatory variable. In a more recent study, Bruggeman et al. (2003) reject a relationship between money demand and share prices for the euro area, including observations for the period after the adoption of the single currency. Moreover, they find that interest rates are not very well determined in the equation. There are also recent studies which aim to estimate the impact of the volatility in share prices. The Institut für Weltwirtschaft (2003), for example, finds a positive correlation with M3, the rationale being that volatility and the associated increased uncertainty leads to a flight in low-risk liquid assets that are included in M3. They also find a negative relationship between the level of share prices and money demand, confirming that money and stocks are substitutes rather than complements. To our knowledge, however, the relevance of a broader set of wealth indicators that includes house prices along with share prices has not been tested to date.

3 An augmented model

In what follows we report an attempt to estimate a money demand equation for the euro area which is augmented with house and share prices to capture wealth effects. It is estimated on data covering the period 1970Q1 to 2004Q4. For the money aggregate (M3), GDP volume and price and the short and long term interest rates we use data available on a quarterly frequency for this period taken from the OECD's Analytical Database (Fig. 2). Value and volume series prior to the first quarter of 1999 are computed using previous period values levels converted in a common currency as weights. This calculation method is applied to growth rates. Corresponding level series are constructed on the basis of these calculated average growth rates and corresponding 1999Q1 values, calculated as the sum of the in-euros converted values of the twelve member countries. The price series is obtained by dividing the value series by the volume series. Interest rates are calculated using the same set of GDP weights while the money aggregate M3 is directly extracted from sources available at the European Central Bank. The series for real house prices is an aggregate of seven euro area countries (Germany, France, Italy, Spain, the Netherlands, Ireland and Finland) taken from Girouard et al. (2006), which together cover 88% of the total area's GDP, in this case using fixed 2000 GDP and purchasing power parity weights. The equity price series consists of weighted averages of the commonly accepted headline stock market indexes for the same set of countries and the same set of weights. It is deflated by the euro-area GDP deflator.

The econometric method rests on cointegration, following Stock and Watson (1993). They propose estimating the long-run relationship between macroeconomic variables in the form of co-integration, adding leads and lags of the

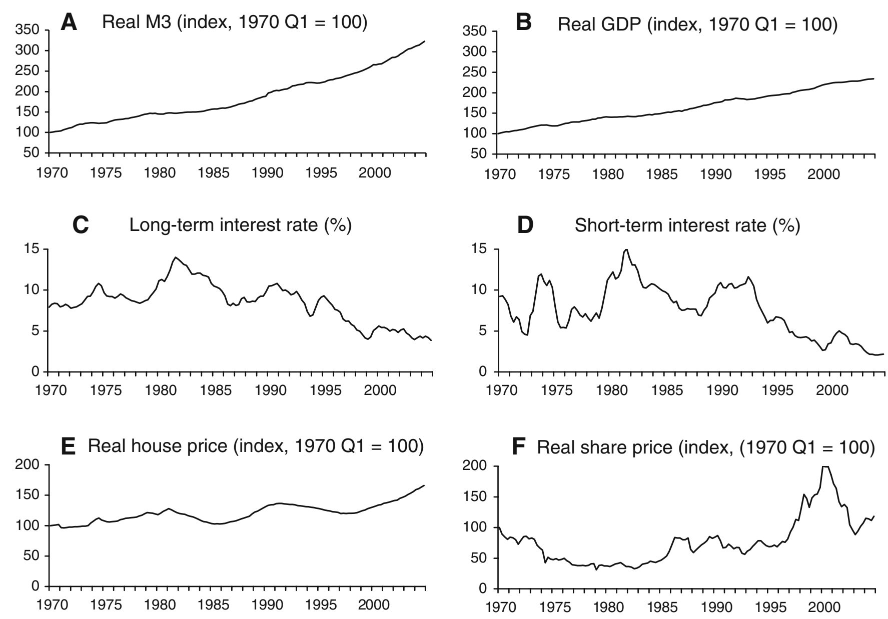

Fig. 2 The data

change in the co-integrating variables, which make the usual statistical tests (such as the t-test for significance of the variables) valid. A first step consists of testing the integration order of the relevant variables, since co-integration can only take place between variables that are integrated of the same order. A second step consists of estimating the co-integrating vectors between those variables. Third, a dynamic relationship in the form of an error correction model (ECM) is derived. For both the long and short-run relationships, a set of statistical tests are run to assess the stability of the relationship, particularly with respect to the introduction of the euro.

