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EMPIRICAL EVIDENCE ON THE ROLE OF EQUITY AND LABOUR MARKETS

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In 2009 all ECB publications feature a motif taken from the €200 banknote

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ABSTRACT

This study presents empirical evidence on the long-run motives for holding euro area money by focusing on the role of equity and labour markets. Equity positively affects money demand through wealth effects, as equities are a significant store of household wealth and thus part of a financial transaction motive. Negative substitution effects through the expected return on equity reflect a speculative motive from the equity market. A precautionary motive from the labour market is captured by the annual change in the unemployment rate. The main conclusion is that equity and labour markets do matter for money. All three new elements, in particular housing and financial wealth, have been found statistically and economically significant in explaining M3 since 1983. These findings are robust across different proxies for the augmented motives and a shorter sample period starting in 1994.

Keywords: euro area money demand, wealth, equity return, precautionary motive

JEL classification: E41, G11, C32

NON-TECHNICAL SUMMARY

The demand for money is and has been at the centre of monetary economics. Understanding the factors determining the demand for money is essential for monetary analysis and constitutes an important part of the framework used by the ECB to extract signals about the risks to price stability over the medium to longer term that stem from monetary developments.

This paper complements the numerous euro area money demand studies by focusing on the role of the equity and labour markets for the long-run motives for holding money. The demand for money is often expressed as a function of prices and economic activity, which serves as a proxy for the level of transactions in the economy, and certain interest rate variables, which measure the opportunity costs of holding money. This study examines three additional determinants of money demand. First, equity positively affects money through a wealth transaction motive as equities are a significant store of household wealth that consists of housing and financial wealth. Second, a negative substitution effect between money and equity is considered. Such a speculative motive from the equity market is for the first time approximated by the expected equity return. The unobserved expected stock returns are approximated by a long-run average of the dividend yield and of corporate earnings growth. Third, a precautionary motive for holding money, which is comparatively unexplored in money demand studies at the euro area level, is captured by the annual change in the unemployment rate. This motive for holding money is added because rising unemployment rates can be associated with higher precautionary savings.

The lesson of this study is twofold. First, equity market developments, i.e. their impact on household wealth and the expected equity return, significantly help to explain euro area M3 in the long-run. The relevance of a positive financial transaction motive from the equity market through wealth and of a negative speculative motive from substitution via the expected return on equity imply that a broad investors' perspective is essential for understanding money demand. Secondly, a precautionary motive from the labour market is found to be a significant determinant of money. Money is hoarded when the labour market weakens. This finding implies that an improvement in the labour market situation – which normally goes hand in hand with higher GDP and thus higher money demand – also results in a lower precautionary demand for money in the long run.

Several model specifications using different proxies for the financial transaction, speculative and precautionary motives and a shorter sample period all result in the same conclusion: equity and labour market developments do matter for holding euro area M3 in the long run. The assessment of money growth thus benefits from closely monitoring equity and labour market developments. Given the promising new evidence, the present study provides a useful starting point for future research in the long history of money demand.

1 INTRODUCTION

The demand for money is and has been at the centre of monetary economics. Research on the demand for money has been an important source of inspiration for innovations in both monetary theory and econometric techniques. The theory is well developed and the empirical literature focuses on the factors that determine money-holding behaviour of the private sector. Knowledge of this reaction pattern is of great importance for assessing the effectiveness of monetary policy and the potential impacts of monetary shocks.

This study complements the well-explored field of monetary economics on money demand. It examines the role of the equity and labour markets for the motives for holding money in a Johansen and Juselius (1990) cointegration framework. Equity positively affects money through a wealth transaction motive as equities are a significant store of household wealth that consists of housing and financial wealth. For the first time a speculative motive from the equity market is approximated by the expected equity return, following the Fama and French (2002) proxy for unobserved expected stock returns. It reflects a negative substitution effect between money and equity. A precautionary motive for holding money, comparatively unexplored in money demand studies at the euro area level, is captured by the annual change in the unemployment rate.

The lesson of this study is twofold. First, equity market developments, i.e. their impact on household wealth and the expected equity return, significantly help to explain euro area M3 in the long-run. Secondly, a precautionary motive from the labour market is found to be a significant determinant of money. Several model specifications using different proxies for the financial transaction, speculative and precautionary motives and a shorter sample period all result in the same conclusion: equity and labour market developments do matter for holding euro area M3 in the long run.

Section 2 briefly reviews euro area money demand studies from a theoretical, empirical, and equity market perspective. Section 3 introduces the estimated empirical model, distinguishing between transaction, precautionary and speculative motives for holding money and focusing on the role of the equity and labour markets. Section 4 describes the data. Section 5 presents the empirical results and checks their robustness. Section 6 provides concluding remarks.

2 MONEY DEMAND

2.1 Theory

The theory on the demand for money is well developed. The history of the neoclassical theory on the demand for money starts with Fisher's (1909) quantity theory of money. This theory opposes the flow of money, MV, to the flow of goods and services, PT. It implies that the volume of current transactions determines the demand for money. In Fisher's theory, interest rates are irrelevant, presumably because the classical quantity theory neglected financial transactions. The exclusion of wealth is a major difference to the related Cambridge variant of the classical quantity theory of money by Marshall, Pigou, Robertson *et*

al., which can be summarised as M = κPT. This cash balance theory explicitly pays attention to money as a store of value. As regards the cash ratio, κ, a certain degree of dependence on interest rates could in principle not be ruled out.

