ESTIMATES OF MONEY DEMAND FUNCTIONS IN ESTONIA

by

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Abstract:

This paper examines the money demand function of Estonia in the period 1995-2006. Since Estonia has a currency board system euro area interest rate are taken into account. We apply different cointegration procedure like the Engle-Granger, dynamic OLS and Johansen-procedure to estimate the long-run relationship among money, output and interest rates. The results show that it is difficult to find a cointegrating relationship for the broad money aggregate M2. For the preferred relationship including Estonian money market rate and euro area bond rate is dynamic equation is estimated. This equation is stable for the whole period. The change of the anchor curreny in the currency board and the entry in the European Union do not alter the relationship.

1. Introduction

The European Central Bank has the main object to maintain price stability and establish a two-pillar strategy to obtain this object (see ECB, 1999 and 2003). In the first pillar economic and business variables are used to estimate the short-term and medium-term price risks. In the second pillar the monetary analysis is organized to estimate the long-run price risk, where the monetary aggregate M3 still have a prominent role. Money demand models represent a natural benchmark against which to assess monetary developments. It allows to distinguish between those changes in M3 which are explained by movements in macroeconomic variables and those changes which are specific to the situation at hand. Therefore, having a stable long-run money demand is very important, as the existence of a well-specified and stable link between money and prices can be seen as prerequisite for the use of monetary aggregates in the conduct of monetary policy. The stability of this relationship is usually assessed in a money demand framework, where money demand is linked to other macroeconomic variables like income and interest rates.

According to the Eesti Pank Act, the primary objective of Eesti Pank is to ensure price stability (Eesti Pank, 2006a and 2006b). The constitutional function of Eesti Pank to maintain the stability of the national currency essentially means the development of a long-term price stability-oriented monetary policy. A main issue of this policy is the currency board. The Estonian kroon is fixed against the euro at 1 EUR = 15.6466 EEK. The exchange rate is equivalent to the former exchange rate against the German mark (1 DEM = 8 EEK), introduced by the monetary reform of 1992. The Estonian kroon is freely convertible, i.e., there are no restrictions on the free movement of capital between Estonia and foreign countries. The currency board arrangement is a special kind of fixed exchange-rate system where the upper limit of base money (notes and coins in circulation and credit institutions' deposits with the central bank) issuance depends on the amount of the central bank's foreign reserves. This ensures an automatic cover for the kroon, as a decrease of central bank's reserves will not jeopardise the stability of the exchange rate.

Moreover, in May 2004 Estonia became member of the European Union and member of the European System of Central Banks. Because of the prominent role of the monetary analysis of the ECB the analysis of money demand functions are more important for Estonia and the other new EU member states. Therefore, Dabušinskas (2005) include a money demand analysis for Estonia and Tillers (2004) for Latvia. A pooled analysis is presented by Dreger, Roffia and Reimers (2007) for all new EU member states.

In line with the other papers a money demand function for a broad aggregate is examined. The innovation of our paper is that the sample is relatively large from 1995Q1 to 2006Q2. A special emphasize is given to the estimates and stability of the long-run relationship. Herefore, the Engle-Granger, DOLS und Johansen procedures are applied and their results are compared. We find that the income coefficient in the money demand function is greater than unity. The results of the Johansen's system approach depends on the lag order. This influence may be result of the relatively short data base. Therefore, the single equation approach is sensible. The preferred function includes in the long run the euro bond yield, which may be explained by the currency board system of Estonia. If the money market rate of Estonia is included in the function its coefficient is negative, hence, the Eesti Pank can influence the development of money.

The rest of the paper is organized as follows. The next section (Section 2) briefly describes the money demand framework. In Section 3, cointegration methods are shortly discussed. Section 4 provides basic analyse of the data and graphs, whereas Section 5 gives the results of the econometric analysis. The last section (Section 6) concludes.