While the model includes real house and real equity prices as explanatory variables, it excludes for reasons of data availability developments in the stocks of these assets held by investors. This is clearly a limitation. However, since most of the dynamics in real wealth must stem from fluctuations in real asset prices, these can be considered to be a "useful and readily available proxy for changes in wealth" (Borio and Lowe 2002). Moreover, it could be argued that the production of new assets (residential and business investment) and their financing (saving) are already covered in the GDP-term of the equation.

3.1 The long-run relationship

The specification of the long-run relationship reads:

$$m_t - p_t = b_0 + b_1 y_t + b_2 irl_t + b_3 irs_t + b_4 t + b_5 e_t + b_6 h_t \quad (3)$$

Table 1 Augmented Dickey–Fuller test

Variable	t-statistics
Real money stock (log)	−7.51***
Real GDP (log)	−9.10***
Long-term interest rate	−6.34***
Short-term interest rate	−7.15***
Real equity prices (log)	−10.24***
Real house prices (log)	−5.48***

*,** and *** indicate that the variables are integrated at order 1 at the 10%, 5% and 1% level, respectively

where m stands for the log of money demand, p for the log of the GDP deflator, y is the log of real GDP, irs and irl the short and long-term interest rates, e the log of real equity prices, h the log of real house prices and b_0 is a constant. A time trend t is included. The simple Dickey-Fuller test confirmed that all these variables are integrated of order 1 so that a co-integration vector may be estimated (Table 1). The Augmented Dickey-Fuller test for higher order AR processes also rejected a unit root.

A salient finding frequently reported in the literature is that the elasticity of real money demand with respect to real GDP tends to exceed one, which is sometimes attributed to the omission of a real wealth variable. Hence, a fortiori inclusion of wealth effects should lead to a lower output elasticity, perhaps forcing it to below one. If so, it would be reasonable to restrict the long-run elasticities on real GDP and real asset prices to sum to one, i.e. to impose linear homogeneity in these variables. However, rather than imposing that restriction from the outset, we prefer to test for it. Therefore the long-term equation was estimated in the following modified form:

$$m_t - p_t = b_0 + b'_1 y_t + b_2 irl_t + b_3 irs_t + b_4 t + b_5(e_t - y_t) + b_6(h_t - y_t) \quad (4)$$

where $b'_1 = b_1 + b_5 + b_6$ and $b'_1 = 1$ in the case of homogeneity of order 1.

Table 2 reports the estimation results. The first column shows the results for a baseline equation without real asset prices. All coefficients have the correct sign, but that of the long-term interest rate is not significant. As expected, the elasticity on real GDP is found to be larger than one, with the Wald test clearly rejecting the hypothesis that it equals unity. As shown in the second column, this changes when a time trend is added; although it is not significant, the output elasticity falls and according to the Wald test it is no longer significantly different from unity. This is broadly consistent with the standard finding in the literature that the inclusion of a trend leads to a lower real GDP elasticity. Both variants of the equation pass the Ducky-Fuller co-integration test.

The inclusion of real asset prices in the equation clearly improves the estimation result (third columns of Table 2). Real stock prices exert a statistically significant negative influence on real money demand, suggesting a substitution effect, although it is rather small. Meanwhile, real house prices exert a large and statistically significant positive impact on real money demand, suggesting complementarity. The hypothesis of a unit root in the residuals is again rejected and the Wald test indicates that the restriction of homogeneity of degree 1 in real GDP and real asset prises may be imposed.