The next important step was Keynes' distinction of three motives for holding money: the transaction motive to meet normal day-to-day needs, the speculative motive in anticipation of a fall in the price of assets, and the precautionary motive to meet unexpected future outlays, basically of a transaction nature (Keynes, 1936). Keynes simplifies the world to two financial assets: money and bonds. The last serves as the aggregate for other financial assets. This distinction between liquidity motives resulted in income and the long-term interest rate as determinants of money. Income captures the transaction and precautionary motives for holding money and the long-term interest rate captures the speculative motive. The absence of the short-term interest rate in Keynes' days was due to the fact that this rate was more or less constant in England at that time. For practical reasons wealth was typically ignored in empirical research.

Another major theoretical contribution is Friedman's (1956 and 1959) reformulation of Fisher's quantity theory. Friedman considers money as one of many alternative assets within the spectrum of wealth. A set of interest rates is used to explain the demand for money. Consequently, Friedman's theory is closely connected to the portfolio approach of Tobin (1956 and 1969), developed in the vein of a general equilibrium framework. In contrast to Friedman, Tobin's approach explicitly takes restrictions into account given that total wealth must be allocated to some financial or real asset. In this view, money is the most liquid financial asset.

In sum, the empirical implications of the different theories are fairly similar. The optimal stock of real money balances is positively related to real (permanent) income and/or wealth and inversely related to the rate of return on earning assets. The main differences arise in terms of using the most appropriate transaction or scale variable, the opportunity cost of holding money and the return on assets other than money.

2.2 Equity

Friedman (1988) suggests several explanations for a relation between money and equity. First, a positive wealth effect: "*A rise in stock prices means an increase in nominal wealth…The higher wealth-to-income ratio can be expected to be reflected in a higher money-to-income ratio*". A second positive link between money and equity arises from a financial transaction channel. "*A rise in stock prices may be taken to imply a rise in the dollar volume of financial transactions, increasing the quantity of money demanded to facilitate transactions.*" A positive relation between the equity market and money demand can also result from a so-called "excessive credit" channel. Experience shows that excessive stock market returns can go hand in hand with high credit growth and therefore high money growth (Roffia and Zaghini, 2007). Third, a negative substitution effect: "*The higher the real stock price, the more attractive are equities as a component of the portfolio*". Fourth, risk considerations: "*A rise in stock prices reflects an increase in the*

expected return from risky assets relative to safe assets…The resulting increase in risk could be offset by increasing the weight of relatively safe assets in an aggregate portfolio". One should keep in mind that the fourth channel is closely related to the third channel, given a risk-return trade-off. A high risk reflects a high expected return and vice versa. It is therefore hard to distinguish between the two channels, especially in the long run. Friedman (1988) stresses the fact that the sign of the relation between money and equity is basically an empirical matter, with both-sided a priori arguments.

2.3 Empirical Studies

Table 1 provides a non-exhaustive overview of empirical studies on euro area money demand published in this century.[1] The focus is on the long-run findings. Six conclusions emerge.

First, the income elasticity varies between 1.0 and 1.8. The four studies that examine also wealth find that the sum of the income and wealth elasticities amounts between 0.9 and 1.3. These studies argue that a money demand function which includes wealth is stable. Boone *et al.* (2004) associate wealth with a composite residential property and stock prices. Greiber and Setzer (2007) analyse house prices or housing wealth. Money demand and housing wealth is also recently examined by Beyer (2008). Hall *et al.* (2007) approximate wealth by smoothing the stock price index, whereas De Santis *et al.* (2008) consider housing and financial wealth. Second, the effect of the own rate on money varies between 0.9 and 3.4 and is typically found to be close to 1. Third, the sign of the short-term interest rate semi-elasticity is ambiguous, depending on whether the short-term interest rate is picking up the own rate on money or the opportunity cost of money. The absolute size of the semi-elasticity varies between 0.1 and 1.9. Fourth, the long-term interest rate semi-elasticity, measuring the opportunity costs of money, is generally found to be around –1, but also higher values up to –7 are found. Fifth, the empirical relevance of equity (equity return, dividend yield, earnings yield, stock price index and stock market volatility) for euro area money demand differs among studies. Biggs (2003) and Cassola and Morana (2004) report significant long-run elasticities with respect to the stock market price index of 0.06, but with opposite sign. Kontolemis (2002) and Bruggeman *et al.* (2003) conclude that stock prices do not matter for money demand in the long run, but may be useful in forecasting exercises. Bruggeman *et al.* (2003) also argue that stock market volatility does not seem to promote the understanding of any short or long-run money demand relation. By contrast, Carstensen (2006) finds a significant long-run impact of stock market volatility on euro area money demand. He shows that a euro area money demand model which includes stock market volatility and equity return exhibits structural stability, whereas this is not the case for a specification without the equity variables. The dividend yield is a significant long-run determinant of aggregate money demand in Von Landesberger (2007). It appears to capture a negative substitution effect given the dividend yield tends to be low (high), when returns on equity have been high (low). De Santis *et al.* (2008) also present a stable money demand including the earnings yield, a proxy for the return on equity, in the euro area vis-à-vis the

[1] For details on the conceptual framework and tools used by the ECB in interpreting monetary developments in this century see ECB (2005 and 2007).

United States. These contrasting findings can be explained by an inappropriate distinction between positive wealth effects and negative substitution effects from the stock price index and by the ambiguous long-run impact of stock market volatility, depending whether it captures risk (positive impact) or expected equity return (negative impact). The sixth and final conclusion is that the estimated adjustment coefficients vary, excluding Biggs (2003), between 0.03 and 0.3, suggesting an average speed of adjustment towards the equilibrium money demand of 3 to 33 quarters.