2. Money demand framework

Based on a correlation analysis, Antczak (2003) and Jarocinski (2003) have stressed the importance of money growth for stabilizing inflation rates. More recently, Buch (2001) has specified money demand functions for Hungary and Poland, which account for the transition situation of these countries. Her money demand function includes an income variable, domestic and foreign interest rates and, changes of exchange rate expectations as well as inflations rates. Hence, this implies more than one variable measuring opportunity costs of money holding. With the exception of Poland, all the other new EU Member States are "small" open economies. The foreign trade liberalisation during the transition process has, therefore, affected agents' behaviour with respect to their demand of foreign and domestic financial assets. Agents could switch more easily between foreign and domestic currencies. This may have affected money holdings in these economies. As a matter of fact, some of the new EU Member States have already given the exchange rate policy a prominent role in implementing their monetary policy aims; therefore, its importance should be taken into account in the study (see Backé et al. 2004). The importance of exchange rates is also stressed by Orlowski (2004) for Hungary, Poland and the Czech Republic as well as by Komarék and Melecký (2001) for the Czech Republic. In contrast, Dabušinskas (2005) takes into account the special exchange rate arrangement of Estonia, e.g. the currency board. Estonia introduced a currency board to the euro in 1992. However, it is important to keep in mind that the euro was only introduced in January 1999 (and in circulation only in January 2002). Therefore, exchange rates are not considered.

The analyses of money demand functions for the euro area do not contain more than two opportunity cost variables (see, for example, Görgens et al. 2004, Bruggeman et al. 2003). Those studies suggest the following functional form for the money demand function:

(1) $M/P = f(Y, oc)$

where M represents a broad monetary aggregate, P is the consumer price index (which may be either the HICP for the euro area or, more generally, the CPI or the GDP deflator), Y is income proxied by real GDP, and oc represents an opportunity cost indicator. According to textbook presentations, the income variable should have a positive effect on money holdings. Conversely, if the opportunity cost measures the earnings of alternative assets, its coefficient should be negative. The interest rate variable includes via the Fisher effect the inflation rate of these countries (see Orlowski 2004).

The real money balances are determined from nominal M2 and the CPI deflator. Real GDP approximated the income variable. In contrast to Dabušinskas (2005) who constructed an own rate of M2 and because of data availability two other interest rates are used to indicate opportunity cost of holding money. First, the three money market rate is used and second, the three months EURIBOR, which is extended by the three month FIBOR before 1999, is applied and finally, the interest rate on long-term government bonds in the euro area is used, which is published by the ECB (see also Dabušinskas 2005).

3. Econometric framework

The estimation of money demand functions is conducted in the cointegration framework, becauce the variables considered are nonstationary. The nonstationarity of the variables is tested by the augmented Dickey Fuller (ADF) test and the Ng Perron (NG) test, which have the null hypothesis of a unit root (see Brooks 2002, Chapter 7). The cointegration analysis is conducted by using different approaches. Since the sample covers a relatively small period the two step approach of Engle Granger (1987) is considered. If all variables (y_t, x_{1t},…, x_{kt}) are I(1), the long-run relationship is given by:

$$y_t = b_0 + b_1 x_{1t} + b_2 x_{2t} + ... + b_k x_{kt} + ec_t ,$$

where *ec* denotes the residuals of this relationship. If the variables are cointegrated by one linear relationship, then the residuals are stationary I(0). This property may be tested by a unit root test of these residuals. The critical values are given by MacKinnon (1991). This equation is consistently estimated by OLS. In the second step this relationship is put into the dynamic equation of the form:

$$\Delta y_t = g_0 + a\,\hat{ec}_{t-1} + g_{10}\Delta x_{1t} + ... + g_{1p}\Delta x_{1t-p} + ... + g_{kp}\Delta x_{kt-p} + g_{k+1,1}\Delta y_{t-1} + ... + g_{k+1,p}\Delta y_{t-p} + v_t .$$

To make the notation simpler all variables have the same lag length *p*. The residuals are denote v_t and should be white noise. The coefficient a of *ec*-term is an adjustment coefficient or loading coefficient. Since this two-step procedure neglect common factor difficulties it is appropriate to check cointegration by the t-value of a in the dynamic equation.

