

SOME ISSUES CONCERNING THE USE OF M3 FOR MONETARY POLICY ANALYSIS IN THE EURO AREA*

*Nuno Alves***

*Carlos Robalo Marques***

*João Sousa***

1. INTRODUCTION

The broad monetary aggregate M3 is the aggregate used as a reference to assess monetary developments in the euro area. In order for this aggregate to be a useful device to assess medium to long-term risks to price stability two conditions must be satisfied. First, a stable long-run relationship between M3 and its determinants must exist and second, M3 must be a leading indicator of inflation.

During the last five years or so, a significant number of papers aiming at establishing those two conditions for M3 in the euro area was produced. Studies aiming at uncovering a stable long-run money demand equation include the papers by Coenen and Vega (2001), Brand and Cassola (2000), Calza, Gerdesmeier and Levy (2001), Cassola and Morana (2002), Bruggeman, Donati and Warne (2003) and Carstensen (2004a). In turn, studies aiming at establishing the leading indicator property of M3 for inflation include Trecroci and Vega (2000) and Altimari (2001). During this period, the prevalent idea was that money demand in the euro area is stable and that the M3 aggregate exhibits good leading indicator properties with respect to future prices (see the ECB May 2001 and October 2004 Monthly Bulletins).

It is well known that after mid 2001 the monetary aggregate M3 started to grow at a very high rate, significantly above the reference value of 4½ per cent annual growth for M3 defined by the ECB. At first, this fact was mainly explained by portfolio shifts in the stock market. More specifically, an increased uncertainty in this market was seen as giving rise to portfolio adjustments towards more liquid and safer assets included in M3, and thus to an acceleration of this aggregate (see the ECB Monthly Bulletins for this period).

However, after almost five years during which M3 grew on average significantly above the reference value of 4½ per cent in annual terms, in a context of moderate economic growth and a stable and low inflation rate close to two per cent, the question of whether the two above mentioned properties for M3 still stand naturally arises. Thus, this article aims at investigating whether a stable long run money demand function for M3 still exists and to discuss the leading indicator properties of this monetary aggregate for inflation in the euro area.

The remainder of the article is organised as follows. Section 2 re-evaluates two important money demand equations for the euro area and section 3 discusses the implications for the excess liquidity indicators, released by the ECB on a regular basis, stemming from cointegration and/or stability breakdown in the long run money demand equation. Section 4 documents the leading indicator properties of M3 and discusses its robustness, with special focus on the more recent period, which was char-

* The analyses, opinions and findings of this article are those of the authors and do not necessarily coincide with those of the Banco de Portugal.

** Banco de Portugal. Economic Research Department

acterised by a strong increase in M3 growth in a context of relative price stability. Finally section 5 puts forward the main conclusions.

2. STABILITY OF THE LONG RUN MONEY DEMAND EQUATION

Among the models aimed at establishing the existence of a stable long run relationship two of them, one proposed in Calza, Gerdemesier and Levy (2001) [CGL (2001)] and the other suggested in Carstensen (2004a), deserve special attention. The importance of the CGL (2001) model stems from the fact that it is the model which, with minor modifications, the ECB used in its monetary assessments (see ECB, 2004). The importance of the model suggested in Carstensen (2004a) stems from the fact that it is an extension of the original version of the CGL model which aims at endogenizing the portfolio shifts that occurred after mid 2001 and also because it is the only model, among the set of models investigated by the author, that remained stable when estimated with data until the second quarter of 2003 (maximum sample available at the date) ¹.

The original version of the CGL (2001) model is a VAR comprising real M3, real GDP and the opportunity cost of M3 (the spread between the short-term market interest rate and the own rate of M3), with two lags in the levels of the variables. A more recent version of the CGL (2001) model (see, ECB, 2004) includes in addition the following exogenous stationary variables affecting only the short-term dynamics: one quarter-lagged change in oil prices and in the yield curve (defined as the spread between the long-term government bond yield and the short-term market interest rate) and the first difference of the annualised quarterly inflation rate (based on the GDP deflator). In what follows these two models will be denoted as the “original version” and the “revised version” of the CGL model.

The model suggested in Carstensen (2004a) is an extension of the original version of the CGL (2001) model, which besides real M3, real GDP and the spread between the short-term market interest rate and the own rate of M3, also includes two stock market variables. These two stock market variables are the stock market volatility and the spread between equity returns and the own rate of M3. Thus, in the case of the model suggested in Carstensen (2004a) the long run money demand function can be written as

$$(m - p)_t = \beta_0 + \beta_1 y_t + \beta_2 (r_t^s - r_t^o) + \beta_3 (r_t^e - r_t^o) + \beta_4 z_t \quad (1)$$

where $(m - p)_t$ stands for the log of the real money stock, y_t for the log of real GDP, r_t^s for the short-term nominal interest rate, r_t^o for the nominal own rate of M3, r_t^e for the nominal equity return and for the stock market volatility². The original version of the CGL model obtains by setting $\beta_3 = \beta_4 = 0$. Following Carstensen (2004b) model (1) will be denoted below as the “stock market” specification.

In this model all the individual variables are assumed to be integrated of order one. For the re-evaluation that follows we use data until the fourth quarter of 2005. We start by looking at the cointegration tests in order to investigate whether cointegration holds when more recent data are added to the analysis and then we test formally for cointegration and stability breakdown using the tests recently suggested in Andrews and Kim (2003).

(1) Very recently Dreger e Wolters (2006) claimed to have found a stable long run money demand involving the real stock of M3, real GDP and inflation. However, it seems that the model was not estimated using the official M3 aggregate but rather a monetary aggregate built on the basis of money holdings not adjusted for reclassifications, other re-evaluations, exchange rate variations and variations other than those related to transactions.

