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Wealth and the demand for money in the European Union*

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Abstract. This study presents the results of an empirical analysis of the demand for money in the European Union as a whole over the period 1971–1995, with a particular focus on the impact of financial wealth. The empirical evidence shows a substantial impact of wealth on the demand for M2 and M3, whereas no influence of wealth on the demand for M1 is found. This finding may explain the remarkable increase of the broad monetary aggregates over the last decade or so. This means that taking into account the growth of wealth, the monetary expansion has been fairly modest. The evidence thus indicates that the strong increase of M2 and M3 should be attributed to portfolio investment considerations rather than to an expansionary monetary policy.

Key words: Demand for money, financial wealth, narrow and broad money

JEL classification: E41, E52

1. Introduction

Under the Maastricht Treaty, the member states of the European Union have agreed to adopt a single European currency and in 1999 at the latest a common monetary policy aimed at price stability. Since this historical moment is rapidly approaching and because of the far-reaching nature of this commitment, the monetary authorities will have to decide soon which monetary policy strategy will be pursued. Price stability has been endorsed by all member states as the ultimate policy objective. The discussion focuses on the issue whether intermediate monetary targeting or direct inflation targeting should be chosen.

* Helpful comments by two anonymous referees, the participants in the Workshop on Money Demand at the Humboldt Universität and Hans Lunsing are gratefully acknowledged.

Monitoring monetary aggregates is important in both monetary strategies but will undoubtedly play a more prominent role in intermediate monetary targeting. The choice for a specific strategy will be crucial for the presentation of monetary policy measures and thus will affect directly the degree of transparency, accountability and credibility of the European central bank. Obviously, the choice between the two strategies will also be determined by an assessment of their effectiveness in achieving price stability. For a strategy of intermediate monetary targeting to be effective, a number of conditions have to be satisfied. The most important are the stability of the demand for money and the controllability of the money stock. Hence, it is not surprising that the demand for money has again been a major research topic in recent years (see e.g. Bekx and Tullio, 1989, Kremers and Lane, 1990, Monticelli and Strauss-Kahn, 1992, Fase, 1994, 1995, Fase and Winder, 1993, 1994). The present study aims to contribute to the discussion by analysing the demand for money in the European Union as a whole, with a particular focus on the impact of financial wealth. In this respect, our analysis differs from earlier studies which have thus far neglected wealth as a determinant of the demand for money.

A stylized feature of the monetary developments in the European Union is the strong increase of notably the broad monetary aggregates M2 and M3, particularly since the beginning of the 1980s. This growth has exceeded the growth of nominal output to a considerable extent. According to the monetarist view on inflation, this monetary expansion should have led to an upward tendency in inflation rates, but the 1980s have actually shown a sharp reduction of inflation. In order to assess the merits of an intermediate monetary targeting policy, it is highly desirable to have an economic explanation for this strong increase of the monetary aggregates. This study will argue that the development of financial wealth provides an explanation for this phenomenon. Taking account of wealth leads to the conclusion that the actual monetary expansion has been fairly modest and that the strong increase of the broad monetary aggregates should be attributed to portfolio investment considerations rather than an expansionary monetary policy.

This paper is organized as follows. The next section briefly discusses the data and presents some tentative empirical evidence concerning the impact of wealth on the demand for money. Section 3 discusses the theoretical framework and the empirical results for the European Union as a whole. Section 4 is devoted to an assessment of the findings. First, we will present evidence on the stability of the demand for money. Next, we will discuss the results of the cointegration analysis, and the section concludes with a further assessment of the role of wealth. Section 5 contains some concluding remarks. The estimation results are set out in appendix A.

2. Construction of data and preliminary analysis

For the present study, the database used in Fase and Winder (1993, 1994), containing data for all EU countries before the most recent accessions for the monetary aggregates M1, M2 and M3, gross domestic product at current and 1985 prices, short and long-term interest rates, has been extended with information for Austria, Finland and Sweden. Hence, data for all present members of the European Union with the exception of Luxembourg, have been used to construct EU-wide variables. The sample period is 1971:I–1995:IV. In order

to obtain a comprehensive picture of the monetary developments we did not restrict the analysis to one monetary aggregate but considered a broad spectrum, i.e. three money concepts: M1, M2 and M3. To investigate the impact of wealth on the demand for money we also constructed wealth data for all individual countries. Fase and Winder (1997) discuss in detail the procedure to construct these data. Following the seminal study of Brainard and Tobin (1968) we considered net financial wealth of the non-monetary private sector as the relevant wealth variable. This is defined as the differential between total assets – the sum of M1, quasi-money, claims on the banking sector and on the government and net foreign assets – and the claims of the monetary authorities and the banking sector on the private sector. A more general wealth concept, which includes not only financial wealth but also non-financial components like the capital stock, houses and perhaps durable consumption goods, has not been considered, because data for these debt instruments are not readily available. One may argue that for money demand behaviour portfolio investment considerations are dominant. In view of this, focusing on financial wealth is justified. However, even if a broader wealth concept would be more appropriate, the results in the present study remain valid if it is assumed that financial wealth is a good proxy for total wealth.