The second approach is the nonlinear approach of Stock (1987). The test equation is:

$$\Delta y_t = g_0 + a\,(y_{t-1} - b_1 x_{1t-1} - b_2 x_{2t-1} - ... - b_k x_{kt-1}) + g_{10}\Delta x_{1t} + ... + g_{1p}\Delta x_{1t-p} + ... + g_{kp}\Delta x_{kt-p}$$

$$+ g_{k+1,1}\Delta y_{t-1} + ... + g_{k+1,p}\Delta y_{t-p} + v_t .$$

Since this equation includes the long-run relationship and the dynamic link it is denoted as error correction model (ECM). Cointegration is checked by the *t*-value of a in this equation. Our analysis is focused on the long-run coefficient. Therefore, these approaches are companied by the dynamic OLS (DOLS) approach of Saikkonen (1991) or Stock and Watson (1993). The equation is written as:

$$y_1 = b_0 + b_1 x_{1t} + b_2 x_{2t} + ... + b_k x_{kt} + \sum_{i=-p}^{p} (g_{1i}\Delta x_{1t-i} + ... + g_{ki}\Delta x_{kt-i}) + v_t ,$$

This equation includes leads and lags of the x_{it} variables. All these three procedures have in common that they are valid for links where only one cointegrating relationship exist. In money demand investigation we examine a system of four variables. Therefore, there could be more than one cointegrating relationship. Johansen (1991) suggest a maximum likelihood procedure to estimate and to test cointegrating relationship in a vector autoregressive model (see also Johansen 1995). The central system is the vector error correction model of the form:

$$\Delta z_t = \Pi z_{t-1} + \Gamma_1 \Delta z_{t-1} + \Gamma_2 \Delta z_{t-2} + ... + \Gamma_{p-1} \Delta z_{t-(p-1)} + m + u_t ,$$

where $z_t = (y_t, x_{1t}, \ldots, x_{kt})'$ is a l – dimensional column vector, Γ_i are coefficient matrices, m a vector of deterministic components and Π the long-run matrix. The variables are not divided into exogenous or endogenous variables. This is a system approach of $l=k+1$ variables. If all variables are nonstationary there will be r cointegrating relationship for $0 < r < l$. With $r = 0$ no cointegrating relationships exist and the system should be analysed in first differences. For $r = l$ all variables are stationary. Under the assumption of r cointegration relationships the matrix Π may be split up into a loading matrix a and cointegration matrix b :

$$\Pi = a b'.$$

The number of cointegrating relationships will be determined by testing for the rank of the matrix Π. Johansen (1991) proposes a trace test and a maximum eigenvalue test. The coefficient are estimated by maximum likelihood procedure.

4. Basic analyse of the data and graphs

The data is from Estonian statistical agency (CPI; GDP) and Estonian Central Bank (M2, I_mo_est) as well as from European Central Bank (I_mo_eu, I_bo_eu). Quaterly data are available for some the indicators above from 1st of January 1993 untill 30th of September 2006, except for the Estonian money market rate, which starts first quarter 1995. The analysis is restricted to the shorter sample period. The base year for CPI is the II quarter 2001=100 and for GDP the prices in 2000.

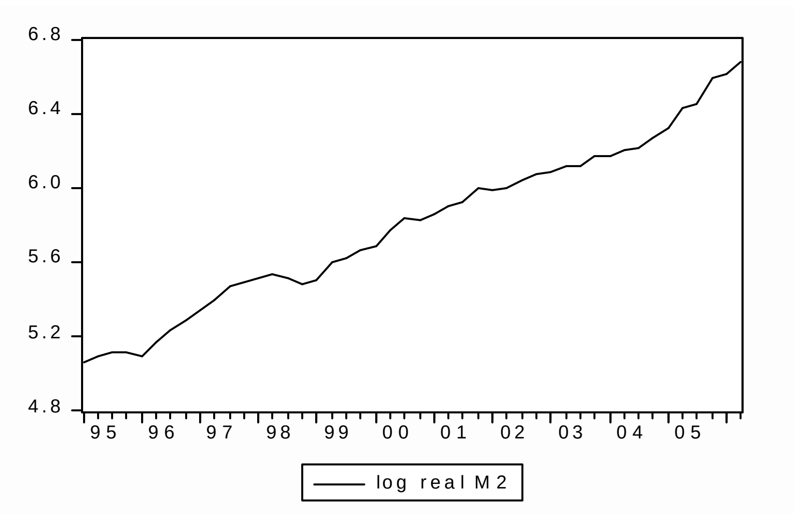

Figure 1: Logarithms of real M2 1995 - 2006.