Table 1
Overview of euro area money demand studies

Study	Estimation period	Income[1)]	Own rate on money[2)]	Short-term rate[2)]	Long-term rate[2)]	Equity return[2)]	Stock market[3)]	Adjustment coefficient
Bruggeman (2000)	1980:I-1994:IV	1.50			-1.09			0.26
Calza *et al.* (2000)	1990:01-1999:09	1.21	0.97	-0.97				0.31
Calza *et al.* (2001)	1980:I-1999:IV	1.34	0.86	-0.86				0.12
Coenen and Vega (2001)	1980:IV-1998:IV	1.16		-1.29				0.13
	1980:IV-1998:IV	1.13		0.87	-0.87			0.13
Dedola *et al.* (2001)	1983:III-1999:I	1.26	3.44	-0.08	-3.36			0.12
Funke (2001)	1980:I-1998:IV	1.21		-0.30[1)]				0.12
Golinelli and Pastorello (2002)	1980:III-1997:IV	1.37			-0.68			0.12
Kontolemis (2002)	1980:I-2001:III	1.00		-1.45				0.12
	1980:I-2001:III	1.00		-1.70			-0.08	0.09
Biggs (2003)	1980:I-2002:IV	1.47		-0.10	-0.50		-0.06	0.69
	1980:I-2002:IV	1.00		0.30	-0.70		-0.06	0.69
Bruggeman *et al.* (2003)	1980:II-2001:IV	1.38	1.31	-0.81				0.12
	1980:II-2001:IV	1.39	1.04	-0.62			-0.001	–
Artis and Beyer (2004)	1983:I-2000:IV	1.00			-6.79			0.10
Boone *et al.* (2004)	1971:I-2003:IV	1.27[4)]		-0.69	-0.44			0.04
Brand and Casola (2004)	1980:I- 1999:III	1.33			-1.61			0.14
Cassola and Morana (2004)	1980:I- 2000:IV	1.14					0.06	0.10
Stracca (2004)	1980:I-2000:IV	1.19			-1.72[1), 6)]			0.15
Greiber and Lemke (2005)	1980:I-2004:IV	1.26	1.20	-1.20				0.15
Carstensen (2006)	1980:I-2003:II	1.25	2.01	-1.87		-0.14	0.04	–
Greiber and Setzer (2007)	1981:I-2006:IV	1.07[4)]			-0.48			0.07
Hall *et al.* (2007)	1980:I-2006:III	1.16[4)]						0.03
Von Landesberger (2007)	1991:I-2005:IV	0.94			-0.29[1)]	0.08[8)]		0.08
De Santis *et al.* (2008)	1980:I-2007:III	1.84			1.37[7)]	-0.38[1), 9)]		0.03
De Santis *et al.* (2008)	1980:I-2007:III	0.87[5)]			-0.64[7)]	-0.13[1),9)]		–

Notes: [1)] Long-run elasticity. [2)] Long-run semi-elasticity. [3)] Long-run elasticity with respect to the stock market price index, except for Carstensen (2006) long-run semi-elasticity with respect to stock market volatility. [4)] Income plus wealth. [5)] Wealth. [6)] Price dual or opportunity costs and Divisia M3 instead of M3. [7)] Euro area vis-à-vis United States. [8)] Dividend yield. [9)] Earnings yield in euro area vis-à-vis United States.

3 EMPIRICAL MODEL

The Keynesian liquidity preference theory and Friedman's general demand theory offer the main building blocks for the empirical model. Keynes' main motives for holding money, albeit mutually interdependent, are for presentational reasons classified under one specific motive. A standard money demand specification is augmented with equity-related and labour market variables:

$$m_t = \alpha_0 + \alpha_1 y_t + \alpha_2 w_t + \alpha_3 rm_t + \alpha_4 re_t + \alpha_5 (ur_t - ur_{t-4}) \quad (1)$$

where m, y, w, rm, re, and ur denote real M3, real GDP, real wealth, own rate of return on money, expected return on equity, and unemployment rate. Real variables are computed by using the GDP deflator and are transformed to logarithms. The other variables are measured as fractions. For example, a 12-percent expected return on equity enters the data set as 0.12. The new elements are wealth, consisting of both housing and financial wealth, the expected return on equity and the annual change in the unemployment rate.

The vector error correction modelling approach by Johansen and Juselius (1990) and Johansen (1991) is applied:

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \ldots + \Gamma_{k-1} \Delta Y_{t-k+1} + \Pi Y_{t-k} + \varepsilon_t \quad (2)$$

The (p x p) matrix, Π, characterises the long-run relationship between the (p x 1) vector of Y variables: m, y, w, rm, re and ur-ur$_{-4}$. The focus is on the long-run specification, because most theoretical models of money demand, whether based on transactions demand or portfolio choice, imply an equilibrium relation in levels. Cointegration is indicated by the rank of Π, r, and equals the number of cointegration vectors. The cointegration space includes a deterministic term containing a constant but no trend. Π is decomposed into $\lambda\alpha'$, where λ and α are (p x r) matrices. The rows of α' are the cointegrating vectors and determine the long-run relationships between the variables. The λ-matrix is a weighting matrix and represents the speed of adjustment of the variables to equilibria.

The transaction motive is captured by GDP and wealth. GDP reflects the impact of real economic transactions' volumes. Wealth reflects both wealth effects and the financial transaction channel. As wealth increases, the demand for all financial assets, including money, can be expected to increase too. Financial transactions capture portfolio investment considerations and are not accounted for appropriately by GDP. Here a general wealth concept, which includes not only financial wealth but also housing wealth, is considered. The focus on financial wealth is justified in case portfolio investment considerations are important for money demand behaviour. Greiber and Setzer (2007) and Beyer (2008) show the importance of housing wealth for money. One may argue that there is a transaction motive from the equity market through wealth when wealth adjusts to equity market developments.

