-RESEARCH ARTICLE-

INVESTIGATING THE HUNGARIAN MONEY DEMAND FUNCTION: POSSIBLE IMPLICATIONS FOR MONETARY POLICY

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─**Abstract**─

Historically, research focusing on the money demand function developing economies (especially Eastern European transition economies) was a difficult undertaking because of under-developed financial systems and the unavailability of data. This study aims to assist in filling this gap in the literature by employing three different estimation techniques to estimate the M1 and M2 money demand functions for Hungary. The study uses quarterly data for an 18-year period, obtained from the IMF's International Financial Statistics database. The results based on the bounds testing procedure as well as the other two approaches confirm that a stable, long-run relationship exists between the demand for money and its determinants. The results' robustness is enhanced by the similarities between the results of the various approaches used in the study. The money

demand function can therefore theoretically serve as a tool to measure the effect of monetary policy decisions and in determining what parameters of the money demand function to adjust in order to yield the required effects. It is suggested that, in the case of Hungary the M1 money demand function might be the most appropriate model on which monetary policy decisions should be based.

Key Words: Money demand, Hungary, stability, ARDL, cointegration

JEL Classification: E4, E40, E41

1. INTRODUCTION

The estimation of a stable money demand is a crucial element of conducting monetary policy, as it allows monetary authorities to play an active role in affecting adjustment in the monetary supply variables (Achsani, 2010:54). A growing demand for money is closely associated with improving macro-economic conditions, as consumers are assumed to demand more currency for their increased consumption needs. The money demand function thereby serves as a tool to measure the effect of monetary policy decisions and determining what parameters of the money demand function to adjust in order to yield the required effects. Research on the money demand function has historically been conducted in developed economies due to the substantial data availability and well-developed financial systems (Calza & Zaghini, 2010:1663; Johansen, 1992:313). Developing economies, especially Eastern European transition economies, have been subject to much less scrutiny given that well-developed financial systems and data are often not available.

Hungary has historically experienced hyperinflation, weak financial institutions and less developed financial systems, which have made the estimation of a stable money demand function a daunting task. Given the substantial institutional and structural changes that Hungary has undergone since the early 1990s, it could be argued that the relationship between the monetary aggregate and the explanatory variables in the money demand function had changed drastically. This could therefore have had an impact on both the existence of a long-run relationship and the stability thereof. This presents a case to examine whether a well-defined and stable money demand function exists this long after significant monetary reforms in Hungary. The question for this study is whether a long-run money demand function exists for Hungary and whether this function is stable. This study contributes in this regard by employing three different estimation techniques in estimating the M1 and M2 money demand function. There are no studies, to our

current knowledge, which employ more than one estimation technique in determining the money demand function for Hungary. The Johansen approach to cointegration and the vector error correction model have not been employed in research on the money demand function and this is another facet in which this study contributes to the literature.

2. THEORETICAL IMPETUS AND LITERATURE REVIEW

The estimation of the money demand function requires a strong theoretical base in support of its viability as a measure of the country's monetary policy effectiveness. There have been several theories on money demand; each subsequent theory being an adaption or amendment to the previous.

The quantity theory of money, as defined by Fisher (1911:515), maintains that the general price level varies proportionately with the volume of money circulating in the economy. Fisher (1911:515) algebraically illustrated his theory through the following equation:

$$MV = p_1 Q_1 + p_2 Q_2 + p_3 Q_3 \, \dots$$

In this equation, M is the average amount of money in circulation, p_i is the average price level of a particular type of good i, Q_i is the total quantity of this particular good i exchanged during a specific period and $V = \frac{E}{M}$ is the velocity of money (E is a measure of the total consumption expenditure during a specific period). The occurrence of several market failures and practical inconsistencies of the original quantity theory of money demand has called into question the ability of this theory to explain the demand for real money balances. This renewed focus gave rise to a more specific formulation of the money demand function, which may be written as:

$$\frac{M}{P} = f\left(r_b; \; r_e; \; \frac{1}{P}\frac{dP}{dt}; \; w; \; \frac{Y}{P}; \; u\right)$$

This equation is formally defined in Friedman's (1956) *The Quantity Theory of Money – A Restatement* in which a formal exposition can be found. The main motivation behind this equation is the assumption that wealth may be held in various substitutable forms. This model also includes a measure of human wealth, w, but is not generally studied empirically given the general difficulty in

measuring such a variable in terms of other forms of capital. The variable, $\frac{Y}{P}$, represents the real return to all forms of wealth. Friedman argues that all sources of income and consumables are contributing measures of total wealth. For this reason, a positive relationship is expected between $\frac{Y}{P}$ and money demand.

2.1. Empirical evidence

Because of the limited research conducted on the Hungarian money demand function, the empirical literature discussed here refers mostly to other Eastern European (structurally similar transition) economies. In a study for Croatia, using a vector error correction model and the Johansen cointegration approach, a stable long-run relationship for M1 money demand for the period 1994 to 2002 was found by Cziráky and Gillman (2006:105). Similarly, a study into the M1 and M2 money demand for Romania, using monthly data for the period January 1994 to August 2003, found a stable long-run relationship between the monetary aggregates and a selection of explanatory variables (Andronescu, Mohammadi, & Payne, 2004:861). This study utilised the Johansen cointegration approach in estimating an error correction model. An autoregressive distributed lag (ARDL) approach was among the modelling techniques followed to estimate the M1 money demand for Hungary for the period 1995 to 2010, using quarterly data. The demand for M1 money in Hungary according to this study was found to be stable (Dritsakis, 2011). Similarly, Buch (2001), employing an error correction framework using monthly data for the period 1991 to 1998 for Hungary and Poland, found that although a stable long-run cointegrating relationship existed prior to 1995 for Hungary, this relationship was strengthened post-1995 when a new exchange rate regime was adopted by the country.