For the construction of EU-wide data, several options are available (see Winder, 1997)¹. In order to express the data on monetary aggregates, nominal income and financial wealth of the individual countries in a common currency, we used the exchange rates against the DM in 1985. Next, the EU-wide variables are calculated as the sum of these national variables. The figures of the countries' national products in 1985 prices have also been converted into 1985 DM prices using the exchange rates against the DM in 1985. EU output in 1985 prices has been obtained by summing these transformed data on national products in 1985 prices. The price index for EU has been calculated as the ratio between EU output at current and constant prices. The short and long-term interest rates for the EU have been calculated as weighted averages of the corresponding interest rates in the individual countries. As weights we used the shares of the national products of the individual countries in aggregated nominal EU output.

The remainder of this section is devoted to a preliminary analysis of the impact of wealth on the demand for money. Particularly, the issue will be addressed whether the development over time of wealth offers an explanation for the monetary expansion experienced in the European Union over the last twenty years. To throw some light on this issue the development of the wealth-income ratio and the liquidity ratio, i.e. the money stock as a percentage of output in nominal terms, are depicted in the charts of figure 1. The shaded bars in the charts denote the periods in which the short-term interest rate was higher than the long-term interest rate for more than two successive quarters, i.e. the yield curve had a decreasing – or inverse – slope.

Figure 1 shows that the wealth-income ratio increased strongly in the first half of the 1980s. For the period 1987–1993 this ratio was as a matter of fact constant and from 1993 onwards it has shown a steady increase. In contrast,

¹ Fase and Winder (1997) discuss the results for alternative aggregation methods, showing that the stylized facts of the data to be discussed in this section, are shared by the data according to alternative conversion methods.

Fig. 1. Liquidity ratios and wealth-income ratio

the wealth-income ratio was relatively constant during the 1970s. Obviously, wealth developed far from proportionally to nominal income, thus causing serious doubts about the often-made assumption in the relevant literature that income can be used as a proxy for wealth. The liquidity ratios in figure 1 illustrate the monetary expansion in the European Union, which has occurred especially for the broader monetary aggregates M2 and M3. A salient feature of the charts in figure 1 is the diverse developments of the liquidity ratios. The M1 ratio has been rather volatile, though between relatively narrow margins, but has been lower in the 1980s and 1990s than in the 1970s. In contrast, the M2 and M3 ratios have increased steadily over the period considered, though at the end of the sample period a stabilization or even small decrease is in evidence. The rise of the M2 ratio was relatively modest during the 1970s and accelerated from the beginning of the 1980s onwards. The M3 ratio, on the other hand, showed a more steady rise during the sample period².

A striking feature of figure 1 is the similar development of the M2 and M3 ratios on the one hand and the wealth-income ratio on the other hand. The development of the M1 ratio is much less in line with that of the wealth-income ratio. Obviously, the decrease of the M1 ratio in the beginning of the 1980s is not related to the development of wealth. The resulting pattern for the broader monetary aggregates, however, supports the hypothesis that the relatively strong increase of wealth offers an explanation for the rising M2 and M3 ratios. In particular during the period 1972–1987 the liquidity ratios for M2 and M3 evolved in parallel with the wealth-income ratio. In the period 1987–1992 the wealth-income ratio stabilized, whereas the M2 and M3 ratios showed a continuing increase. It is likely that this further rise was related to interest rate developments. In all EU countries the short-term interest rate increased sharply in this period leading to inverse yield curves. The resulting shift from capital market investments to near money led to high growth rates for the broad monetary aggregates, and hence to a further increase of the M2 and M3 ratios. Periods with an inverted yield curve are denoted in figure 1 by shaded bars, showing that in two other subperiods the short-term interest rate exceeded the long-term rate. The effect of interest rate developments in these periods on the liquidity ratios is much less clear-cut, perhaps because the length of these subperiods was considerably shorter than the period around 1990. The adverse development of the liquidity ratios for the broad aggregates and the wealth-income ratio during the period 1987–1993, however, seems to be related to the movements in interest rates, illustrating that account must be taken by other determinants of the demand for money than income and wealth in order to assess the monetary developments. The theory of the demand for money offers an analytical framework for such a more comprehensive analysis. The results of this analysis will be discussed in the next section.