Wealth, although classified under the transaction motive, can also be seen as a proxy for risk considerations, which, in turn, relate to the speculative motive for money demand. For instance, a rise in stock prices results in higher wealth and increases the risk profile of the total investment portfolio, which could then induce investors to shift towards risk-free assets as included in M3. In addition, two return variables capture the speculative motive. Friedman's theory and the portfolio approach of Tobin consider

a variety of assets alternatively to money for their portfolio decisions. Given the high correlations between the own rate of return on money, the short-term interest rate, and the long-term interest of between 0.96 and 0.98 since 1983 and thus the problem of multicollinearity, only the own return of money is considered. The expected return on risky equity is also examined given the focus on equity as an alternative asset to money. Both variables are estimated freely instead of in relative terms. The former provides more insight in the statistical significance of the two return variables, whereas the latter puts a priori the restriction that both coefficients are identical, but of opposite sign.

The precautionary motive is introduced by the annual change in the unemployment rate (*ur*). This variable is available long backward and represents the tendency for money hoarding when the labour market weakens and for dishoarding when the labour market improves. It may also reflect a general "feel bad" factor. Joblessness negatively affects the well-being of people (Di Tella *et al.*, 2001) and the unemployment rate builds together with the inflation rate the misery index as created by Okun.

Four versions of the baseline Equation (1) are estimated:

- A precautionary motive from the labour market as the only new element: $\alpha_2 = 0$, $\alpha_4 = 0$;
- The motives for holding money coming from the equity market as the only new elements: $\alpha_5 = 0$;
- Unrestricted;
- Elasticities with respect to GDP and wealth adding up to one: $\alpha_1 + \alpha_2 = 1$.

The baseline specification that adds the GDP and wealth elasticities up to one is the preferred specification, because money adjusts then, as theoretically expected, one-to-one to changes in real and financial transactions in the long run. In order to check the stability of the results, Greene (1999) Min-P tests are applied for possible breaks in Stage III of the Economic and Monetary Union (EMU). This stability test is based on the minimum probability value of a sequence of Chow forecasts tests with an unknown breakpoint. It is like the Max-F or Sup F-test, which is based on a series of Chow breakpoint tests, but the Max-F test has the disadvantage that each sub-sample requires at least as many observations as estimated parameters. For the Max-F test there are not enough observations to split the sample, due to a large number of estimated parameters as a consequence of a high optimal lag order.

As a further robustness check seven alternative specifications are estimated by approximating the augmented motives for holding money in a different way. The wealth impact is also considered by looking only at financial wealth. As alternatives for the return on equity, a risk-adjusted expected equity return, an expected equity return calculated by three-year averages, and a realised equity return calculated over a five-year horizon, are considered. The risk-adjusted expected equity return is examined against the background of the earlier described risk-return trade-off. By adjusting directly the equity return to risk, the ambiguity whether a separate risk variable captures in the long run risk or return is avoided. The considerations of a horizon of three years and of realised equity returns follow from Carstensen (2006). In the long run, the use of realised current equity returns instead of expected future returns can be justified as long as the difference between the two is stationary in the long run. In the short run, current equity returns are as good as any predictor if equity returns behave like a random walk. The precautionary motive is also

approximated by the natural logarithm of the trend restored OECD composite leading indicator, the consumer confidence index, and the industrial confidence indicator. In addition, Equation (1) is estimated for a sub-sample starting in 1994. In all cases Equation (1) with GDP and wealth elasticities adding up to one is the starting point, because the long-run adjustment of M3 to changes in real and financial transactions is then as expected one-to-one.

- Financial wealth instead of financial and housing wealth (1a)
- Risk-adjusted expected equity return instead of expected equity return (1b)
- Expected equity return calculated over a period of three instead of five years (1c)
- Realised return on equity over a five-year period instead of expected return over the same period (1d)
- OECD composite leading indicator instead of the annual change in the unemployment rate (1e)
- Consumer confidence index instead of the annual change in the unemployment rate (1f)
- Industrial confidence indicator instead of the annual change in the unemployment rate (1g)
- Sample starting in 1994 (1h)

4 DATA

The sample period starts in the first quarter of 1983 (1983Q1) and ends in the second quarter of 2007 (2007Q2). Sub-sample results starting in 1994Q1, the beginning of Stage Two of EMU, are also reported. The sub-sample estimates should be interpreted with more than the usual caution, because the sub-sample is short. It has, however, the advantage of a limited use of synthetic euro area data, which might distort the "real" euro area outcome. The results for the consumer and industrial confidence indicators as a proxy for the precautionary motive are shown for the sub-sample, because both indicators are not available from 1983 onwards. Data are obtained from ECB statistics and from the 7th updated version of the database in Fagan *et al.* (2001). The own rate of return on M3 is constructed as a weighted average of the national own rates of return of M3, where the latter are calculated as a weighted average of the rates of return on the various components of M3 (see, for details, Bruggeman *et al.*, 2003). From July 2003 onwards, with the introduction of the euro area Monetary Financial Institution interest rates statistics, the own rate of return on M3 is calculated using a bridge equation. All stock market variables are based on the Datastream EMU stock price index. The composite leading indicator is from the OECD and consumer and industrial confidence indicators are published by Eurostat.