Nominal money M2 is divided the consumer price index to determine real M2. Consumer price index in Estonia has moved upwards consistently during the years 1993-2006. The growth has actually slowed down since 1999 after the deflation period in Russia and its stock market. Therefore most of Eastern-European countries were experiencing large difficulties in their economies. The growth of CPI was specially fast in the beginning of 1990s – after the independence and introduction of the kroon. The change in the CPI compared with the previous year was 89.8% in 1993, 23.1% in 1996 and only 1.3% in 2003. In general, real money grows over the whole period. It decreases during the Russian financial crisis 1998. In the most recent period money starkly rises.

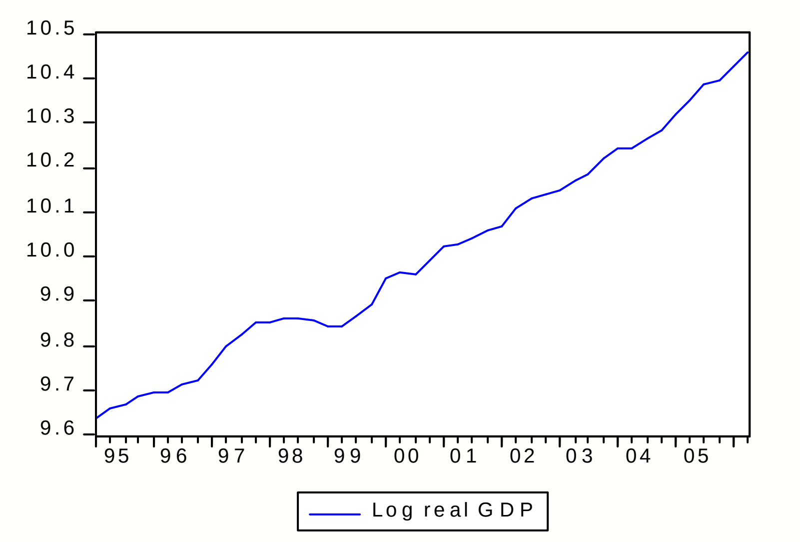

Figure 2. The logarithms of real gross domestic product from 1995:Q1 to 2006:Q2

The real GDP has been seasonally adjusted to get rid off the seasonal pattern (see Figure 2). It is generally increasing over the whole sample. Its growth rate has been more quick in 1997, in the 2002-2003 as well as in 2005-2006. Due to the Russian financial crisis deep decreases took place in 1998 to 1999.

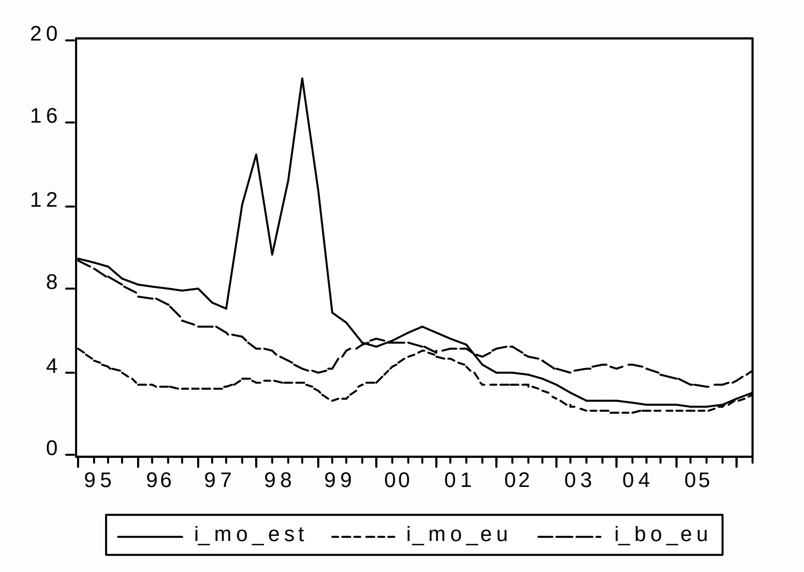

Figure 3: Interest rates of 1995 – 2006

The different interest rates considered are shown in Figure 3. The interest rate of government bonds with a maturity of around 10 years in euro area (i_bo_eu) is always higher than the three months money market rate of the euro area (i_mo_eu). The money market rate of Estonia (i_mo_est) converge to the euro area money market rate over the sample. During the Russian financial crisis it was markedly higher than the euro area to defeat against effects of the Russian crisis in Estonia. This phase complicates the estimation of a money demand function. The econometric analysis is done using the EViews 5.1.