Table 2 Long term money demand equation

Dependent variable: Real M3 stock (log)	Equation without real asset prices		Equation with real asset prices		
	Baseline equation	Equation with trend	Baseline equation	Equation with dummy	Equation with dummy and homogeneity restriction
Constant	−7.754 (0.372)***	−5.831 (3.977)	7.511 (2.361)***	8.289 (2.158)***	6.063 (0.587)***
Real GDP (log)	1.255 (0.013)***	1.188 (0.138)***	0.975 (0.079)***	0.922 (0.073)***	1.000 (-)
Long-term interest rate (/100)	−0.444 (0.276)	−0.472 (0.283)*	−0.864 (0.198)***	−0.784 (0.181)***	−0.732 (0.175)***
Short-term interest rate (/100)	−0.509 (0.214)**	−0.463 (0.235)*	−0.440 (0.138)***	−0.438 (0.126)***	−0.496 (0.114)***
Time trend		0.000 (0.001)	0.003 (0.000)***	0.003 (0.000)***	0.002 (0.000)***
Real stock prices/real GDP (log)			−0.025 (0.006)***	−0.029 (0.006)***	−0.028 (0.006)***
Real house prices/real GDP (log)			0.320 (0.022)***	0.291 (0.022)***	0.291 (0.021)***
Dummy (pre-Ostmark conversion equal to 1, otherwise 0)				−0.027 (0.005)***	−0.026 (0.005)***
R^2 adjusted	0.992	0.992	0.998	0.998	0.998
Co-integration test (t)	−10.88***	−10.79***	−10.83***	−10.57***	−10.74***
Wald-test on non-homogeneity (F)	413.34***	1.85	0.10	1.15	

Standard errors in parentheses. *,** and *** denote significance at the 10, 5 and 1 per cent level. Critical values for the residual test of co-integration are from MacKinnon (1996)

One of our main concerns was that the empirical relationship may have been disrupted by major events around the time of the creation of the single currency. Obviously, the advent of the single currency itself on 1 January 1999 qualifies as the single most important event. Also potentially important has been the enlargement of what is now the euro area with the conversion of Ostmarks into Deutschmarks in 1990. This may distort our dataset. The Chow forecast test (based on estimations up to 1990Q1 and 1998Q4, respectively, rejected a structural break associated with the advent of the euro, but it did detect a break related to the German currency unification. Therefore the model was re-estimated with a dummy variable which has a value 1 prior to the conversion and 0 afterwards (fourth column of Table 2). The dummy is indeed very significant and has the expected sign (negative, because the money stock pre-unification was smaller than post-unification), but its inclusion hardly affects the other coefficients. Co-integration is again confirmed and the Wald test on homogeneity is passed. The last column of Table 2 shows the result after strict homgeneity was imposed, and we consider this as our final co-integration relationship.

3.2 The short-run relationship

The next step of the procedure consists in estimating the short term dynamic relationship explaining the change in the real money stock. The short-run equation to be estimated reads:

$$\begin{aligned}\Delta(m-p)_t = \alpha ECM_{t-1} + a_0 + \sum_{i=1}^{4} a_{1i}\Delta(m-p)_{t-i} + \sum_{i=1}^{4} a_{2i}\Delta y_{t-i} \\ + \sum_{i=1}^{4} a_{2i}\Delta irl_{t-i} + \sum_{i=1}^{4} a_{3i}\Delta irs_{t-i} + \sum_{i=1}^{4} a_{4i}\Delta e_{t-i} \\ + \sum_{i=1}^{4} a_{5i}\Delta h_{t-i} + \sum_{i=0}^{4} a_{6i}\Delta D_{t-i} \qquad (5)\end{aligned}$$

where

$$\begin{aligned}ECM_{t-1} = m_{t-1} - p_{t-1} - y_{t-1} - b_0 - b_2 irl_{t-1} - b_3 irs_{t-1} - b_4(t-1) \\ - b_5(e_{t-1} - y_{t-1}) - b_6(h_{t-1} - y_{t-1}) - b_7 D_{t-1}\end{aligned}$$