Wealth refers to the gross stock of household wealth, because wealth for non-financial corporations is not available long backward. Household wealth is composed of housing wealth (see, for details, ECB 2006) and financial wealth. The latter equals the market value of household financial assets. The growth rates of financial wealth typically fluctuate, in particular because of the changes in stock prices. Data on financial wealth data are derived from the quarterly integrated euro area accounts from 1999 onwards and for the years before 1999 from available national data. The share of money in household wealth varies between 18% and 20%. Table 2 provides the estimated long-run adjustment of

wealth to stock market capitalisation. It shows that both household wealth and financial wealth adjust for about 40% to stock market capitalisation developments in the long run. This is consistent with Sutton (2002) and Kakes and Van den End (2004) who find a strong impact of stock prices on house prices. Sub-sample results and stability tests show that the long-run adjustment of wealth to stock market capitalisation has been robust.

The expected return on equity is approximated following the earnings-based methodology of Fama and French (2002).[2] This approach assumes that the expected equity return equals the sum of the dividend yield and the earnings growth:

$$A(re_t) = A(D_t/SP_{t-4}) + A(GE_t) \quad (3)$$

where D_t is the four-quarter trailing dividend at time t, SP_{t-4} is the four-quarter lagged stock price, $GE_t = (E_t/E_{t-4})/E_{t-4}$ is the annual growth rate of earnings (E) at time t, and A represents an average value. For the baseline specification the average is taken over a five-year horizon, assuming a five-year investment horizon for equity. The mean and median of the expected equity return are 13%. The maximum and minimum are 21% and 4%, respectively. The risk-adjusted expected equity return is the expected equity return divided by the quarterly standard deviation of daily stock returns for a five-year period.

The maximum and minimum of the annual change in the unemployment rate are 1.5% and -1.0%, respectively. Figure 1 illustrates that the annual change in the unemployment rate tends to be associated with a general "feel bad" factor among consumers. There is a high positive correlation between the yearly change in the unemployment rate and the inverted consumer confidence index: 0.86 since the release of the euro area consumer confidence index in 1985, with a corresponding t-statistic of 16.

Table 2
Long-run equity market impact on wealth

	1983-1993	1994-2007	1983-2007	Max F	Exp F	Ave F
Household wealth	0.41 **	0.39 **	0.41 **	8.56	2.19	2.20
	(0.03)	(0.06)	(0.02)	[0.10]	[0.13]	[0.33]
Financial wealth	0.42 **	0.39 **	0.42 **	6.75	1.98	2.68
	(0.02)	(0.03)	(0.01)	[0.20]	[0.17]	[0.24]

Notes: Estimated stock market capitalisation elasticities from regressions with the natural logarithm of wealth as regressand and a constant together with the natural logarithm of stock market capitalisation as regressors. ** denotes the 1% significance level. Newey-West standard errors are reported between parentheses, the P-values of Quandt-Andrews unknown break-point F-tests with 30% trimming percentage between square brackets.

[2] While Fama and French (2002) examine three models (average return, dividend growth and earnings growth), this study considers the earnings-based approach, because the average return model produces higher standard errors and dividend payments are, in contrast to earnings, sensitive to the dividend payout, share buyback, and tax policies.

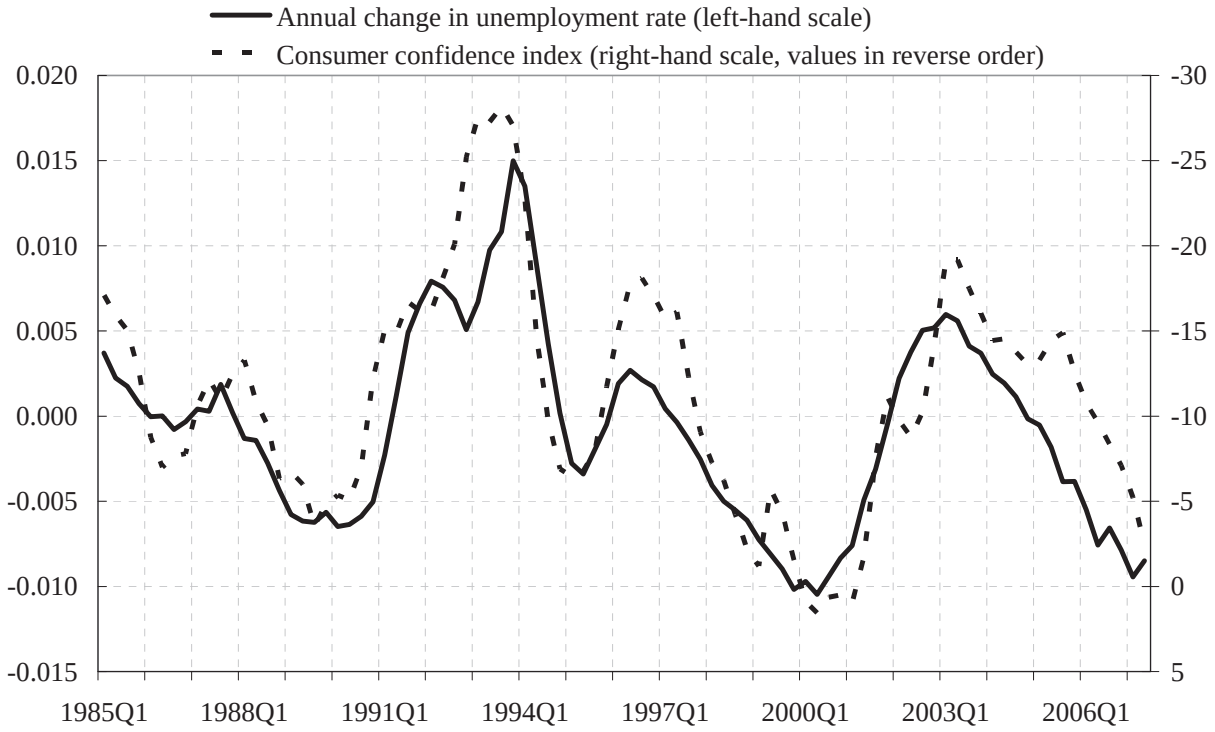

Fig. 1 Annual change in unemployment rate and consumer confidence index in the euro area