Table 1: Results for unit root tests

Variable	Level		First difference		Level	First dif.
Variable	Specifi-cation	ADF	Specifi cation	ADF	Ng-Perron	Ng-Perron
Log(GDP)	C,0	1.843	C,0	-6.498***	1.760	-2.460**
Log(M2r)	C,0	1.373	C,0	-7.239***	0.921	-1.608
I_mo_est	C,6	-0.722	C,5	-3.838***	-0.630	-1.784*
I_mo_eu	C,1	-2.874*	C,0	-4.314***	-1.413	-2.980***
I_bo_eu	C,1	-2,833*	C,0	-4.017***	-0.400	-2.652***

Notes: For the ADF-test the lag order is selected automatically using the SC-criterion. The Ng-Perron-test is applied for the MZt test by incorporating the AR GLS detrending and using the SC-criterion. Sample period is 1995 Q1 to 2006 Q2.

Table 1 gives the results of the unit root tests for the variables considered. In this paper the ADF test and the Ng-Perron (2001) test are applied. The tests are conducted for the level and for the first difference of a variable. The specification of the test regression is automatically selected using the SC-criterion. Its results are given in Table 1. All equations include an intercept term. The lag order varies from 0 to 6 (0 to 5) for the level (first difference) equation. For the level tests the null hypothesis is not rejected at the 5% level. Using the ADF the null hypothesis is rejected for all first difference equations. The results of the Ng-Perron point in the same direction except for real money. Herefore, the test indicates an I(2) variable. Nevertheless, we stick to the I(1) case.

5. Analysing the model

Starting point of the analysis is system approach of Johansen. This approach needs to estimate the lag order. This is done for the unrestricted vector autoregressive model (VAR) using the lag order selection criteria like AIC, HQ and SC (see Lütkepohl 2005, pp. 146-156). The maximum of lag order is set to 5. It is assumed that the systems include an unrestricted intercept term. The results for the different systems are given in the Tables A1 to A5 in the appendix. As expected the SC criterion selects the lowest lag order, e.g. lag order 1 in all systems. The choices of the other criteria are 1 to 5. The cointegration property is tested in the reparametrized vector error correction model (VEC). In this parametrization the lag order is related to the number of dynamic coefficient matrices, which is always one lower than the VAR-order. To check the robustness of the test results the cointegration tests are done for all selected orders. The results of the applied cointegration tests, e.g. trace test and maximum eigenvalue test are given in the tables. These tests are stepwise tests. In the beginning the null hypothesis of no cointegration ($r = 0$) is tested. If this null hypothesis is not rejected at conventional significance levels the test procedure is ended and it is concluded that the system is stationary in first differences. If this hypothesis is rejected the null of one cointegration relationship is checked ($r = 1$). If this null is rejected the null hypothesis of two ($r = 2$) is tested. This procedure is finished if the null hypothesis of ($r = l - 1$) is tested. If we find evidence for cointegration the estimates of the long-run relationships, which are given the matrix (for $r > 1$) or the vector (for $r = 1$) beta. The corresponding loading matrix alpha, which includes the adjustment coefficients (alpha) is presented below, where the estimated *t*-statistic are given in parentheses.

In sum it is apparent that for most specifications of the systems at least one coinegrating relationship is found. However, this result is not as stable as expected for the different lag specifications. Moreover, if a cointegrating rank of one is selected, the *t*-statistic of the loading coefficient in the money equation is absolutely less than 2. Hence, it is difficult to interpret this linear relation as a money demand function. It seems that more structure assumptions are necessary to identify the money demand functions. Therefore, we conduct the single equation analysis.