(2) The nominal equity returns and the stock market volatility were computed as in Carstensen (2004a). More specifically the nominal equity returns are constructed as the annualised three-year log differences of quarterly nominal stock prices as measured by the Dow Jones Euro Stoxx50. In turn, the stock market volatility is constructed as the two-year average of the conditional variance estimated from a Garch model with t-Student innovations applied to daily yields of the nominal stock price index. Data for the remaining variables were obtained from the ECB.

Table 1

CGL MODEL (REVISED VERSION)					
Sample	Johansen cointegration tests				Weak exogeneity of GDP
	Trace test [Prob]	Max test [Prob]	Trace test [Prob, T-nm]	Max test [Prob, T-nm]	$\chi^2(1)$ [Prob]
(1)	(2)	(3)	(4)	(5)	(6)
80Q3-02Q1	32.5 [0.02]*	19.2 [0.09]	30.2 [0.05]*	17.9 [0.14]	0.0 [0.86]
80Q3-02Q4	31.0 [0.04]*	18.4 [0.12]	28.9 [0.06]	17.2 [0.17]	0.1 [0.76]
80Q3-03Q1	29.3 [0.06]	17.9 [0.14]	27.4 [0.10]	16.7 [0.20]	0.5 [0.47]
80Q3-03Q2	27.1 [0.10]	17.6 [0.15]	25.3 [0.16]	16.4 [0.21]	1.5 [0.22]
80Q3-03Q3	27.4 [0.10]	17.4 [0.16]	25.6 [0.15]	16.3 [0.22]	1.4 [0.23]
80Q3-03Q4	26.1 [0.13]	17.2 [0.17]	24.5 [0.19]	16.1 [0.23]	2.2 [0.14]
80Q3-04Q4	21.9 [0.32]	16.4 [0.21]	20.5 [0.40]	15.4 [0.27]	5.3 [0.02]*
80Q3-05Q4	19.9 [0.44]	15.7 [0.21]	18.7 [0.53]	14.8 [0.32]	6.9 [0.01]*

Note: * marks significance at 95% level.

Table 1 displays the results of the Johansen cointegration tests for the null of zero cointegrating vectors against the alternative of (at least) one cointegrating vector (with p-values in brackets) in the revised version of the CGL model, as defined above. The sample starts in 1980Q3 (the first two observations are used to account for the two lags of the model) and the end-of-sample varies from 2002Q1 to 2005Q4. Table 1 reports the p-values using both the asymptotic distribution (columns 2 and 3) and the small sample correction (denoted by “trace test (T-nm)” and “max test (T-nm)” in columns 4 and 5). Following the discussion in the literature that suggests that the conventional asymptotic trace and maximum eigenvalue tests are subject to size distortions in small samples, we focus on the small sample corrected critical values.

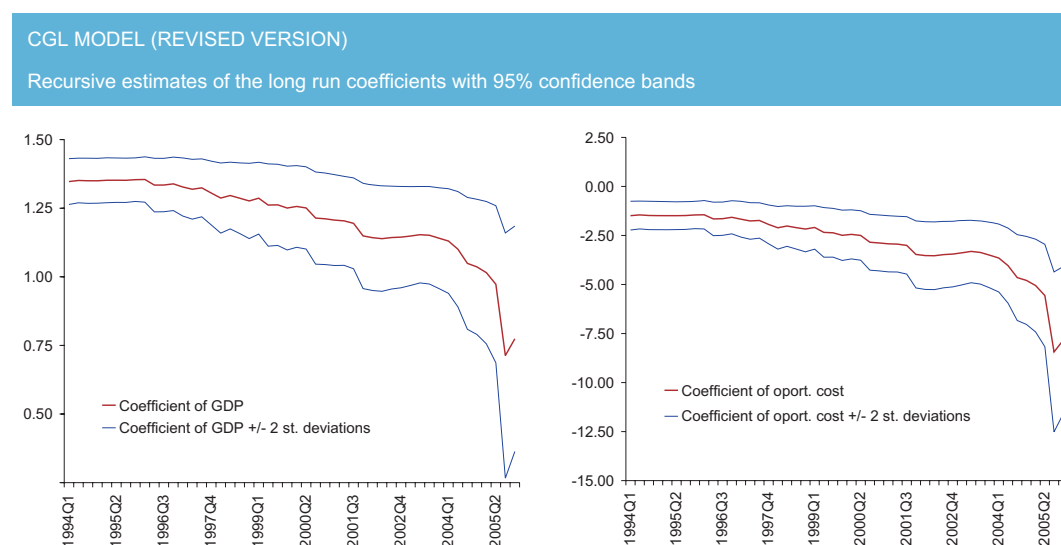
The CGL (2001) model was developed under the assumption of a single cointegrating vector. Looking at the cointegration tests in Table 1 we see that cointegration is lost in 2003, as for none of the tests including data for 2003Q2 and thereafter is the null of zero cointegrating vectors rejected (for a 10% test). Moreover, the evidence against cointegration accumulates steadily over the remainder of 2003 and during 2004 and 2005. Using the maximum sample period available (data until 2005Q4) we see that the null of zero cointegration vectors is not rejected even for a 30% test. More specifically the p-values for the null of zero cointegrating vectors are 53% (trace test) and 32% (max test). Those figures are far beyond any acceptable level of significance used in the literature (which usually conducts tests at 1%, 5% or at most 10%).

Overall, given the lack of evidence favouring the existence of cointegration when the last three years of data are added to the sample, we can no longer claim that a long run money demand exists in the context of the “revised version” of the CGL model.