Table 3 reports unit root tests in order to assess the time series properties of the data. The augmented Dickey Fueller and Philipps-Perron tests show that all variables considered in the baseline specification are integrated of the order 1, i.e. I(1). The variables considered in the alternative specifications are also I(1) according to the Phillips-Perron test, but there is some ambiguity according to the augmented Dickey Fueller tests. All in all, unit root tests indicate reasonable evidence that all series are I(1). This implies that the levels of the variables mentioned in Table 3 should be relevant for the long-run money demand.

Table 3
Unit root tests

Variables	ADF level	ADF difference	PP level	PP difference
Baseline specification				
Money	0.72	-7.81 **	0.21	-7.84 **
GDP	-1.14	-8.09 **	-0.94	-8.30 **
Wealth	2.02	-3.99 **	2.29	-5.90 **
Own rate on money	-1.38	-4.81 **	-1.44	-4.82 **
Expected equity return	-2.48	-3.06 *	-1.71	-3.32 *
Unemployment rate yearly change	-2.83	-3.85 **	-2.32	-4.80 **
Alternative specification				
Financial wealth	-0.59	-6.73 **	-0.54	-6.82 **
Risk adjusted equity return	-2.61	-3.53 **	-1.86	-3.66 **
Expected equity return, 3-year horizon	-3.75 **	-5.18 **	-2.36	-3.10 *
Realised equity return, 5-year horizon	-3.31 *	-2.36	-1.90	-2.96 *
OECD composite leading indicator	-0.42	-6.09 **	-0.64	-4.62 **
Consumer confidence indicator	-3.29 *	-5.15 **	-2.44	-4.60 **
Industrial confidence indicator	-4.92 **	-6.19 **	-2.70	-4.24 **

Notes: ADF denotes Augmented Dickey Fuller test and PP Philips-Perron test, in both cases the H_0 is that the series has a unit root. ** and * denote rejection of the null hypothesis at the 1% and 5% significance level, using the test critical values of -3.50 and -2.89, respectively.

5 EMPIRICAL RESULTS

Panel A of Table 4 reports lag exclusion tests for up to and including 7 lags. The optimal lag order is 4 for the specification without wealth and 6 for the specifications with wealth. Panel B of Table 4 presents cointegration rank tests. Adjusted trace test statistics, following Reimers (1992) suggestion to take account of the number parameters to be estimated in the model, indicate the existence of one cointegrating relationship. The only exception is the result for the version of the model without stock variables (α_2=0, α_4=0), where the null hypothesis of at most one cointegration vector is rejected at the 5% significance level.

Table 4

Lag exclusion and cointegration rank tests

Panel A: Chi-squared statistics for joint lag exclusion							
Lag length	1	2	3	4	5	6	7
(1) with $\alpha_2=0$, $\alpha_4=0$	74.4 **	37.3 **	39.3 **	30.1 *	21.8	22.4	18.7
(1) with $\alpha_5=0$	126.7 **	51.7 **	48.7 **	58.1 **	54.1 **	37.7 *	26.5
(1) unrestricted	173.6 **	59.7 **	58.8 **	97.6 **	73.1 **	62.4 **	46.2
(1) with $\alpha_1+\alpha_2=1$	167.6 **	55.6 **	60.6 **	87.1 **	66.5 **	59.2 **	41.8
Panel B: Adjusted trace test statistics							
Cointegration rank	0	1	2	3	4	5	
(1) with $\alpha_2=0$, $\alpha_4=0$	60.6 **	32.6 *	6.85	0.61			
(1) with $\alpha_5=0$	70.9 **	37.4	18.8	7.19	0.09		
(1) unrestricted / with $\alpha_1+\alpha_2=1$	105.2 **	63.7	40.1	22.3	9.94	0.06	

Notes: Intercept but no trend in error-correction specification of Equation (1). ** and * denote the 1% and 5% significance level, i.e. for panel B a rejection of the H_0 of at most r cointegration vectors using the criticial values of MacKinnon, Haug and Michelis (1999). Degrees of freedom adjusted λ-max tests show the same cointegration rank outcomes.

Table 5 summarises for the baseline specification (1) the estimated long-run (semi-)elasticities and the adjustment coefficient (λ) towards the long-term equilibrium relation. Three conclusions emerge.

First, equity market variables play a significant role in holding money in the euro area. The version of the model without equity market variables performs comparatively poor. The estimates of the other model versions indicate both positive wealth effects and negative substitution effects from the equity market. The estimated wealth elasticity of about 0.85 together with a robust relation between wealth and stock market capitalisation suggest that movements in stock market capitalisation can be expected to positively affect M3. At the same time, the expected return on equity negatively affects the long-run money demand. The semi-elasticity with respect to the expected return on equity is found to be between -0.2 and -0.4. Figure 2 illustrates the economic importance of both effects. It plots the estimated coefficient multiplied by the annual change in the variable for the version of Equation (1) with GDP and wealth elasticities adding up to one. The latter restriction is not binding according to the Likelihood Ratio test. The positive impact of wealth on money, which generally varies between 0% and 6%, is much larger in economic terms than the negative substitution effect of the expected equity return of between -1% and +1%. With minor exceptions the wealth impact has positively contributed to money growth. This finding can explain why studies that ignore wealth find income elasticities above one (see Table 1).

