〔研究ノート〕

An Analysis of M4 in the United Kingdom

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1. Introduction

Inflation targeting has recently been adopted by many countries. Inflation or price stability is one of the most important assignments for policy makers, especially central banks. Efforts to maintain price stability have been varied between policymakers of various EU countries. The ECB has stated that its primary goal is stable prices and that all member countries should focus on controlling inflation.

The financial policy strategy of the ECB contributes some role to money supply, as it is decided by a reference for Euro zone. M3 or M4 is a good anchor for monetary policy if there is a stable money demand function. In the past many central banks all over the world took this idea. A stable relationship between money supply and its determinants (income or interest

rates) has been broadly discussed and examined in the academic field.

For a long time the debate on monetary integration focuses on which countries would meet the Maastricht treaty's convergence criteria. The Maastricht criteria were not all that closely followed although many countries made great efforts to get as close to satisfying them as possible.

The United Kingdom did not join the currency integration, Euro. And the financial policy strategy seems to have been different from Germany, France, or ECB.

Coenen and Vega (1999), Fagan and Henry (1999) and Brand and Cassola (2000) supports the stable relationship of the demand for euro zone. Angeloni (1994) and Todter and Reimers (1995) are scarce literatures. However, there is little paper that has examined the properties of the individual components of money supply especially for the United Kingdom.

This paper is to analyze demand functions for M4 in the UK using alternative econometric methods. The method is based on Kremers et al. (1992). The results suggest that the demand of M4 may be well explained in terms of their traditional determinants. The cointegration supports the stable relationships between the M4 and its determinants.

This paper is organized as follows. Section 2 gives the theoretical background of the analysis of the demand for the element of M4. Section 3 provides the results of the empirical analysis. Section 4 gives a brief summary. And this paper is largely owed to Calza et al. (2000).

2. Theoretical Analysis

Since ECB's current goal is being decided to achieve stable prices, some EU countries have adopted direct inflation control as a target of financial

policy. Several other countries, however, have adopted other targets, such as monetary targeting, exchange rate targeting, or other targeting. The UK has chosen inflation targeting.

Money demand theory usually distinguishes between an income related transaction demand, an income related precautionary demand and an interest related speculative demand for money. Demand functions for the components of M4 could be explained by an income variable and interest rates. Of course some studies that have other variables have been provided, I follow these traditional ideas.

A number of recent papers suggest that including income as a transactions variable and an interest rate spread as opportunity cost is suitable to analyze the demand for M4.[1] One possible drawback of using spread is that these may be stationary, whereas money and output tend to be I(1). This, however, is not the case. The inclusion of the interest spread, instead of its interest rate itself, is motivated by the need of avoiding multi-collinearity problems. I t is easily understandable to used spread instead of interest rate itself. According to this approach, the demand for the M4, can be expressed as a function of the two determinants:

$$M4 = f(GDP, \text{spread}) \quad (1)$$

In the equation (1), spread means the difference between the rate of return on a representative asset and the own rate of return.

Some studies suggest that the omission of a separate variable for private sector wealth in a money demand equation may bias the analysis for a stable money demand relationship. However, due to the lack of the data for private sector wealth, I do not consider wealth as a variable listed above. On the other hand, the portfolio demand approach treats the different of money as exogenous and that the sum of the various components equals to

money.

The portfolio demand approach allows us to make the substitution process within M4 directly. The portfolio approach has the advantage that it shows more clearly the origins of the substitution processes. Typical portfolio demand equations can be expressed for the shares of the components on M4. This provides the following approach:

$$M/M4 = f(GDP/M4, \text{Return}) \quad (2)$$

In this expression (2), M means the share of component in M4, Return means the rate of return of M4. An alternative approach is to model the money demand function in a multivariate framework that includes the term structure as a separate equation. However, I follow the two expressions (1) and (2) and analyze them by econometrical approach.

The signs of the explanatory variables are different from those of various models because the portfolio demand explains the components of money demand. In this model, the sign of the coefficient for the transaction variable should be negative. This reflects a relative decrease in the less liquid components in substitution for these components with a tight relationship with it. And the opportunity cost variable would take either a negative or a positive effect on the share. This depends on the extent to which the rate of return on money demand represents an alternative interest rate.