² The development of the EU aggregates conceals substantial differences between the individual countries. As documented in Fase and Winder (1993) monetary expansion has occurred especially in the northern EU countries, notably in Denmark, the Netherlands and the United Kingdom, whereas the southern countries offer a relatively stable picture. Differences between the demand for money relationships for the individual countries give rise to an aggregation bias in the estimates of EU-wide demand for money equations. Aggregation may on the other hand reduce the specification bias. As a result of the trade-off between aggregation and specification bias, EU-wide estimates may perform better than single-country ones (see Kremers and Lane, 1990 and Filosa, 1995).

3. Theoretical framework and empirical results

In line with Friedman's reformulation of Fisher's quantity theory and the closely related portfolio approach of e.g. Tobin, the postulated long-run demand for money relationship reads as

$$M \propto P^{\alpha_1} y^{\alpha_2} w^{\alpha_3} \exp(\alpha_4 rs + \alpha_5 rl + \alpha_6 \dot{p}) \quad (1)$$

with M the desired nominal money stock in a steady-state situation, P the price level, y real income, w real wealth, $\dot{p}$ the inflation rate while rs and rl represent the short-term and long-term interest rates. The price elasticity equals α_1 , while α_2 and α_3 represent the income and wealth elasticities; α_4 , α_5 and α_6 measure the relative change of money demand as a result of a one percentage point increase of the short-term interest rate, the long-term interest rate and the inflation rate respectively. These parameters are therefore the semi-elasticities with respect to the short and long-term interest rates and inflation. The often made assumption of price homogeneity, i.e. $\alpha_1 = 1$, is not imposed as an *a priori* restriction, but considered as an empirically testable hypothesis. If this restriction is valid, the steady-state relationship of equation (1) relates real money balances to the explanatory variables, with y reflecting the impact of the transactions volume and wealth the scale variable reflecting portfolio investment considerations. An alternative interpretation of this latter determinant is that it is a proxy for the influence of the money demand resulting from financial transactions (see also Friedman, 1971). These transactions are not accounted for appropriately by the income variable. The interest rates and the inflation rate represent the substitution processes between financial and physical assets. The short-term interest rate is the appropriate yield on near money. For the narrow monetary concept M1 α_4 should therefore be negative, while for the broader aggregates M2 and M3 a positive sign is plausible on theoretical grounds. The semi-elasticities α_5 and α_6 should be negative for M1, M2 as well as M3. Including both the short and long-term interest rate in the analysis ensures that the influence of the slope of the yield curve on the demand for money is also taken into account.

Equation (1) is the maintained hypothesis and describes the steady-state demand for money relationship. When deviations from this long-run equilibrium occur, adjustment processes occur to restore equilibrium. These short-run adjustment processes are modelled by means of lagged values of the variables in equation (1), leading to an error correction equation in which the short and long-run properties of the demand for money are described jointly. Following Friedman (1971) and earlier studies carried out at the Netherlands' Bank, a cyclical indicator, $conj$, has also been included to describe these short-run adjustment processes (see e.g. Fase and Kuné (1974) and Den Butter and Fase (1981)).

In our discussion of the empirical results we will focus on the long-run properties implied by the estimated demand for money relationships. In order to gain insight into the properties of the demand for money, a discussion of the steady state is obviously most revealing. To this end, the estimates of the parameters of the steady-state demand for money relationships for the various monetary aggregates are summarized in table 1. The detailed estimation results for M1, M2 and M3 are reported in appendix A. A number of restrictions on the parameters of the long-run demand for money relationship

Table 1. Estimates of parameters of long-run money demand relationship

Monetary aggregate	α_1	α_2	α_3	α_4	α_5	α_6
M1	1	0.8619 (15.14)	0	-0.0086 (2.89)	-0.0052 (1.74)	-0.0052 (1.74)
M2	1	0.7479 (11.25)	0.2521 (3.79)	0.0126 (1.99)	-0.0195 (3.44)	-0.0195 (3.44)
M3	1	0.6590 (12.19)	0.3410 (6.31)	0.0107 (2.28)	-0.0133 (2.91)	-0.0133 (2.91)

Explanatory note: *t*-values are given in parentheses.

have been imposed. Examples are the restriction that the price elasticity equals one or the restriction that the sum of the income and wealth elasticity is equal to one. In the estimated equations we have also imposed the restriction that the long-run semi-elasticities with respect to the long-term interest rate and the inflation rate are equal. All these restrictions constitute testable hypotheses, which can be tested by means of *t*-tests. The results of the *t*-statistics for the respective hypotheses are reported in Fase and Winder (1997) and indicate that all restrictions imposed are justified from a statistical point of view.