Second, a precautionary motive from the labour market is found to be a statistically significant long-run determinant of M3. The estimated coefficients for the two specifications that also include the equity variables imply that a 1 percentage point increase in the annual change in the unemployment rate results, *ceteris paribus*, in a 3.8 to 5.1 percentage point higher M3 growth. Its economic importance for M3 as plotted in Figure 2 has varied between -8 percentage points and +6 percentage points.

Third, the estimated coefficients of the standard money demand variables are in line with previous findings as summarised in Table 1. Ignoring wealth, the GDP elasticity is clearly above one. An

elasticity of one for the sum of the GDP and wealth elasticities cannot be rejected, as indicated by the Likelihood Ratio test. With this restriction money adjusts one-to-one to changes in real and financial transactions in the long run. For this preferred specification the semi-elasticity with respect to the own rate on money is 0.7, in line with other studies and statistically not significantly different from 1. The estimated error-correction term of -0.2 is within the range of -0.05 and -0.3 as found in other studies. There are no signs of serial correlation, as indicated by the respective rows of the Lagrange Multiplier residual test. The Min-P tests support in all cases the stability of the parameters.

Table 5
Estimation results of baseline long-run specification

GDP	α_1	1.69 **	0.10	0.07	0.16 **
		(0.19)	(0.08)	(0.08)	(0.06)
Wealth	α_2		0.76 **	0.85 **	0.84 **
			(0.07)	(0.06)	(0.06)
Own rate on money	α_3	2.11	0.19	0.27	0.73 *
		(1.90)	(0.45)	(0.38)	(0.32)
Expected equity return	α_4		-0.42 **	-0.27 **	-0.15 *
			(0.09)	(0.08)	(0.06)
Unemployment rate	α_5	23.1 **		3.79 **	5.07 **
		(4.67)		(0.93)	(0.86)
Error-correction term	λ	-0.05 **	-0.27 **	-0.21 **	-0.19 **
		(0.01)	(0.06)	(0.07)	(0.06)
R-squared		0.47	0.63	0.61	0.61
Log Likelihood		1839	2151	2777	2747
LM(1)		0.31	0.30	0.67	0.57
LM(4)		0.08	0.86	0.11	0.08
Min P-test		0.10	0.06	0.09	0.16
LR test for restrictions					0.21

Notes: Johansen's Maximum Likelihood estimates of error-correction specification of Equation (1) with 1 cointegration relation with 4 lags excluding wealth and 6 lags including wealth over the sample 1983:I-2007:II. Standard errors are reported between parentheses. LM reports the p-value of the Lagrange Multiplier residual test. Min P-test refers to the lowest p-value with respect to a sequence of Chow's forecast F-tests for Stage III of EMU forecast periods, i.e. 1999:I-2007:II up to 2007:II-2007:II. LR reports the p-value of the Likelihood Ratio test for binding restrictions. ** and * denote different from zero at the 1% and 5% significance level.

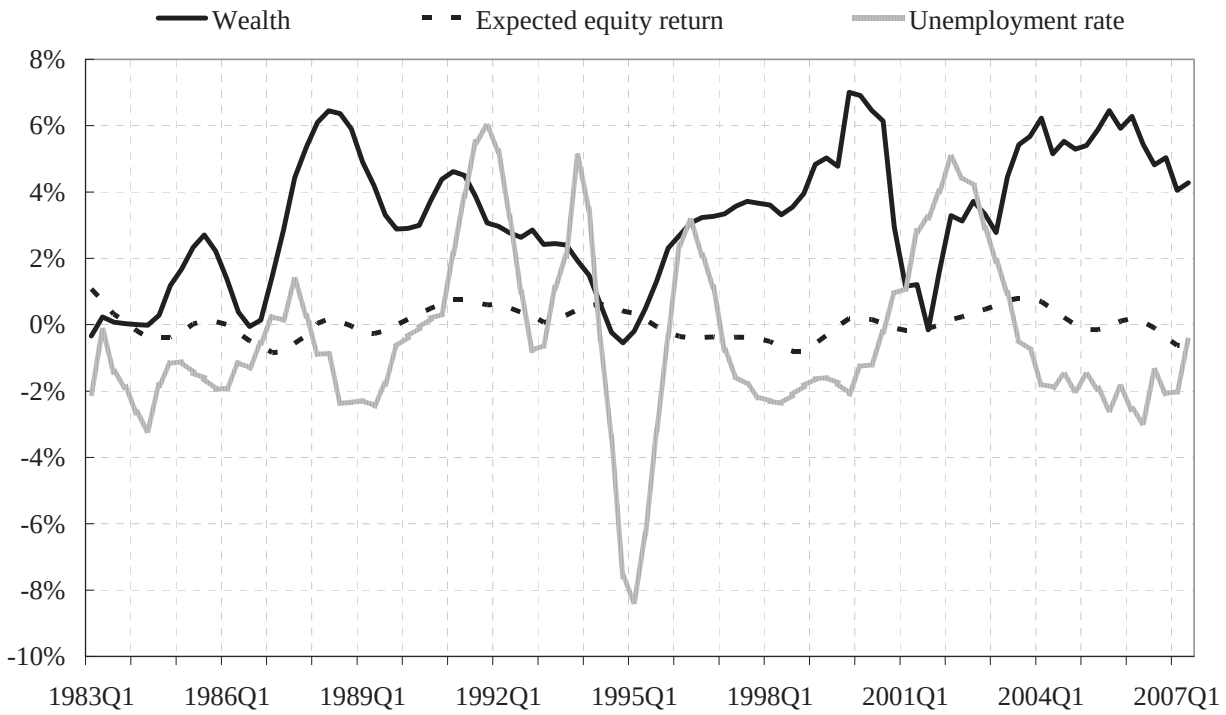

Fig. 2 Economic importance of the augmented motives for holding euro area M3 (Estimated coefficient multiplied by the annual change in the respective variable)