Chart 1 depicts the recursive estimates of the long run parameters associated with GDP and the opportunity cost with 95% confidence bands³. Even though simple inspection of recursive graphics does not constitute a formal stability test it nevertheless constitutes a very useful exercise as it allows a quick check of the evolution over time of the parameter estimates. By looking at Chart 1 we see that the recursive estimates change significantly as more recent data enter the sample. For instance, the point estimate for GDP elasticity is 1.31 when data until 2002Q4 are used but drops to 0.77 when data until 2005Q4 are added to the sample. The situation is even more acute as regards the opportunity cost semi-elasticity that increases (in absolute terms) from -1.30 in 2002Q4 to -7.84 in 2005Q4. In both

(3) Charts 1 and 2 were obtained without re-estimating the short-run dynamics during the recursive estimation of the system.

Chart 1



cases the point estimates in 2005Q4 are clearly out of the 95% confidence interval that surrounds the estimates in 2002Q4, suggesting that a break could have occurred in both coefficients⁴.

Let us now look at the model suggested in Carstensen (2004, a, b), i.e. the “stock market” specification. Similarly to Table 1, Table 2 displays the results of the Johansen cointegration tests for the null of zero cointegrating vectors against the alternative of (at least) one cointegrating vector (with p-values in brackets). The tests are for a sample starting in 1980Q3 (the first two observations are used to account for the two lags of the model) and with the end-of-sample varying from 2003Q2 to 2005Q4.

From Table 2 we conclude that the “stock market” specification does a good job, as far as cointegration is concerned, until the first half of 2005. It is only when data for the second half of 2005 are added to the analysis that cointegration seems to be lost.

Intuitively we can understand the outcome of the cointegration tests of the model by looking at Charts A1 to A6 in the Appendix. From Chart A1 we see that the real money stock accelerates after 2001. As this acceleration is not accompanied by an acceleration of real GDP (Chart A3) or by a significant de-

Table 2

CARSTENSEN'S MODEL				
Johansen cointegration tests				
Sample	Trace test [Prob]	Max test [Prob]	Trace test [Prob, T-nm]	Max test [Prob, T-nm]
(1)	(2)	(3)	(4)	(5)
80Q3-03Q4	78.3 [0.01]*	40.4 [0.01]*	70.0 [0.05]*	36.1 [0.02]*
80Q3-04Q4	80.5 [0.01]*	38.8 [0.01]*	72.3 [0.03]*	34.8 [0.03]*
80Q3-05Q1	80.3 [0.01]*	38.5 [0.01]*	72.2 [0.03]*	34.6 [0.04]*
80Q3-05Q2	80.5 [0.01]*	38.3 [0.01]*	72.5 [0.03]*	34.5 [0.04]*
80Q3-05Q3	71.5 [0.04]*	30.0 [0.14]	64.4 [0.12]	27.0 [0.27]
80Q3-05Q4	70.9 [0.04]*	29.4 [0.16]	63.8 [0.14]	26.5 [0.30]

Note: * marks significance at 95% level.

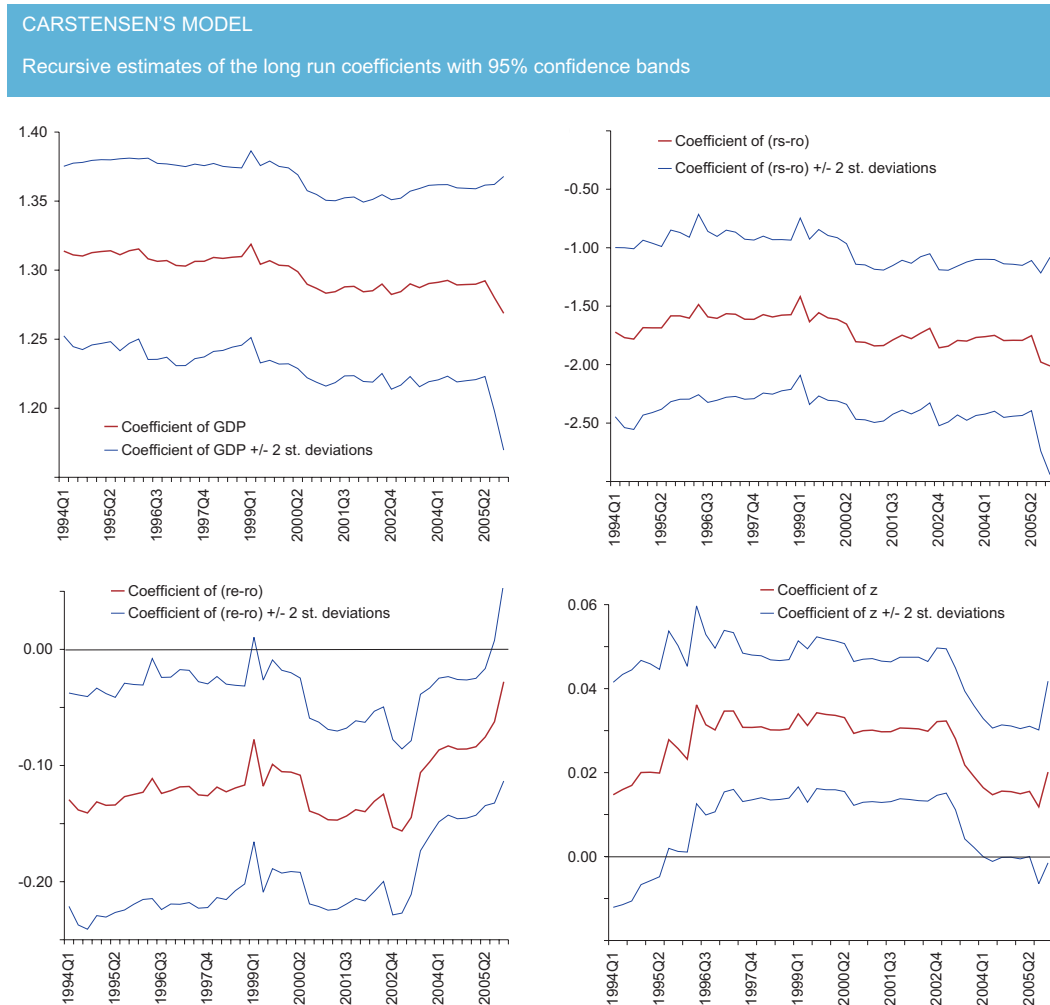
(4) Chart 1 was obtained without imposing any weak-exogeneity restriction. As an alternative one could look at the recursive estimates of the long run money demand coefficients after imposing the weak-exogeneity restriction of GDP, as in ECB (2004). In such a case the situation is more favourable as regards stability of the two coefficients, and this is especially so for the coefficient of GDP that decreases from 1.32 in 2002Q4 to 1.17 in 2005Q4. We note however, that imposing such a restriction is now highly questionable, because as the test of weak-exogeneity in the last column of Table 1 suggests such a restriction ceased to be valid (the restriction is rejected for a 5% test when data after 2004Q3 are added to the model). Moreover the validity of such a test is itself at stake because it is valid only under the assumption of cointegration, which according to Table 1 is difficult to sustain.