3. Empirical Analysis

3-1 ADF Tests for Unit Roots

I estimate the demand for the main components of M4 in terms of their levels. In the first step, the integration properties of the variables are checked by means of standard unit root tests. The results of Augmented

Table 1a ADF Tests: Components of M4 and GDP

	Coefficient	First difference
Currency in circulation	0.22	−5.28***
Overnight deposits	−0.18	−5.11***
Short-term deposits	−0.55	−5.26***
Shares of Currency in circulation	−0.27	−5.11***
Shares of Overnight deposits	−0.32	−4.99***
Shares of Short-term deposits	−0.29	−5.02***
M4	−0.77	−6.01***
GDP	−0.48	−5.23***

Table 1b ADF Tests: Components of Interest Rates and Spreads

	Coefficient	First difference
Short-term interest rate	−1.89	−4.44***
Long term interest rate	−2.55	−4.95***
Spreads	−2.11	−3.28**

Note: ***indicates rejection of null at 1%, ** indicates at 5%.

Dickey Fuller tests on the logs of all variables, except for interests rate indicate that the variables are all integrated of order one (Table 1and b). These tests support that the variables are integrated of one order. Next, I analyze the demand function for M4.

3-2 Demand Function

The recent theorem indicates that cointegrated series can be stated by error-correction model. This paper uses simple form like this, following Kremers et al. (1992):

$$M=\alpha+\beta\Delta M(-1)+\gamma\Delta spread+\delta\Delta GDP+\phi ECT(-6)+\varepsilon \quad (3)$$

where Δ stands for the 6 month difference operator, ε denotes the error

term. This approach is also used by Gilbert (1990) and Ericsson (1998). The sample period is from 1990 to 2001. Owing to data availability, longer periods of the estimate could not be conducted. This would be preferable to assess long-run stability. On the other hand, the degrees of freedom were enlarged. Some studies rely on the assumption of weak exogeneity of the regress. These tests showed they were satisfied in all cases for GDP and interest rate. These equations can be interpreted as demand functions.

Table 2a and 2b reports the results of estimation.

Table 2 shows that the theoretically expected signs are confirmed in all

Table 2a Demand Functions: Long-term Coefficients for ECT

	Constant	GDP	Interest Rates
Currency in circulation	−2.68*** (−8.68)	1.56*** (5.88)	−0.35* (−1.83)
Overnight deposits	3.28*** (5.68)	0.52*** (7.25)	−1.99*** (−6.85)
Short-term deposits	0.25 (0.48)	0.99*** (7.19)	−1.08*** (−3.61)
M4	−5.28*** (−6.58)	1.08** (20.24)	−0.58*** (−28.21)

Table 2b Demand Functions: Dynamic Demand

	Constant	Lagged	GDP	Interest Rates	ECT
Currency in circulation	0.11 (0.32)	0.92*** (10.28)	1.33*** (20.32)	−0.45* (−1.44)	−0.33*** (−2.57)
Overnight deposits	2.33** (2.20)	0.88*** (18.57)	0.29*** (2.33)	−0.44 (−1.08)	−0.39*** (−5.62)
Short-term deposits	0.58*** (7.41)	0.48*** (20.36)	0.19*** (5.29)	−0.40*** (−2.41)	−0.65* (−8.63)
M4	1.02*** (5.68)	0.84*** (11.45)	0.22* (1.38)	−0.63* (−4.61)	−0.68*** (−10.23)

Note: *** indicates rejection of null at 1%, ** indicates at 5% and * indicates at 10%.

cases. GDP has a positive large effect on the demand for M4. It is interesting to note that he elasticity for currency in circulation is quite large. And this shows an inverse relationship between the demand for the components of money demand and the interest rate spread. For the dynamic specification, the results are ones as expected. There is a strong relationship between the dependent variable and its lagged ones. ECM term is positive and it would be indicative of cointegration.[2]

Given the possibility of serial correlation between among error terms, I use a SUR for the shares in M4 (see, Zellner, 1963). This method is based on GLS estimation. A number of institutional factors may have an impact on money demand. And the diagnosis is indicative of serial correlation. The correlation from SUR estimates is in Table 3.

Coefficients reported in the table are small. However that substitution has not included in the SUR may not be significant. However, this finding should be treated with caution. There may be some possibilities that segmented trend included in the case of some cases may pick some of the substitution between these components. The estimated results of the SUR are in Table 4a and 4b.