Table 1 shows that wealth has a significant impact on the demand for M2 and M3. For M1 no influence of wealth was found, a result that had already been suggested by figure 1. The income elasticity of the demand for M1 is higher than for M2 and M3, indicating that M1 balances are mainly held for transaction purposes. For M2 and M3, the restriction has been imposed that the income and wealth elasticity add to 1. This finding corresponds with the results reported for various individual European countries. Examples are the Bundesbank (1995) and Gerdesmeier (1996) for Germany, Hall et al. (1989) for the United Kingdom, and Fase and Winder (1996) for Belgium and the Netherlands (see also Sterken, 1992). Fase and Winder (1996) found for both Belgium and the Netherlands that the wealth elasticity of the demand for M2 was slightly higher than for M3. The results in table 1 show that for the European Union as a whole the wealth elasticity of M3 is somewhat higher. Table 1 shows furthermore that for all monetary aggregates considered price homogeneity applies.

With respect to the semi-elasticities of the short and long-term interest rate and the inflation rate, table 1 shows that all the estimates obtained have the theoretically plausible sign and are, with the exception of the semi-elasticities of M1 with respect to the long-term interest rate and inflation, significantly different from 0. For both M1, M2 and M3 the results of the econometric specification analysis give rise to impose the restriction that the inflation and long-term interest rate semi-elasticities are equal. Testing these restrictions shows that in all three cases the hypothesis that these semi-elasticities are equal cannot be rejected (see Fase and Winder, 1997). Table 1 shows also that the demand for M2 is more sensitive to changes in the interest rates and the inflation rate than the demand for M1 and M3. M1 balances have relatively low interest rates and inflation semi-elasticities, a finding that corresponds with the notion that these balances are mainly held for transaction purposes.

An alternative way to assess the estimation results is to consider the properties of near money. The elasticities found for M1, M2 and M3 imply elas-

Table 2. Long-run elasticities

Monetary aggregate	Price	Income	Wealth	Short-term interest rate	Long-term interest rate	Inflation
M1	1	0.862	0	-0.082	-0.053	-0.035
M2	1	0.748	0.252	0.120	-0.199	-0.129
M3	1	0.659	0.341	0.102	-0.136	-0.088
M2-M1	1	0.636	0.501	0.319	-0.343	-0.223
M3-M1	1	0.562	0.504	0.190	-0.175	-0.114
M3-M2	1	0.494	0.506	0.068	-0.019	-0.012

ticities of the demand for M2-M1, M3-M1 and M3-M2 and these elasticities must of course be economically plausible. This offers the opportunity to assess the mutual consistency of the results obtained for M1, M2 and M3. Therefore, the elasticities of the various near money concepts are presented in table 2 together with the elasticities for M1, M2 and M3. The price, income and wealth elasticities follow from table 1, whereas the elasticities with respect to the short and long-term interest rate and the inflation rate have been calculated by multiplying the semi-elasticities given in table 1 by the sample means of the corresponding variables.

Table 2 shows that the elasticities of the various near money concepts have an economically plausible sign and a reasonable size, implying that the results for M1, M2 and M3 are mutually consistent. The price elasticities of the various near monies are equal to 1, reflecting the similar properties of M1, M2 and M3. The income elasticities of the various near money concepts are smaller than for M1, with the demand for short-term time deposits and foreign currency deposits, i.e. M2-M1, having a higher income elasticity than the demand for short-term saving deposits, i.e. M3-M2. A striking feature of table 2 is the similar values of 0.50 for the wealth elasticities of the demand for the various near monies. The sum of the income and wealth elasticity equals 1 for M3-M2. This result reflects the corresponding property for the demand for M2 and M3. For the other two near money concepts the sum of the income and wealth elasticity is slightly larger than 1, reflecting that the income elasticity of M1 is smaller than 1, while the income and wealth elasticities for M2 and M3 add to 1.

The general picture following from table 2 for the interest rates and inflation elasticities of M1, M2 and M3 is similar to that found for the semi-elasticities discussed before. This is not surprising given the way these elasticities are calculated. A notable feature of table 2 is that the demand for M2-M1 is particularly sensitive to changes in the interest rates and the inflation rate, while the interest rates and inflation elasticities of the demand for M3-M2 are very small.

4. An assessment

In order to assess the results reported in the preceding section we examine three issues. In the first subsection we will present empirical evidence on the stability of the demand for money. The next subsection assesses the robustness of the empirical results by means of a cointegration analysis. Subsection 4.3

will further analyse whether the development over time of wealth offers an explanation for the monetary expansion that has occurred in the European Union since the beginning of the 1980s.

4.1 *Stability of the demand for money*

An important assessment criterion, both from a policy and an economic viewpoint, is the degree of stability of the demand for money. Several methods are available to assess stability. Here we consider three methods. The first concerns the residuals of the estimated equations. The standard error of the residuals of the estimated demand for money equations, reported in appendix A, are 0.67%, 0.80% and 0.58% for M1, M2 and M3 respectively. The size of these standard errors is rather low for all monetary aggregates considered, indicating that the overall fit is satisfactory. According to this measure of stability, the demand for M3 is more stable than the demand for M1 and M2, a finding that is in line with the results in Fase and Winder (1993) for the individual countries of the European Union. The residuals reflect the noise inherent in the estimated equations and may be useful to determine the width of the target zone if a policy of monetary targeting is pursued. However, this measure is less useful as a criterion to assess possible misspecification of the equations chosen.