cline in the spread between the short term market rate and the own rate (Chart 4), the CGL model starts to perform poorer and poorer and eventually cointegration is lost in the first half of 2003, as Table 1 shows. On the other hand, Charts A5 and A6 show that the spread between the equity returns and the own rate, $(r_t^e - r_t^o)$, decreases and the volatility, z_t , increases until the beginning of 2003, which explains the good performance of the “stock market” specification, in this period. However, after the first quarter of 2003 the spread increases while volatility decreases. This, all else equal, should have brought about a decrease or at least a deceleration in money growth during this period which did not occur. This is why the model performs poorer in the second half of 2005.

Chart 2 displays the recursive estimates of the long run parameters⁵. As could be expected the estimated coefficient of $(r_t^e - r_t^o)$ and z_t start to exhibit some instability after the beginning of 2003 converging towards zero, reflecting the fact that during this period the developments in the money market are at odds with the developments in the stock market.

We have just seen that when the most recent data are added to the sample, the evidence on cointegration in the CGL and Carstensen’s model weakens and that the estimated long-run coefficients display significant changes. However, against this type of analysis it may be argued that

Chart 2



(5) Chart 2 was obtained without imposing any weak exogeneity restriction. Imposing weak exogeneity of GDP has no significant implications of the estimated coefficients.

cointegration tests may exhibit power problems and the recursive estimates of the long run parameters with the corresponding 95 percent confidence intervals do not constitute formal stability tests. Thus, we now address the issue in a more formal way by resorting to cointegration and stability breakdown tests recently suggested in the literature.

Andrews and Kim (2003) introduced some tests for cointegration breakdown that may occur at the end of the sample and thus are specially designed to investigate the problem at hand. The tests are conducted under the assumption that cointegration and stability of the long run coefficients hold until a certain point in time and we want to investigate whether there is a cointegration breakdown after that period. Cointegration breakdown may occur due to a shift in the cointegration vector or to a shift in the errors from being stationary to being integrated.

To test for cointegration breakdown Andrews and Kim (2003) developed two families of tests, each family including three alternative statistics. Using Monte Carlo simulations Andrews and Kim found that the statistics R_c and P_c performed slightly better than the other ones in terms of size and/or power. For such a reason, below we stick to these two statistics⁶.

For the models under scrutiny the tests are conducted under the assumption that there is cointegration and long run stability when the models are estimated with data until the third quarter of 2001. Thus, the cointegration breakdown is investigated for the period 2001Q4-2005Q4. The choice of this period stems from the fact that the second half of 2001 marks the beginning of high money growth so that 2001Q4 is a date where instability may show up. On the other hand the validity of the tests rests on the assumption that the model is stable before the date of the break and there is evidence that the models are stable when estimated with data until 2001Q3 (see Carstensen, 2004a).

Table 3 presents the simulated p-values of the P_c and R_c tests for the models under investigation, using FM-OLS and FIML to estimate the long-run relationships. From Table 3 we see that there are no strong

Table 3

COINTEGRATION BREAKDOWN TESTS (P-VALUES)		
Test (1)	CGL (revised version) (2)	"Stock market" specification (3)
Break at 2001Q4, sample until 2003Q2		
P_c (FM-OLS)	0.089	0.190
R_c (FM-OLS)	0.076	0.203
P_c (FIML)	0.260	0.166
R_c (FIML)	0.364	0.104
Break at 2001Q4, sample until 2004Q4		
P_c (FM-OLS)	0.000	0.137
R_c (FM-OLS)	0.000	0.233
P_c (FIML)	0.014	0.394
R_c (FIML)	0.239	0.507
Break at 2001Q4, sample until 2005Q2		
P_c (FM-OLS)	0.000	0.000
R_c (FM-OLS)	0.000	0.000
P_c (FIML)	0.000	0.044
R_c (FIML)	0.015	0.145
Break at 2001Q4, sample until 2005Q4		
P_c (FM-OLS)	0.000	0.000
R_c (FM-OLS)	0.000	0.000
P_c (FIML)	0.000	0.000
R_c (FIML)	0.000	0.000

Note: Entries in the Table are the bootstrapped P-values of the P_c and R_c cointegration breakdown tests proposed in Andrews and Kim (2003).

(6) In the computations of the Andrews and Kim tests we used a Rats procedure, which Kai Carstensen kindly made available to us.

signs of instability or cointegration breakdown in the two models, if only the sample until 2003Q2 is considered⁷. When the sample is extended until 2004Q4, cointegration and/or stability is generally rejected in the CGL model (the exception is the R_c test when the model is estimated by FIML), but not in the stock market specification. However, when data until 2005Q4 are considered cointegration and/or stability of the two models is strongly rejected.