The estimates of the long-run relationship are given in Table 2. Its upper block includes the results of the Engle-Granger-procedure of the different models. These models differ regarding the specificatio of interest rates, where the money rate of Estonia, the money rate of the euro area and the bond rate of the euro area are considered. Whether the long-run relationships cointegrated is tested by using the ADF principle, where the critical values depend on the specification of the deterministic part in the test regressions, the number of regressors and the number of observations. The null hypothesis of no cointegration is rejected in the second and fourth equation at the 5% level. Despite this fact all equations have in common that the income elasticity is clearly above unity. The interest rate coefficients are mostly negative, whereas the coefficient of the euro area money market rate is positive.

Looking at the results of the DOLS procedure it is apparent that the income coefficient is always greater than unity. In two cases the coefficient of the money market rate of Estonia is positive. The changes of the sign are related to the relative high standard errors of these estimates. The ECM approach offer a cointegration test. It is the *t*-statistic of the adjustment parament of the long-run relationship (ECM-term). Especially, for the fourth model the null hypothesis of no cointegration is not rejected at conventional significance levels. Nevertheless, the income coefficients points in the same direction as the other approaches. This is also true for the coefficient of the euro area bond rate.

Since the information base is not broad we stick to the Engle Granger approach and present the dynamic equation for two relations. Both equations include the euro bond rate. One equation contains the money market of Estonia and the other euro money market rate. The equations are specified applying the general-to-specific approach. It starts for a lag length of the variables of four. Coefficients, which are not significantly different from zero are set stepwise to zero. The estimated t-statistic, where the heteroscedasticty is Newey-West-corrected, are show below the coefficients in parentheses. The preferred equation is given below.

Table 2: Estimates of the long-run relationship using single-equation procedures

Method	intercept	Log(GDP)	I_mo_est	I_mo_eu	I_bo_eu	Spec.	ADF
Engle-Granger	-12.91 (23.75)	+1.871 (35.47)	-0.00188 (0.557)			0	-2.798
	-13.63 (23.57)	+1.934 (35.27)	-0.00229 (0.720)	+0.030 (2.636)		0	-3.391
	-10.04 (11.03)	+1.608 (18.90)	-0.0083 (2.410)		-0.0360 (3.699)	0	-2.809
	-12.27 (23.12)	+1.810 (36.65)		+0.0419 (4.210)	-0.0337 (4.291)	0	-3.974*
	-11.74 (19.32)	+1.766 (31.05)			-0.0242 (2.728)	0	-2.908
DOLS	-13.63 (15.34)	+1.931 (22.77)	+0.0091 (1.413)				
	-15.89 (19.06)	+2.133 (27.63)	+0.0117 (2.166)	+0.0717 (4.894)			
	-7.38 (2.532)	+1.355 (5.039)	-0.0150 (1.235)		-0.0511 (1.712)		
	-11.62 (17.50)	+1.739 (27.84)		+0.0838 (6.873)	-0.0577 (5.894)		
	-10.51 (13.32)	+1.644 (21.98)			-0.0320 (2.729)		
	ECM-term						
ECM	-0.187 (2.138)	1.790	-0.0120				
	-0.260 (2.615)	1.833	-0.0119	0.0166			
	-0.315* (3.089)	1.461	-0.0194		-0.0453		
	-0.144 (1.165)	1.833		-0.0196	-0.0392		
	-0.163 (1.604)	1.841			-0.0425		

Notes: The Engle-Granger cointegration test uses the ADF test, where the null hypothesis is no cointegration. Critical values are from MacKinnon (1991). * (**, ***) indicates that the test is rejected at the 10% (5%, 1%) level. ECM-term gives the adjustment coefficient of the long-run relationship

$$?LM2r_t = \underset{(0.80)}{0.0085} + \underset{(1.93)}{0.659}\ ?Log(GDP)_t + \underset{(1.86)}{0.182}\ ?LM2r_{t-1} + \underset{(1.95)}{0.263}\ ?LM2r_{t-2} - \underset{(4.60)}{0.439}\ ec_{t-1}$$

adj. R^2 = 0.121; DW = 2.01; LB(12): pv=0.242; JB: pv=0.874; ARLM(2): pv=0.991
ARCH(1): pv=0.523; White(no cross terms): pv=0.393; Reset(2): pv=0.085
Chow breakpoint test 1999.Q1: pv=0.194
Chow breakpoint test 2004.Q2: pv=0.472
Chow forecast test 2004.Q2 to 2006.Q2: pv=0.394.