Therefore, we have examined the stability over time of the estimated demand for money equations. This procedure involves re-estimation of the specifications for sub-periods and testing for parameter stability by means of Chow tests. To this end, the equations have been re-estimated for the sample periods before and after the German unification in 1990 using 1990:III as a breaking point. The hypothesis that the parameters in both subperiods are constant can be tested with an F -test, the F -statistic having an $F(13, 69)$ distribution for M1, M2 as well as M3. The values obtained are 2.27, 1.25 and 1.48 for M1, M2 and M3 respectively. Only for M1 the F -statistic is significant at a 0.05 significance level, suggesting that the M1 equation is not stable. For M2 and M3 the hypothesis that the parameters are constant during both subperiods considered cannot be rejected. As a further test of stability we have also considered the constancy of the long-run parameters before and after German unification. From a policy viewpoint the long-run properties of the demand for money are more important than the short-run dynamics. The Chow statistic is in this case $F(3, 79)$ distributed. This test yields the values 0.74, 0.65 and 0.20 for M1, M2 and M3 respectively. These results are all insignificant at a 0.05 significance level, indicating that the hypothesis that the long-run parameters are constant during the subperiods considered cannot be rejected. These results also indicate that the instability of the M1 equation found by the Chow test for constancy of all parameters, is related to non-constancy of the parameters describing the short-run dynamics of the M1 equation³.

As a final procedure to assess the stability of the demand for money we considered recursive estimation procedures, which are particularly useful to

³ In the misspecification analysis, we tested also for residual autocorrelation, normality of the disturbance terms and heteroscedasticity of the ARCH-type. The results are discussed in Fase and Winder (1997) and show that there is no evidence of misspecification.

Fig. 2. Recursive residuals

detect structural changes. More specifically, we calculated the cumulative sum (CUSUM) and the cumulative sum of the squares (CUSUMSQ) of the recursive residuals⁴. Figure 2 depicts for M1, M2 and M3 the CUSUM and

⁴ The CUSUM and CUSUMSQ have been calculated conditionally on the dummy variable incorporated to account for the effect of the German unification (see appendix A).

CUSUMSQ graphically, together with the 5% significance lines. For all monetary aggregates considered, both the CUSUM and CUSUMSQ do not cross the significance lines, suggesting that there is no evidence of parameter instability. This finding is encouraging and supports the earlier preliminary result that stability increases with the size of the economic geographical area considered using Divisia aggregates (see e.g. Fase, 1995). An explanation for this remarkable result found again in this paper is that the degree to which the supply of money is exogenous – strictly speaking a condition for the estimation of a single demand for money equation – is perhaps dependent on the capacity to absorb shocks which certainly increases with the size of the economy.

4.2 Results of a cointegration analysis

In order to assess the robustness of the empirical results found, a cointegration analysis has been carried out. One way to examine cointegration is to apply Johansen-type tests. Since these tests require the specification of a VAR model rather than a single equation approach, the Johansen procedure has not been applied. Instead, we estimated the equation

$$\begin{aligned}
 \Delta \ln(M/P) \propto & \alpha \ln(M/P)_{-1} + \beta_1 \ln y_{-1} + \beta_2 \ln w_{-1} + \beta_3 rs_{-1} + \beta_4 rl_{-1} \\
 & + \beta_5 \dot{p}_{-1} + \sum_{i=1}^4 \alpha_i \Delta \ln(M/P)_{-i} + \sum_{i=0}^4 \beta_{1i} \Delta \ln y_{-i} \\
 & + \sum_{i=0}^4 \beta_{2i} \Delta \ln w_{-i} + \sum_{i=0}^4 \beta_{3i} \Delta rs_{-i} + \sum_{i=0}^4 \beta_{4i} \Delta rl_{-i} \\
 & + \sum_{i=0}^4 \beta_{5i} \Delta \dot{p}_{-i}
 \end{aligned} \tag{2}$$

One way to test the null hypothesis of no cointegration is to consider the t -statistic of $\hat{\alpha}$, t_{ecm} (see Kremers et al., 1992). Under specific assumptions this statistic is normally distributed. If these assumptions are violated, the Dickey-Fuller critical values can be used. Boswijk (1994) has shown that the Wald-statistic for the null hypothesis $\alpha = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ can also be used to test for cointegration. This statistic does not have the familiar χ^2 -distribution, but Boswijk reports the relevant critical values. If cointegration occurs, equation (2) also yields consistent estimates of the long-run parameters, which are, under specific exogeneity conditions, asymptotically normally distributed (see also Inder, 1993).