Thus, the evidence we get from the Andrews and Kim cointegration breakdown tests is in line with the evidence on the Johansen cointegration tests presented above. When data for the period 2003-2005 are considered cointegration is progressively lost and stability is rejected both in the CGL and in the Carstensen models. The fact that a cointegration breakdown has occurred in Carstensen's model during 2005 casts strong doubts on the idea that excessive money growth can be explained only by the above-mentioned portfolio shifts and suggests that other explanations may need to be considered in order to justify the continuation of M3 excessive growth, in the most recent period.

At a more structural level the emergence of cointegration breakdown or parameter instability implies that there is no longer a stable long-run relation linking M3, prices and the level of activity so that, in the context of these models, this monetary aggregate is no longer a well-suited tool to assess monetary developments. In particular, as shown below, cointegration breakdown also implies that the so-called excess liquidity indicators based on the residuals of the cointegrating regressions lose their information content⁸.

3. CONSEQUENCES OF COINTEGRATION BREAKDOWN FOR EXCESS LIQUIDITY INDICATORS

In assessing monetary developments the ECB uses the real and nominal money gaps as excess liquidity measures which are usually interpreted as useful leading indicators of inflation. In their own words “these measures are useful for a comprehensive medium term-oriented monetary analysis, since a protracted upward or downward deviation of the observed money stock from its equilibrium level may bring about risks to price stability which might not be visible in the annual growth rate of M3” [see, for instance, ECB, 2001, and ECB, 2004].

In this section we briefly review the different excess liquidity indicators and address the consequences for such indicators stemming from cointegration breakdown or parameter instability in the underlying money demand equations.

In line with the relevant literature let us assume that the “desired level” of (log) real balances, $(m - p)_t^*$, is given by the “the static long run money demand equation”:

$$(m - p)_t^* = \alpha + \beta y_t + \gamma r_t \quad (1)$$

where y_t is the log of real GDP and the opportunity cost of money.

The *monetary overhang/shortfall* (MO) is defined as the difference (in logs) between the actual real money balances and its “desired” level:

(7) This is the sample used in Carstensen (2004a,b).

(8) As a complement to the official M3 aggregate the ECB has built a new aggregate, the so-called “M3 corrected for the impact of portfolio shifts” [see ECB, 2004]. However, using such an aggregate for monetary analysis raises several important questions. First, the correction is completely ad-hoc, based on simple non-causal time series models, implying that in fact we do not know what the money stock would have been in the absence of such portfolio shifts. Second, it is used under the assumption that the existing models (including the estimates of the parameters) would have remained valid after 2001/2002 in the absence of such shifts, something that cannot be investigated. Finally, as we have seen, cointegration breakdown in the long run money demand, for the most recent period, cannot be explained by portfolio shifts, because it also occurs in the “stock market” specification.

$$MO_t = (m - p) - (m - p)_t^* = (m - p) - \alpha - \beta y_t - \gamma r_t \quad (2)$$

and reflects developments in money not explained by macroeconomic variables of the long-run money demand model. In practical terms, MO_t corresponds to the residuals of the static money demand equation (1).

The *nominal money gap* (NMG) is defined as the difference between the actual nominal money stock and the “equilibrium” nominal money stock:

$$NMG_t = (m_t - m_t^{eqn}) = m_t - (p_t^* + \alpha + \beta y_t^* + \gamma r_t^*) \quad (3)$$

where y_t^* and r_t^* stand for the equilibrium values of output and the opportunity cost, and p_t^* is the price level consistent with price stability as defined by the ECB. In turn, the *real money gap* (RMG) is the difference between the actual real money stock and the “equilibrium” real money stock:

$$\begin{aligned} RMG_t &= (m_t - p_t) - m_t^{eqr} = (m_t - p_t) - (m_t^{eqn} - p_t^*) \\ &= (m_t - p_t) - \alpha - \beta y_t^* - \gamma r_t^* \end{aligned} \quad (4)$$

In theory both the nominal money gap and the real money gap should be computed using the right hand side of (3) and of (4), respectively⁹.

In monetary assessments the above monetary indicators are frequently used as measures of excess liquidity, which in turn is seen as a potential source of future inflation (see, for instance, ECB, 2004). The use of such measures as leading indicators of inflation has been legitimated with some empirical evidence. For instance, Gerlach and Svensson (2003) and Trecroci and Vega (2000) conclude that the real money gap has substantial predictive power for future inflation. However, such evidence was obtained using data until 2000. Thus the relevant question is whether such evidence still stands once more recent data are considered in the analysis. This issue is particularly relevant because as we have seen above the strong monetary developments that took place after 2001 cannot be explained in the context of the money demand equation and this may be expected to have important consequences for the leading indicator properties of the monetary indicators based on money demand equations.

To see how the lack of cointegration in the money demand equation may have important consequences for the properties of the estimated real money gap, we start by noticing that the real money gap may be written as

$$RMG_t = MO_t + \beta(y_t - y_t^*) + \gamma(r_t - r_t^*) \quad (5)$$

where MO_t stands for the “monetary overhang/shortfall” indicator. As MO_t is estimated as the residuals of the cointegrating regression corresponding to the underlying money demand equation (see, equation 2) it is immediate to recognize that cointegration or stability problems of the underlying long run money demand equation will show up directly on the properties of the real money gap through the monetary overhang component.

If the underlying money demand equation exhibits cointegration, then by definition, MO_t is a stationary variable and so would be the estimated real money gap. This is expected to have been the case until 2001/2002, which corresponds to the maximum period of data used in the papers by Trecroci and Vega (2000), Altinari (2001) and Gerlach and Svensson (2003). However, we have seen that as data

(9) As an alternative the nominal and real money gaps may also be computed using the constant money growth rate corresponding to the reference value for M3 growth (4½% in annual terms) and the constant inflation rate corresponding to monetary authority’s definition of price stability (see, ECB 2001, 2004). However, such money gaps do exhibit some limitations stemming from the fact that they coincide with the actual money stock up to a linear time trend and thus, their information content does not differ from the information content of the actual money stock itself.

after 2002 are added to the analysis the evidence on cointegration for the CGL model disappears, and this, by definition, implies that the monetary overhang/shortfall indicator ceases to be a stationary variable. As a consequence, the estimated real money gap also ceases to be stationary.