Table 6 presents the estimation results of the alternative long-run specifications. The main conclusions still hold. Positive wealth effects and negative substitution effects from the equity market and a precautionary motive from the labour market do matter for holding M3. The estimation results are robust across another wealth variable (only financial wealth), other approximations for the return on equity and other precautionary indicators. A short sample starting in 1994 does not alter the main findings. The small and sometimes insignificant GDP elasticities as reported in Tables 5 and 6 suggest that the wealth variable also captures part of the impact of GDP on money demand.

Table 6
Estimation results of alternative long-run specifications

		1983:I-2007:II				1994:I-2007:II			
		(1a)	(1b)	(1c)	(1d)	(1e)	(1f)	(1g)	(1h)
GDP	α_1	0.31	0.12 *	0.15 **	0.08	0.30 **	0.31 **	0.30 **	0.14 **
		(0.30)	(0.05)	(0.04)	(0.06)	(0.06)	(0.06)	(0.09)	(0.04)
Wealth[1)]	α_2	0.69 *	0.88 **	0.85 **	0.92 **	0.70 **	0.69 **	0.70 **	0.86 **
		(0.31)	(0.05)	(0.04)	(0.06)	(0.06)	(0.06)	(0.09)	(0.04)
Own rate on money	α_3	4.06 *	0.51	0.55 *	0.85 *	-0.12	-0.09	-0.03	0.90 **
		(1.75)	(0.33)	(0.25)	(0.38)	(0.55)	(0.20)	(0.40)	(0.21)
Expected equity return[2)]	α_4	-0.32	-0.03 *	-0.12 *	-0.08 *	-0.40 **	-0.30 **	-0.50 **	-0.11 *
		(0.24)	(0.01)	(0.04)	(0.04)	(0.08)	(0.05)	(0.06)	(0.04)
Precautionary indicator[3)]	α_5	3.34	4.69 **	5.91 **	4.92 **	-0.20 *	-0.17 **	-0.31 *	0.89 *
		(4.64)	(0.87)	(0.70)	(0.91)	(0.08)	(0.05)	(0.13)	(0.42)
Error-correction term	λ	-0.06 **	-0.18 **	-0.26 **	-0.19 **	-0.33 **	-0.13	-0.30 **	-0.19
		(0.02)	(0.07)	(0.07)	(0.05)	(0.06)	(0.12)	(0.09)	(0.16)
R-squared		0.68	0.61	0.60	0.61	0.69	0.91	0.90	0.86
Log Likelihood		2664	2560	2699	2687	2600	1611	1587	1791
LM(1)		0.06	0.54	0.67	0.81	0.11	0.32	0.35	0.99
LM(4)		0.06	0.24	0.22	0.13	0.96	0.89	0.39	0.10
Min P-Test		0.41	0.12	0.04 *	0.36	0.02 *			
LR test for restrictions		0.08	0.00 **	0.65	0.22	0.12	0.02 *	0.00 **	0.50

Notes: Johansen's Maximum Likelihood estimates of error-correction specification of Equation (1) with GDP and wealth elasticities adding up to 1 and with 1 cointegration relation and 6 lags. Standard errors are reported between parentheses. LM reports the p-value of Lagrange Multiplier residual test. Min P-test refers to the lowest p-value with respect to a sequence of Chow's forecast F-tests for Stage III of EMU forecast periods, i.e. 1999:I-2007:II up to 2007:II-2007:II. LR reports the p-value of the Likelihood Ratio test for binding restrictions. ** and * denote different from zero at the 1% and 5% significance level. [1)] Financial wealth for (1a). [2)] Risk-adjusted for (1b), calculated over three-year horizon for (1c), and realised equity return over five-year horizon for (1d). [3)] Annual change in unemployment rate, except OECD composite leading indicator for (1e), consumer confidence index for (1f), and industrial confidence index for (1g).

6 CONCLUSION

The empirical analysis results in two clear-cut conclusions.

First, both positive wealth effects and negative substitution effects from the expected equity return do significantly help to explain long-run money demand in the euro area. In particular, wealth effects are of economic importance. The relevance of financial transaction and speculative motives from the equity market implies that a broad investors' perspective is key for understanding money demand. One should also look at the interplay between money and equity. An implication of the importance of wealth for the demand for money is that the velocity of money also depends on wealth.

Second, a precautionary motive coming from the labour market is found to be a statistically and economically significant long-run determinant of money demand in the euro area. This finding implies that an improvement in the labour market situation, which normally goes hand in hand with higher GDP and thus higher money demand, also results in a lower precautionary demand for money in the long run.

Both conclusions are found to be robust over time and across different ways to capture wealth, equity return and the precautionary motive. The assessment of money growth thus benefits from closely monitoring equity and labour market developments. Given the promising new evidence, the present study provides a useful starting point for future research in the long history of money demand.

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