In the present study, we have estimated equation (2) and subsequently removed the most insignificant ones of the differentiated explanatory variables. The results obtained for the ultimate equation are reported in table 3. In case of M1, the model with and without wealth as an explanatory variable has been considered, since in the M1-equation discussed before wealth is absent. Table 3 shows that in all four cases considered the results for the t_{ecm} and the Wald-statistic are supportive for the cointegration hypothesis. The long-run properties of the demand for money implied by the estimated equations are

Table 3. Results of cointegration analysis

Monetary aggregate	Cointegration test		Elasticities		Semi-elasticities		
	t_{ecm}	Wald	Income	Wealth	Interest Rates		Inflation
					short	long	
M1	-2.50	23.32	0.6959 (2.61)	0.0661 (0.63)	-0.0023 (0.46)	-0.0166 (2.16)	-0.0003 (0.06)
M1	-3.31	21.06	0.8835 (16.71)	0	-0.0013 (0.33)	-0.0159 (2.82)	0.0003 (0.09)
M2	-3.61	45.88	0.6481 (1.15)	0.2826 (1.29)	0.0267 (2.32)	-0.0528 (3.22)	-0.0117 (1.15)
M3	-2.81	53.82	0.6091 (1.49)	0.3838 (2.44)	-0.0094 (1.20)	0.0121 (1.16)	-0.0141 (2.31)

Explanatory note: t -values in parentheses.

also given in table 3. If wealth is included in the M1-equation, we obtain a very small and insignificant estimate of the wealth elasticity, a finding which is in line with the result in the former section that wealth does not have an impact on the demand for M1. If wealth is excluded from the M1-equation, the income elasticity is estimated to be 0.88, which is very close to the estimate of 0.86 reported before. A remarkable result obtained for M2 and M3 is that the estimate of the sum of the income and wealth elasticity is close to 1. The M2-equation yields an estimate of 0.93, whereas for M3 an estimate of 0.99 results. These findings constitute empirical support for the result in the former section that the income and wealth elasticity of M2 as well as M3 sum to 1. The estimates of the long-run semi-elasticities with respect to the short and long-term interest rates and inflation obtained with the mechanic procedure carried out, have a similar magnitude as the findings reported before. In three out of nine cases the point estimates have the wrong sign, but these estimates are not significantly different from zero. In all other cases the estimates of the semi-elasticities have the theoretically plausible sign. All in all it can be concluded that the results in table 3 yield supportive evidence for the findings reported before.

4.3 Further assessment of the role of wealth

The empirical results in section 3 revealed a substantial impact of wealth on the demand for M2 and M3, whereas for M1 no influence of wealth could be found. The tentative analysis in section 2 showed a parallel development of the M2 and M3 ratios on the one hand and the wealth-income ratio on the other hand, suggesting that the increase of wealth offers an explanation for the rising liquidity ratios observed in the 1980s.

In the spirit of Fisher's quantity theory, liquidity ratios – or their inverse, i.e. the velocities of money – are often used as a simple indicator to assess monetary developments. It is a well-known fact that these ratios are fairly rough measures because substitution processes resulting from changes of interest rates and inflation may cause large fluctuations in the money stock. Another

reason to consider the liquidity ratios with some caution is that the assumption of a unit income elasticity of the demand for money may be violated. In this regard it may be recalled that for M1 the income elasticity is estimated to be 0.86. Moreover, the results in the present study show that wealth also exerts a major influence on the demand for money. Obviously, this influence should be taken into account when assessing the monetary developments.

The long-run demand for money relationship (1) implies

$$M \propto P^{\alpha_1 - \alpha_2 - \alpha_3} Y^{\alpha_2} W^{\alpha_3} f(rs, rl, \dot{p})$$

with Y and W nominal income and nominal wealth respectively and $f(rs, rl, \dot{p}) = \exp(\alpha_4 rs + \alpha_5 rl + \alpha_6 \dot{p})$. Thus,

$$\frac{M}{Y} \propto P^{\alpha_1 - \alpha_2 - \alpha_3} Y^{\alpha_2 - 1} W^{\alpha_3} f(rs, rl, \dot{p}),$$

showing that the liquidity ratio also depends on wealth. If the price elasticity α_1 equals 1 and the income and wealth elasticity sum to 1, i.e. $\alpha_2 + \alpha_3 = 1$, we have

$$\frac{M}{Y} \propto \left(\frac{W}{Y}\right)^{1 - \alpha_2} f(rs, rl, \dot{p}).$$