where Δ stands for the first difference operator and ε_t for the standard-normally distributed error. The cointegrating vector estimated above (fifth column of Table 2), lagged one quarter, is used to construct the error correction term (ECM). The dummy variable to capture German currency conversion is again included, but now as its change (which is equal to minus one in the second quarter of 1990 and zero otherwise). Initially four lags were introduced. Insignificant variables were removed in a sequential fashion. The results are shown

Table 3 Dynamic relationship

Explanatory variables	Coefficient	Standard error
Constant	0.003	0.001***
Error correction term(t-1)	−0.120	0.037***
Δ log Real money stock (t-1)	0.506	0.069***
Δ log Real GDP (t-4)	0.167	0.080**
Δ Short-term interest rate/100 (t-1)	−0.256	0.069***
Δ Dummy	−0.034	0.005***
Δ Dummy (t-1)	0.017	0.006***
R^2 adjusted	0.468	
SE and SSR	0.005	0.003

*,** and *** denote significance at the 10, 5 and 1 per cent level.

Dependent variable: Δ log Real money stock

in Table 3. The explanatory power is significant, and the standard statistical tests are passed without difficulties. Importantly, the Chow forecast test rejects the hypothesis of a break in 1999Q1. The error correction term is significant at the 1 per cent level, pointing to the existence of an equilibrium relationship between real money demand, real GDP, interest rates and real asset prices. The magnitude of the coefficient is somewhat larger than reported in the literature (Calza et al. 2001; Coenen and Vega 2001; Brand and Cassola 2004). Other significant variables in the short-run equation are the changes in the short-term interest rate (with a one-quarter lag) and the rate of growth of real GDP (with a four-quarter lag). This suggests that only output and short-term interest rates affect real money demand in the short run while asset markets (bonds, shares and houses) only play a role as a determinant of demand for real money in the long-run relationship. This does not look implausible given that portfolio decisions are essentially of a longer-term nature whereas decisions on liquidity positions may be expected to be more tightly related to short-run fluctuations in short-term interest rates and economic activity.

4 Did wealth effects push up M3 growth?

What matters for the policy maker is to what extent wealth fluctuations may explain the overshooting of the ECB's M3 target. Breaking down the M3 evolution into the different explanatory components provides information on the relative contribution of each variable, including the wealth indicators. Substituting the long-term relationship in the dynamic equation and rearranging yields:

$$\begin{aligned}(m-p)_t = \Gamma\{&-\alpha(1-b_5-b_6)y_{t-1} + \sum_{i=1}^{4} a_{2i}(y_{t-i}-y_{t-i-1}) - \alpha b_2 irl_{t-1} \\ &+ \sum_{i=1}^{4} a_{2i}(irl_{t-i}-irl_{t-i-1}) - \alpha b_3 irs_{t-1} + \sum_{i=1}^{4} a_{3i}(irs_{t-i}-irs_{t-i-1}) \\ &-\alpha b_5 e_{t-1} + \sum_{i=1}^{4} a_{4i}(e_{t-i}-e_{t-i-1}) - \alpha b_6 h_{t-1} + \sum_{i=1}^{4} a_{5i}(h_{t-i}-h_{t-i-1}) \\ &-\alpha b_0 + a_0 - \alpha b_4(t-1) + \varepsilon_t\} \qquad (6)\end{aligned}$$