A battery of diagnostic statistic is given under the equation (see Brooks 2002). In most cases we present the p-value of the corresponding test statistic. Only the Reset(2) is rejected at the 10% test level. All others tests including the CUSUM and CUSUMQ tests indicate no problems. The cointegration test of ECM-approach is conducted by the t-statistic of the ec variable. Using the tables of Ericsson and MacKinnon (2002) this *t*-value implies a p-value of 0.011.

Since the adjusted R is relatively low and the dynamic coefficients are not significant at the 5% level this equation can be improved. The best results is obtained for the following equation containing the Estonian money market instead of the euro money market rate.

$$?LM2r_t = \underset{(2.72)}{0.021} - \underset{(5.73)}{0.007}?i\_mo\_est_t - \underset{(4.72)}{0.005}?i\_mo\_est_{t-4} + \underset{(3.33)}{0.434}\ ?LM2r_{t-2} - \underset{(3.75)}{0.356}\ ec_{t-1}$$

adj. R^2 = 0.425; DW = 1.76; LB(12): pv=0.101; JB: pv=0.531; ARLM(2): pv=0.872
ARCH(1): pv=0.822; White(no cross terms): pv=0.694; Reset(2): pv=0.030
Chow breakpoint test 1999.Q1: pv=0.665
Chow breakpoint test 2004.Q2: pv=0.215
Chow forecast test 2004.Q2 to 2006.Q2: pv=0.229.

This equation passes the diagnostic statistics except for the Reset(2), where its null is rejected at the 5% level but not at the 1% level. Using the tabels of Ericsson and MacKinnon (2002) the t-statistic of –3.75 obtains a p-value of 0.059. The evidence for cointegration is not very strong. The relation estimated gives evidence that the dynamic equation converge to the long-run relationship. It shows that the Estonian central bank may influence the real money balance by the money market rate. A positive growth rate of real GDP influences real money growth by the ec-term. Moreover, this equation stable for the more recent period. The Chow tests considered show give no hints of instabilities.

6. Conclusion

In this study we have analysed a money demand function of the broad aggregate M2 for Estonia. This relationship is formulated for real money balances depending on real GDP and interest rates as opportunity cost measure. Since Estonia is in a currency board in relation to the euro, euro area interest rates are considered.

The empirical examination is done for the period 1995:Q1 to 2006:Q2. The estimates of the long-run relationship give strong evidence that the income coefficient is greater than unity and greater than estimates for the euro area money demand functions (see Görgens et al. 2004). This is a sign of deeping the financial sector of Estonia. Moreover, the preferred equations include the euro area bond rates. This can be explained by the exchange rate arrangement. The money market rate of Estonia has a negative sign in the dynamic relationship and shows that the Estonian central bank can influence money holding in its country. Furthermore, the relationship is stable for recent period.

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Appendix A: Results of system analysis

Table A1: Results of Johansen's procedure for the system including i_mo_est

System	Log(M2r)	Log(GDP)	I_mo_est	
Unrestricted VAR	AIC = 5	HQ = 4	SC = 1	
VEC(lag=0)	Trace statistic	31.31**	Max. eigenvalue	23.07**
		8.23		7.51
		0.72		0.72
r = 1: *ß*	1.00	-2.489	-0.079	
a	0.013 (0.530)	0.039 (4.56)	2.63 (2.13)	
VEC(lag=3)	Trace statistic	21.60	Max. eigenvalue	11.27
		10.34		8.19
		2.15		2.15
VEC(lag=4)	Trace statistic	44.98***	Max. eigenvalue	22.67***
		22.31***		20.48***
		1.83		1.83
r = 2: *ß*	1.00	0.00	0.381	
	0.00	1.00	0.214	
a	-0.318 (2.49)	-0.004 (0.097)	-7.96 (1.45)	
	0.567 (2.49)	-0.011 (0.161)	14.2 (1.44)	

Table A2: Results of Johansen's procedure for the system including i_mo_est and i_mo_eu