The relationship between the liquidity ratios and the wealth-income ratio has been considered in figure 1. With the above restrictions concerning the price, income and wealth elasticities, we also have

$$M / (Y^{\alpha_2} W^{1 - \alpha_2}) \propto f(rs, rl, \dot{p}).$$

Since the interest rates and inflation do not display trend-like behaviour, it may be expected that the same property holds for $M / (Y^{\alpha_2} W^{1 - \alpha_2})$. It may therefore be interesting to consider this ratio for the monetary aggregates. It goes without saying that this ratio is a purely descriptive statistic⁵. In figure 3 this statistic has been depicted together with the liquidity ratio for each of the money concepts considered, using the estimates of the long-run income elasticities given in table 1. Since the wealth elasticity of M1 is 0, the ratio $M / (P^{1 - \alpha_2} Y^{\alpha_2})$, with α_2 being the long-run income elasticity, has been depicted. If the income and wealth elasticity add to 1, the modified ratio is independent of the unit in which the money stock, income and wealth are expressed. This situation applies to M2 and M3. If the elasticities do not add to 1, as is the case for M1, the level of the modified ratio depends on the unit in which the variables are expressed. Thus, it makes a difference whether M1 and income are expressed in millions or billions of German marks. It can easily be shown, however, that the development over time is not influenced by the choice of unit. It is only the level that is affected. Therefore, the chart for the

⁵ If W is proportional to Y , $M / (Y^{\alpha_2} W^{1 - \alpha_2})$ will – apart from a constant – be equal to the liquidity ratio and therefore develop in parallel with the liquidity ratio.

Fig. 3. Liquidity ratios and modified ratios

M1 ratio and the corresponding modified ratio is depicted with a double scale. For M2 and M3 a single scale suffices.

Figure 3 shows that the modified M2 and M3 ratios were relatively constant over the 1970s and 1980s. The charts display an increase of these ratios at the end of the 1980s, notably for the modified M2 ratio. This relatively strong increase of M2 and M3 is probably related to the influence of the inverted yield curve, which initiated shifts from capital market investments to liquid assets (see also section 2). Like the M1 ratio, the modified M1 ratio was rather volatile, albeit between relatively narrow margins. A salient feature of the modified M2 and M3 ratios in figure 3 is that no upward tendency is present during the 1980s. This result indicates that no excessive monetary expansion occurred, a conclusion that is in line with the modest development of the inflation rates during the 1980s. The relatively stable monetary developments according to these modified ratios may therefore be taken as a justification of the reserved policy reactions of the monetary authorities to the growth of the liquidity ratios⁶.

5. Concluding remarks

This study presented the results of an empirical analysis of the demand for money in the European Union as a whole over the period 1971–1995, with a particular focus on the impact of financial wealth. In order to obtain a comprehensive picture of the monetary developments we did not restrict the analysis to a single monetary aggregate, but considered M1, M2 as well as M3. The empirical evidence shows a substantial impact of wealth on the demand for M2 and M3. In contrast, no influence of wealth on the demand for M1 could be found, indicating that portfolio investment considerations are less important for M1 balances. The empirical results show also that for M2 and M3 the income and wealth elasticity add to 1, and that M2 is more sensitive to changes in interest rates and inflation than M1 or M3. An extensive specification analysis indicated that the demand for the three money concepts considered for the European Union as a whole is stable. This finding is important because it is one of the main conditions for a policy of monetary targeting.

In the European Union, the broad monetary aggregates M2 and M3 have increased much more strongly than nominal output, in particular since the beginning of the 1980s. In the spirit of the monetarist view on inflation, according to which – loosely speaking – inflation is the result of too much money chasing too few goods, this monetary expansion should have led to an upward tendency in inflation. The 1980s have actually shown, however, a substantial reduction of the inflation rates. The analysis in the present study indicates that the strong growth of financial wealth in the 1980s offers an ex-

⁶ Fase and Winder (1997) argue that the use of Divisia aggregates offers an alternative way to account for the impact of portfolio investment considerations on the demand for money. Correction of M2 and M3 for these portfolio investment balances according to the methodology put forward by Divisia (1925, 1926) shows that money growth relative to income growth has been modest during the 1980s, yielding supportive evidence for the hypothesis that the sharp increase of the liquidity ratios for the broad money concepts can be attributed to the increase of the volume of liquid assets held for portfolio investment purposes (see Fase and Winder, 1997).

planation for the sharp increase of the M2 and M3 ratio. Taking into account the development of wealth leads to the conclusion that the monetary expansion has been fairly modest, and thus that the strong increase of M2 and M3 should be attributed mainly to portfolio investment considerations.