The result is similar to Table 2. The results of the SUR estimation tend to be of similar order and magnitude as those reported in Table 2. The

Table 3 Correlation Matrix from SUR Estimates

	Currency in circulation	Overnight deposits	Short-term deposits
Currency in circulation	1.00	−0.123	0.095
Overnight deposits		1.00	0.088
Short-term deposits			1.00

Table 4a Demand Functions: SUR

	Constant	GDP	Interest Rates
Currency in circulation	−0.91*** (−8.51)	1.98*** (4.77)	−0.48* (−5.18)
Overnight deposits	4.84*** (11.01)	0.99*** (10.23)	−2.62*** (−15.88)
Short-term deposits	1.02*** (6.23)	1.02*** (10.25)	−1.09*** (−3.66)
M4	−6.98*** (−15.02)	1.38*** (16.52)	−0.39** (−2.11)

Table 4b Demand Functions: SUR

	Constant	Lagged	GDP	Interest Rates	ECT
Currency in circulation	0.39** (1.41)	0.77*** (19.23)	1.78*** (10.55)	−0.48*** (−4.99)	−0.17*** (−3.08)
Overnight deposits	2.94** (5.19)	0.99*** (25.24)	0.48** (3.05)	−0.55 (−1.22)	−0.69*** (−7.62)
Short-term deposits	0.77*** (7.69)	0.84*** (20.12)	0.28*** (4.51)	−0.40** (−2.22)	−0.68*** (−7.35)
M4	3.99*** (18.12)	0.94*** (11.25)	0.36*** (5.33)	−0.61*** (−4.90)	−0.91*** (−12.13)

Note: *** indicates rejection of null at 1%, *** indicates at 5% and * indicates at 10%.

ECM test confirms the test results regarding cointegration. However, in the case of currency circulation, the SUR estimation indicates significant difference. The currency in the less interest sensitive component of M4 is supported.

Finally, in order to examine the substitution between the components more explicitly, I estimate them using their shares in M4. ADF tests confirm that the shares of M4 and the transaction variable are integrated of one order. The estimated equation is the same with the equation (3). It should be noted that annual data' M4 are I(0). However, for the monthly

data was not supported. Given the possibility of serial correlation between the error terms, I estimate SUR for the shares of money demand.

The result is reported in Table 5a and 5b.

These results indicate that substitution is not so significant for the sample considered. Overall, the demand functions for the shares seem to be behaved well. The ECM term is significant. This means a stable long-run relationship between the shares of M4 and its determinants. The co-

Table 5a Portfolio Demand Functions: Long-term coefficients for ECT

	Constant	GDP	Interest Rates
Currency in circulation	−1.98*** (−10.24)	1.33*** (4.61)	−0.55* (−4.84)
Overnight deposits	4.55*** (14.22)	0.88*** (9.22)	−2.55*** (−13.22)
Short-term deposits	0.99*** (5.61)	0.85*** (8.28)	−1.00*** (−4.25)
M4	−6.15*** (−9.22)	1.15*** (24.25)	−0.44** (2.21)

Table 5b Portfolio Demand Functions: Dynamic Demand

	Constant	Lagged	GDP	Interest Rates	ECT
Currency in circulation	0.43** (1.32)	0.85*** (15.23)	1.95*** (16.23)	−0.44*** (−4.85)	−0.19*** (−2.99)
Overnight deposits	2.99** (5.26)	0.85*** (23.25)	0.24** (2.18)	−0.41 (−1.01)	−0.66*** (−7.81)
Short-term deposits	0.55*** (7.12)	0.56*** (18.52)	0.22*** (4.85)	−0.41** (−2.32)	−0.61*** (−7.23)
M4	3.58*** (15.23)	0.86*** (10.22)	0.34*** (5.17)	−0.68*** (−4.94)	−0.94*** (−12.24)

Note: *** indicates rejection of null at 1%, ** indicates at 5% and * indicates at 10%.

efficients of the ECM term have negative and significant signs. The stability for the demand functions as shares of M4 is fairly good.(3)

4. Conclusions

This short paper analyzes the demand for the components of M4 over the period from 1990 to 2001. Against the main analysis using aggregate money supply, this paper made to model separate demand functions for the main components of M4 in the United Kingdom. There is a stable long-run relationship between traditional components, the shares of M4 and its determinants.

Moreover, the nominal demand functions for the components of M4 can be well explained in terms of their traditional determinants (GDP and interest rates). With the exception, the present analysis provides some evidence that the components of M4 had a long-run relationship. The portfolio demand approach was also used to estimate the money demand. Overall, the results indicated that the components of M4 might be well explained in terms of traditional variables. And a refinement of the empirical analysis took into account the correlation of the unexplained movements of the individual components using SUR. However the result was almost same with the traditional approach.

Notes

(1) See, for example, Ericsson (1998) and Coenen and Vega (1999).

(2) In order to check the robustness and stability, Chow tests etc. can be used.

(3) This approach has advantage that it shows clearly the origins of the substitution processes.

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