Table 4 Decomposition of money growth

	1999	2000	2001	2002	2003	2004	Average
Nominal M3	0.049	0.053	0.062	0.068	0.072	0.059	0.061
GDP deflator	0.009	0.013	0.023	0.025	0.020	0.020	0.018
Real M3	0.040	0.040	0.039	0.042	0.052	0.039	0.042
Contribution from							
Real GDP	0.005	0.056	−0.017	0.021	0.007	0.008	0.013
Long-term interest rate	0.008	−0.008	0.001	0.001	0.005	0.001	0.001
Short-term interest rate	0.009	−0.022	0.010	0.009	0.006	−0.004	0.001
Real equity price	−0.002	−0.006	0.003	0.007	0.008	−0.005	0.001
Real house price	0.010	0.016	0.009	0.012	0.016	0.019	0.014
Constant and trend	0.005	0.015	−0.002	0.012	0.008	0.007	0.008
Error term	0.013	−0.017	0.035	−0.014	0.001	0.015	0.005

Annual average year-on-year change in logarithms. Components may not add up to total due to rounding

where

$$\Gamma = 1 \Big/ \left[1 - (1 + a_{11} + \alpha)\frac{(m-p)_{t-1}}{(m-p)_t} + a_{11}\frac{(m-p)_{t-2}}{(m-p)_t} - \frac{\sum_{i=2}^{4} a_{1i}[(m-p)_{t-i} - (m-p)_{t-i-1}]}{(m-p)_t} \right]$$

Inserting the estimated numerical values of the coefficients in this equation yields:

$$\begin{aligned}(m-p)_t = {} & \Gamma\{0.120^*(1 + 0.028 - 0.291)^* y_{t-1} + 0.167^*(y_{t-4} - y_{t-5}) \\ & - 0.120^* 0.732^* irl_{t-1} - 0.120^* 0.496^* irs_{t-1} - 0.256^*\,(irs_{t-1} - irs_{t-2}) \\ & - 0.120^* 0.028^* e_{t-1} + 0.120^* 0.291^* h_{t-1} + 0.120^* 6.063 \\ & + 0.003 + 0.120^* 0.002^*(t-1) + \varepsilon_t\}\end{aligned}$$

where

$$\Gamma = 1 \Big/ \left[1 - (1 + 0.506 - 0.120)\frac{(m-p)_{t-1}}{(m-p)_t} + 0.506^*\frac{(m-p)_{t-2}}{(m-p)_t} \right] \quad (7)$$

Table 4 reports the results of this breakdown, showing the annual averages year-on-year growth in money demand and its determinants for the period 1999–2004. In the period as a whole, the money stock grew on average by roughly 6 % per annum and its real equivalent by around 4 1/4% per annum. About 1 1/4% is explained by real output growth, which leaves 3% to be explained by a fall in money velocity. Of this, half (1 1/2%) can be explained by the run-up in real house prices. Hence real house price developments apparently explain all of the “excess” money growth over an above the 4 1/2% reference value since the inception of the single currency in 1999. This is a potentially important finding. It implies that, abstracting from the impact of the housing boom, money demand in the euro area since the inception of the single currency has been growing at almost exactly its target rate of 4 1/2% the European Central Bank considers to be consistent with price stability in the medium to long run. This is not to say that "excess" money growth would not be of any concern at all, but it does suggest that there is no immediate inflation risk associated with the current development of money demand in the euro area.

5 Concluding remarks

This paper presented an empirical analysis of the demand for money in the euro area over a period including the introduction of the euro in 1999. The analysis sought to explain the rapid growth of money since the inception of the euro by the increase of real asset prices. We regressed real M3 on real GDP, short- and long-term interest rates and real housing and stock prices within an error-correction framework. We indeed find evidence of a positive relationship between house prices and liquidity and a negative relationship with equity prices and liquidity in the long run. Tests suggest that the relationship is stable and has not been disrupted by the introduction of the euro on 1 January 1999. The empirical evidence suggests that a large part of the overshooting may indeed be due house price developments. This suggest that the systematic overshooting of the M3 target in the euro area may be less of a puzzle in a low inflation environment with a credible monetary policy framework where money is considered to be a relatively safe asset of which agents are prepared to hold more if their (housing-) wealth position improves. Obviously the euro area and the single monetary policy are relatively young, and further monitoring will add valuable information as to the validity of this conclusion.

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