System	Log(M2r)	Log(GDP)	I_mo_est	I_mo_eu
Unrestricted VAR	AIC = 5	HQ = 3	SC = 1	
VEC(lag=0)	Trace statistic	46.23*	Max. eigenvalue	27.33*
		18.89		15.10
		3.80		3.70
		0.10		0.10
r = 1: *ß*	1.00	-2.160	-0.022	-0.059
a	0.013 (0.207)	0.104 (5.00)	4.342 (1.34)	1.523 (3.11)
VEC(lag=2)	Trace statistic	45.77*	Max. eigenvalue	23.49
		22.27		13.62
		8.66		8.40
		0.25		0.25
r = 1: *ß*	1.00	-2.165	-0.014	-0.076
a	-0.011 (0.082)	0.153 (3.44)	-9.33 (1.55)	1.77 (2.07)
VEC(lag=4)	Trace statistic	77.13***	Max. eigenvalue	37.58***
		39.68***		24.13***
		15.55**		12.72*
		2.83*		2.83*
r = 3: *ß*	1.00	0.00	0.00	0.629
	0.00	1.00	0.00	0.346
	0.00	0.00	1.00	-2.194
a	-0.679 (3.14)	0.062 (0.93)	-9.71 (1.01)	1.11 (0.79)
	1.33 (3.02)	-0.159 (1.17)	18.6 (0.946)	-2.88 (1.00)
	0.003 (0.700)	-0.005 (3.95)	-0.003 (0.018)	0.010 (-0.38)

Table A3: Results of Johansen's procedure for the system including i_mo_est and i_bo_eu

System	Log(M2r)	Log(GDP)	I_mo_est	I_bo_eu
Unrestricted VAR	AIC = 5	HQ = 5	SC = 1	
VEC(lag=0)	Trace statistic	54.77***	Max. eigenvalue	32.08**
		22.69		13.85
		8.84		8.65
		0.19		0.19
R = 1: *ß*	1.00	-2.478	-0.045	-0.066
a	0.013 (0.341)	0.055 (4.09)	2.631 (1.34)	1.113 (3.91)
VEC(lag=4)	Trace statistic	65.69***	Max. eigenvalue	34.80***
		30.89**		17.28
		13.61*		12.06
		1.55		1.55
r = 2: *ß*	1.00	0.00	0.119	0.222
	0.00	1.00	0.059	0.119
a	-0.293 (2.37)	-0.044 (1.18)	-2.51 (0.45)	-0.058 (0.06)
	0.727 (2.58)	-0.013 (0.15)	5.93 (0.465)	-1.31 (0.58)

Table A4: Results of Johansen's procedure for the system including i_mo_eu and I_bo_eu

System	Log(M2r)	Log(GDP)	I_mo_eu	I_bo_eu
Unrestricted VAR	AIC = 2	HQ = 1	SC = 1	
VEC(lag=0)	Trace statistic	55.17***	Max. eigenvalue	41.13***
		24.04		8.30
		5.74		4.80
		0.94		0.94
r = 1: *ß*	1.00	-1.771	-0.053	+0.030
a	-0.040 (0.33)	0.197 (4.95)	2.878 (3.23)	3.342 (3.85)
VEC(lag=1)	Trace statistic	52.94**	Max. eigenvalue	31.79**
		21.23		11.50
		9.73		7.06
		2.67		2.67
r = 1: *ß*	1.00	-1.786	-0.068	0.037
a	0.070 (0.40)	-0.256 (4.76)	2.801 (2.54)	1.579 (1.28)

Table A5: Results of Johansen's procedure for the system including i_bo_eu

System	Log(M2r)	Log(GDP)	i_bo_eu	
Unrestricted VAR	AIC = 1	HQ = 1	SC = 1	
VEC(lag=0)	Trace statistic	32.63**	Max. eigenvalue	21.83**
		10.80		8.12
		2.67		2.67
r = 1: *ß*	1.00	-1.716	0.011	
a	-0.082 (0.82)	0.109 (2.93)	2.591 (3.60)	
VEC(lag=1)	Trace statistic	21.01	Max. eigenvalue	10.44
		10.57		8.42
		2.16		2.16