The first implication of such a situation is that the real money gap itself, similarly to what happens to the underlying money demand equation, loses its economic meaning. This applies, in particular, to its interpretation as an excess liquidity indicator. In fact, since this is an $I(1)$ variable, it does not exhibit mean-reversion. In other words, there is no longer any meaningful equilibrium level of real money balances corresponding to zero excess liquidity, to which the real money gap can be expected to return on a regular basis.

The second important implication is that the corresponding estimated real money gap is also likely to lose its leading indicator properties of inflation. To see that let us take a look at the model estimated in Trecroci and Vega (2000):

$$\Delta\pi_t = \theta_0(\pi_{t-1} - \hat{\pi}_t) + \theta_1 RMG_{t-1} + \theta_2(y - y^*)_{t-1} + \theta_3(r - r^*)_{t-1} + \dots + v_t \quad (6)$$

where, π_t , $\hat{\pi}_t$ and y^* stand for inflation, inflation target and potential GDP respectively. Given that θ_1 is found to be significantly different from zero (and positive) the authors conclude that the real money gap exhibits substantial predictive power for future inflation in the euro area¹⁰.

Now, under the assumption of cointegration in the underlying money demand model, (6) is a balanced equation in which the regressand ($\Delta\pi_t$), as well as, all the regressors (in particular RMG_{t-1}) are stationary. However, in the absence of cointegration, (6) is unbalanced from a statistical point of view, because a stationary regressand is being regressed on a set of regressors where all but one (RMG_{t-1}) are stationary. Statistically we should thus expect to have $\theta_1 = 0$. Thus, we conclude that cointegration breakdown in the money demand equation, brought about by monetary developments not explained by the determinants included in the money demand equation, is also likely to imply that the corresponding real money gap would lose its leading indicator properties.

4. M3 AS A LEADING INDICATOR OF PRICES IN THE EURO AREA

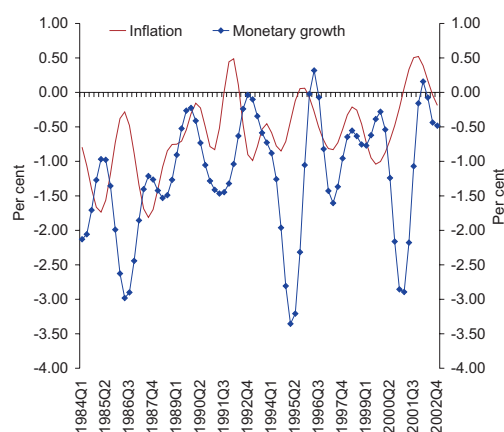
The previous section showed that given the breakdown in cointegration in the long-run money demand function it is likely that the properties of excess liquidity indicators as leading indicators of inflation deteriorate once the more recent data is included in the estimation of the models. The cointegration breakdown in money demand could have similar consequences in terms of the properties of the M3 aggregate. In fact, it could imply that M3 may no longer be a good instrument to analyse the medium to long-term prospects for inflation. Against this background, this section aims at documenting and discussing the leading indicator properties of M3 in the medium to long-term. The emphasis in the medium to long-term stems from two arguments. On one hand, this is the relevant horizon in terms of the current monetary policy strategy of the ECB. On the other hand, it is consensual that the relation between M3 and prices in the short-run is fragile, of an ambiguous sign and not relevant for the conduct of monetary policy. This fact has been stressed in many studies (see ECB, 2004)¹¹. The lack of a short-run relation between M3 and inflation can also be seen looking at Chart 3, which presents the year-on-year rate of change in the short to medium-term component of M3 growth and inflation (fre-

(10) Gerlach and Svensson (2002) carry out a similar analysis in a slightly different model.

(11) The reason underlying this result is immediate: the response of M3 and prices varies as a function of the shocks that are continuously hitting the economy (such as, just to name a few representative examples, monetary policy shocks, technological shocks, velocity shocks, consumer preference shock and fiscal shocks).

Chart 3

FREQUENCY COMPONENTS BETWEEN 6 AND 32
 QUARTERS OF MONEY GROWTH AND INFLATION
 (CHRISTIANO-FITZGERALD FILTER)



quencies between 6 and 32 quarters) computed with the Christiano-Fitzgerald (2003) filter, in its symmetric version.

The most quoted work in favour of the existence of a leading indicator role for money to inflation in the euro area is Altimari (2001) who applies the methodology proposed by Stock and Watson (1999) to the euro area. This methodology compares the forecast performance of univariate models of inflation with that of bivariate models including monetary growth as an additional explanatory variable. According to the results of Altimari (2001), money growth has leading indicator properties for inflation in the two to three year horizon. However, the conclusions of this study should be qualified. First, the results obtained with the methodology of Altimari (2001) are based on specifications which assume that M3 growth and inflation were stationary variables during the sample period. This hypothesis is, however, rejected by the data, which suggest that both inflation and money growth are better classified as integrated variables of order 1. Second, when the specification of the Altimari (2001) test takes into account the properties of the series in the sample period, the information content of monetary aggregates completely disappears¹². This outcome suggests that the finding of significant indicator properties of money may be associated with the disinflation period seen in the euro area, which contributed to a common declining trend of the growth of both M3 and prices.