Though the development of financial wealth offers an explanation for the strong increase of the broad monetary aggregates, it cannot be ignored that the resources embodied in the wealth position of the private sector – as far as the household sector is concerned – is a source of future consumption. The developments since the beginning of the 1980s indicate that these accumulated resources have not been used for consumption on a large scale. For the near future, it is likely that this will not be the case either. Demographic factors like the ageing of the population and austerity policies of the governments, including a re-shaping of the social welfare system, may well be an impetus for further increases of wealth. The fact that wealth may be used for actual spending objectives is, however, a reason for the monetary authorities to monitor the development of the wealth position of the private sector. This applies also if wealth is not yet used for current consumption, but is intended for future consumption. The results in our study show that wealth has a substantial impact on the demand for money. For an adequate assessment of the monetary developments it is therefore useful to take into account the development of wealth.

Appendix A: Estimation results

This appendix presents the estimated demand for money equations for the European Union as a whole. The notation of the variables is the same as in the main text. Since the data are not seasonally adjusted, seasonal dummies s_1 , s_2 and s_3 are included in the estimation equations. Moreover, we included a dummy variable D_{903} with the value 1 in 1990:III and 0 in the other periods to account for the effect of the German unification. The t -values of the estimates, shown in brackets in the following equations, are adjusted for the possible presence of heteroscedasticity. $\bar{R}^2$ denotes the multiple correlation coefficient adjusted for degrees of freedom and SE is the standard error of the residuals.

$$\begin{aligned} \Delta \ln(M1/P) = & \underset{(3.19)}{-0.1833}(\ln(M1/P)_{-1} - \ln y) - \underset{(2.90)}{0.0253} \ln y - \underset{(2.16)}{0.0016} rs_{-1} \\ & - \underset{(2.17)}{0.0010} rl_{-1} - \underset{(2.17)}{0.0010} \dot{p} - \underset{(2.57)}{0.0064} \Delta \text{conj}_{-2} - \underset{(2.46)}{0.0032} \Delta rs_{-1} \\ & - \underset{(3.49)}{0.0049} \Delta \dot{p} + \underset{(2.96)}{0.2648} \Delta \ln(M1/P)_{-4} + \underset{(2.74)}{0.1457} \Delta \ln y_{-4} \\ & + \underset{(2.69)}{0.1850} - \underset{(0.04)}{0.0004} s_1 + \underset{(1.51)}{0.0072} s_2 + \underset{(0.59)}{0.0048} s_3 + \underset{(9.80)}{0.0202} D_{903} \end{aligned}$$

$$\text{Estimation period : 1972:I–1995:IV} \quad \bar{R}^2 = 0.89 \quad SE = 0.0067$$

$$\begin{aligned}
\Delta \ln(M2/P) = & \underset{(5.28)}{-0.0866}(\ln(M2/P)_{-2} - \ln y_{-1}) + \underset{(2.58)}{0.0218}(\ln w - \ln y_{-1}) \\
& + \underset{(1.87)}{0.0011}rs - \underset{(3.33)}{0.0017}rl_{-2} - \underset{(3.33)}{0.0017}\dot{p}_{-2} - \underset{(2.95)}{0.0052}\Delta \text{conj}_{-3} \\
& - \underset{(2.92)}{0.0058}\Delta rl_{-1} + \underset{(3.07)}{0.2355}\Delta \ln(M2/P)_{-4} + \underset{(3.70)}{0.2430}\Delta \ln y \\
& - \underset{(2.10)}{0.0982}\Delta \ln w_{-3} + \underset{(4.53)}{0.0533} + \underset{(1.26)}{0.0114}s_1 + \underset{(0.72)}{0.0042}s_2 \\
& + \underset{(1.40)}{0.0117}s_3 + \underset{(9.84)}{0.0236}D_{903}
\end{aligned}$$

Estimation period : 1972:I–1995:IV $\bar{R}^2 = 0.68$ $SE = 0.0080$

$$\begin{aligned}
\Delta \ln(M3/P) = & \underset{(5.77)}{-0.1032}(\ln(M3/P)_{-2} - \ln y) + \underset{(3.55)}{0.0352}(\ln w_{-1} - \ln y) \\
& + \underset{(2.14)}{0.0011}rs - \underset{(3.09)}{0.0014}rl - \underset{(3.09)}{0.0014}\dot{p} - \underset{(4.70)}{0.0040}\text{conj}_{-1/2} \\
& - \underset{(2.58)}{0.0034}\Delta (rl - rs)_{-2} + \underset{(3.26)}{0.1805}\Delta \ln y_{-4} + \underset{(3.99)}{0.1121}\Delta \ln w \\
& - \underset{(1.92)}{0.0634}\Delta \ln w_{-3} + \underset{(5.94)}{0.0943} + \underset{(2.95)}{0.0228}s_1 + \underset{(0.72)}{0.0034}s_2 \\
& + \underset{(1.65)}{0.0121}s_3 + \underset{(16.16)}{0.0331}D_{903}
\end{aligned}$$

Estimation period : 1972:I–1995:IV $\bar{R}^2 = 0.77$ $SE = 0.0058$

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