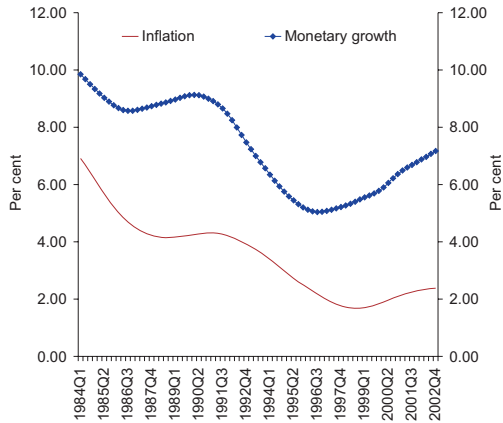
In addition, at this stage, given the breakdown of cointegration, one can expect that the medium-term leading indicator properties of M3 have been affected. However, this conjecture cannot yet be tested on the basis of the methodology of Altimari (2001) given that the data for 2004/2005 are exactly those which have to be left out when assessing the leading indicator properties for horizons above two years.

An alternative way for assessing the leading indicator properties of money in the medium to long-term is to investigate to what extent the money growth trend has exhibited a close and leading relation with the inflation trend (see ECB, 2004). In descriptive terms, this relation is visible in Chart 4 which presents the year-on-year rate of change in the long-run component of M3 growth and inflation computed with the Christiano-Fitzgerald (2003) filter (frequencies above 32 quarters), in its symmetric version. Chart 4 suggests two important considerations regarding the relation between the very long-term trends (frequencies above 8 years) of M3 growth and inflation. First, there seems to be a close relation

(12) This finding is reported in Altimari (2001), but usually is not duly emphasised in the quotations of the paper.

Chart 4

LONG RUN TRENDS IN INFLATION AND MONEY GROWTH (CHRISTIANO-FITZGERALD FILTER; FREQUENCIES>32 QUARTERS)



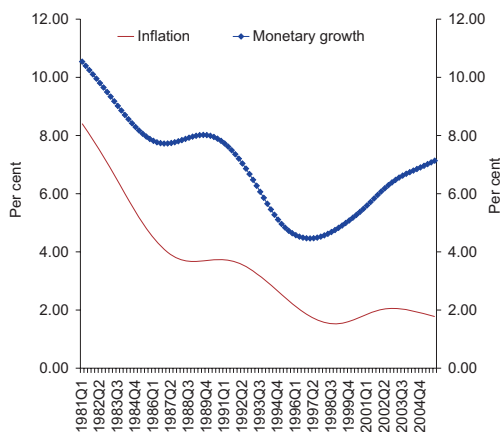
between the long-run evolution of money and prices, even though there is a marked deterioration in the more recent period, probably related to the breakdown in cointegration shown in section 2. The weakening of the relation is particularly noticeable if more conventional measures of trends that also take into account the more recent period such as, for example, the Hodrick-Prescott filter, are used instead (see Chart 5). Second, Charts 4 and 5 suggest that the trend component of money growth leads the inflation trend component by about 6 to 8 quarters.

Despite these findings, there are several arguments that suggest that trend measures of money growth are difficult to interpret as leading indicators of inflation.

First, the existence of a leading indicator relation has a complex interpretation when dealing with low frequencies. In fact, the construction of trend measures for a certain period using Christiano-Fitzgerald or HP filters takes into account not only the past information of the variables but future information as well (crudely, these measures can be interpreted as weighted averages of past and future values of

Chart 5

TRENDS IN MONEY GROWTH AND INFLATION (HODRICK-PRESCOTT FILTER; LAMBDA=1600)



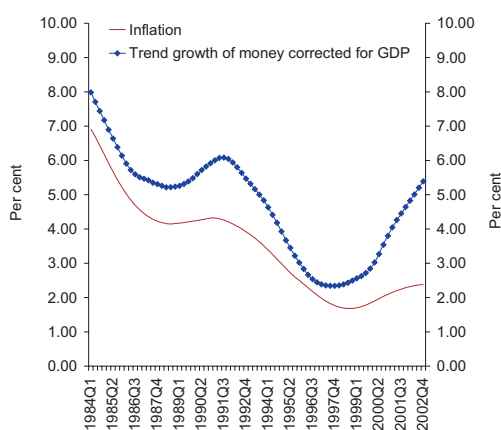
monetary growth and inflation). This supports the claim that it is difficult to discuss leading indicator properties in this context. In addition, and on more operational grounds, it should be noted that the correlation between money and prices only arises at very low frequencies, which implies that trend money measures are not too responsive, being difficult to relate to short and medium term economic developments.

Second, it is important to note that the quantity theory of money suggests that the long run relation between money and prices should take into account the trend evolution of output. However, the empirical relation between the long run component of money and prices in the euro area presents a peculiar feature: when one takes into account the trend evolution of GDP, the relation between M3 (corrected for the trend growth in GDP) and prices ceases to be seemingly leading and becomes contemporaneous. This conclusion emerges equally from recent contributions on structural filters for monetary analysis (see Bruggeman et al., 2005). This contemporaneous relation is evident in Chart 6, which presents the trend growth of the ratio of M3 to GDP and trend inflation in the euro area¹³.

Third, and from a monetary analysis perspective, it is important to understand the structural factors that may underlie the relation between monetary developments and inflation. In particular, it is important to ask what type of shocks may generate an empirical leading indicator relation from money to prices in the longer-run. In this time frequency, the main candidate is a change in expectations concerning the price stability objective of the monetary authority, either via a deliberate change in that objective or via a change in the credibility of the monetary authority in pursuing its goals¹⁴. In this case, money growth could be a leading indicator of inflation. This mechanism may actually explain why there exists an empirical leading indicator property in the disinflation period in the euro area in the 80s and 90s. However, this should not be a relevant phenomenon in the context of a price stability regime. In other words, in case the ECB is successful in pursuing its price stability objective, one should not ex-

Chart 6

TREND GROWTH OF MONEY CORRECTED FOR GDP AND TREND INFLATION
(CHRISTIANO-FITZGERALD; FREQUENCIES >32 QUARTERS)



(13) The series in the Chart were computed using the Christiano-Fitzgerald filter applied to the difference between the logarithm of nominal M3 and the logarithm of real GDP in the euro area. The results are robust to the postulation of a non-unitary coefficient of GDP (for example, 1.3, which corresponds to the GDP-elasticity of money demand estimated in CGL, 2001). This latter case would correspond to incorporate in the analysis the downward trend of M3 velocity observed in the sample period.

(14) For example, in models with a significant degree of real and nominal rigidity, as well as in models where agents learn the behaviour of the central bank, a permanent decrease in nominal interest rates (and the corresponding permanent reduction in monetary growth) could be accompanied by a slow response of prices to the new level of steady state inflation.

pect money to exhibit any empirical relation of leading indicator of prices in the long-run. In fact, in this context, changes in trend money should only reflect changes in trend GDP or in the trend velocity of money, without any counterpart in trend prices. This assertion illustrates once more the fact that empirical monetary indicators cannot be expected by themselves to identify the nature of risks to price stability.

5. CONCLUSIONS

This article reassesses the role of the M3 monetary aggregate for monetary policy purposes. The analysis leads to the conclusion that the money demand models suggested in Calza, Gerdesmeier and Levy (2001) and Carstensen (2004a,b) show strong signs of instability or cointegration breakdown when data up to the end of 2005 are considered. The cointegration breakdown implies that there is no longer a stable long-run function relating M3 and the level of prices, activity and its opportunity cost. Therefore, the monetary aggregate M3 has ceased to be a good instrument for monetary analysis. The cointegration breakdown also implies that, in the context of these models, the concept of “excess liquidity”, based on an equilibrium value for M3, lost its meaning and the so-called excess liquidity indicators based on the residuals of the cointegration regression in those models might have lost their information content.

A second conclusion of this study, which confirms the one of previous studies, is that there seems to be a relation between the long-run trend of the M3 aggregate and long-run movements of inflation, which, however, seems to have deteriorated in recent years reflecting the cointegration breakdown in the money demand models. However, the existence of a leading relation between money and prices in the long-run is difficult to assess and hardly exploitable for monetary policy purposes given that the frequencies over which the two variables are correlated are extremely long.

In sum, the recent evidence raises serious doubts regarding the use of M3 as an indicator for evaluating the risks to price stability. However, this does not imply that the analysis of money, and in a broader sense, monetary analysis is not useful. In this respect, one should mention the importance of credit – and its components – as a relevant indicator for the analysis of financial stability, the analysis of the transmission mechanism of monetary policy and for signalling possible episodes of asset price overvaluation. In turn, money can be useful in the identification of certain shocks or in characterising the portfolio adjustment of economic agents. In this context, a careful modelling of money in general equilibrium models is a route that may, in the future, deepen our understanding of the importance of monetary developments in the context of a monetary policy strategy.

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ANNEX

Chart A1

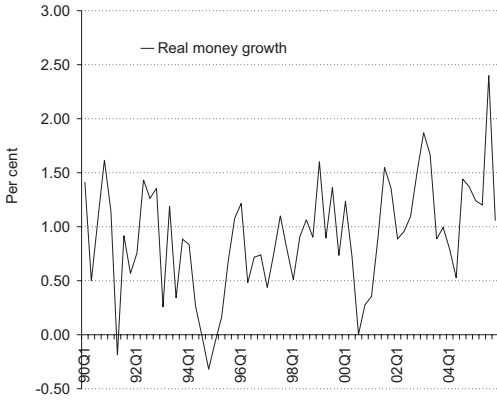


Chart A2



Chart A3

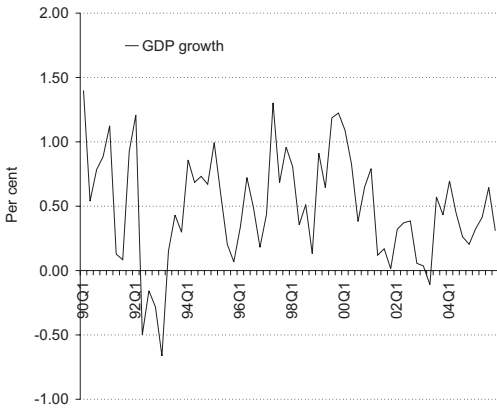


Chart A4

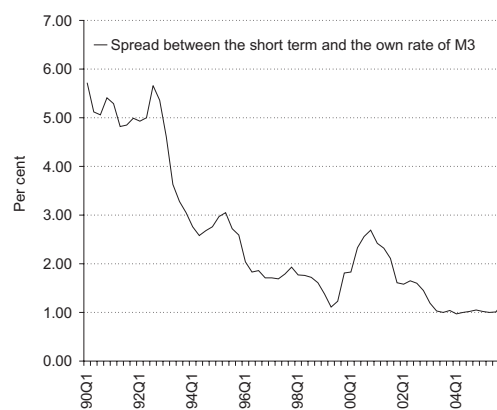


Chart A5

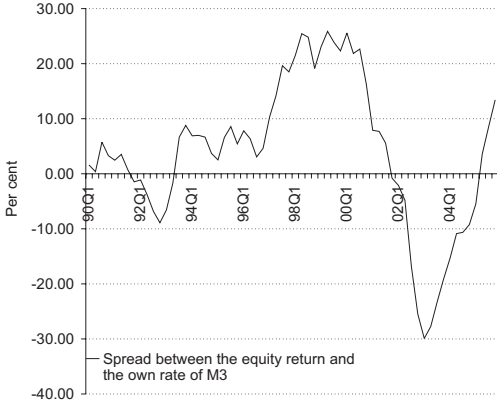


Chart A6