3. METHODOLOGY AND MODEL SPECIFICATION

In this study, three estimation techniques form the focal point of observation. These are the ARDL, the Johansen approach to cointegration and the vector error correction model (VECM), and the one-step error correction model.

3.1. Data

The monetary aggregates considered in this study include the M1 monetary aggregate, which in Hungary's case includes money in circulation and demand deposits, and the M2 aggregate, which is the sum of M1 money and fixed deposits with maturities of less than two years. Consistent with the study of Payne

(2000:1352), the natural logarithm of real GDP is used as the scale variable in this study. There is an expected positive and significant relationship between real GDP and both definitions of the monetary aggregates. The first opportunity cost variable included in the estimations is the own rate for holding money, which is measured by the interest rate on demand deposits in the case of Hungary. The relationship should be negative for narrow money demand. Also included is a measure of the inflation rate in the form of the first differenced consumer price index (CPI) divided by the current observation of the CPI. Buch (2001) included the real effective exchange rate in her study, while Dritsakis (2011) included the logarithm of the nominal exchange rate. In this study, the nominal exchange rate is opted for, which measures the units of domestic currency per base currency in the form of United States dollars. *A priori* expectations dictate either a positive- or negative influence of the nominal exchange rate on money demand, depending on whether the wealth- or substitution effect is dominant (Bahmani-Oskooee & Ng, 2002:147). Omitting variables reflecting the simplicity of cross-border currency flows could lead to serious misspecification of the model (Arango & Ishaq Nadiri, 1981:69).

The money demand function is estimated using quarterly data for the period 1995Q1 to 2013Q4. All the data have been obtained from the IMF's International Financial Statistics database. Variables that exhibit seasonality will be seasonally adjusted using the Census X-12 multiplicative procedure. These variables include the monetary aggregates, M1 and M2, the scale variable, y and the consumer price index prior to calculating the CPI inflation rate (infla). The X-12 multiplicative procedure was the preferred choice for seasonal adjustment in Calza and Zaghini (2010:1663), Korap (2011:1) and Sun, Sun and Lin (2013:512).

Furthermore, account has to be taken of the structural variables that are dealt with. Possible structural breaks in the data need to be tested for by the inclusion of an appropriate shift dummy variable. For Hungary, a possible break could be identified at 2001, which marks the onset of their inflation targeting regime. Another possible influence on model's stability could perhaps be attributed to Hungary's accession to the EU in 2004. Lastly, Hungary recovered from a recession in 2013, which could also have impacted on the money demand function.

3.2. Theoretical model specification and proposed estimation techniques

From the proposed specifications, the money demand function of the following extended form will be considered:

$$m = \alpha + \beta_1 y + \beta_2 i + \beta_3 infla + \beta_4 exch + u \qquad (1)$$

Measuring the real money balances, the natural logarithm of the difference between the nominal monetary aggregates and the consumer price index measured at 2010 prices as a measure of the general price level have been used to transform the nominal money supply to real money supply, m. The included scale variable is represented by y. The domestic interest rate is i, which is the deposit rate on sight deposits that will divided by 100 prior to estimation to simplify interpretation by the reader. The expected CPI inflation rate is given by $infla$, which will also be divided by 100 for the same reason as for i. Finally, the nominal exchange rate is given by $exch$, which is the natural logarithm of the nominal exchange rate, as measured by the value of national currency per base currency, which, in this case, is the United States dollar.

4. EMPIRICAL RESULTS

Expectations dictate that the money supply variable should exhibit a positive relationship with the scale variable and generally a negative relationship with the various opportunity cost variables. Literature has suggested, however, that either a positive or negative relationship could exist between the money supply variables and the foreign variables, exchange rate and foreign interest rate. This analysis will determine whether these expectations are justified.

4.1. Autoregressive distributed lag approach

The empirical part starts with augmented Dickey-Fuller (ADF) test, testing for the presence of a unit root. The optimal lag length utilised in the ADF test was determined using the Schwarz Bayesian information criterion. Depending on its individual significance for each variable, as determined in the ADF procedure, a time trend, a trend with a drift or neither of the two was included in the ADF test. The results indicate that there is a mixture of *I(1)* and *I(0)* variables, thereby making the ARDL procedure the most appropriate technique to estimate cointegrating relationships among all the variables, whether they are *I(1)* or *I(0).*

Individual VAR lag order selection tests are conducted next with the inclusion of a drift component. Based on the Akaike information criterion, the optimal lag length for both M1 and M2 as dependent variables was found to be five quarters. The model with the suggested lag is estimated for each of the M1 and M2 monetary aggregates. This model takes on the form of the underlying equation:

$$\Delta m_t = \alpha + \sum_{j=1}^{k1} \beta_{0j}\Delta \ln M_{t-j} + \sum_{j=0}^{k2} \beta_{1j}\Delta y_{t-j} + \sum_{j=0}^{k3} \beta_{2j}\Delta i_{t-j}$$
$$+ \sum_{j=0}^{k4} \beta_{3j}\Delta \ln exch_{t-j} + \sum_{j=0}^{k5} \beta_{4j}\Delta infla_{t-j} + \delta_0 m_{t-1} + \delta_1 y_{t-1}$$
$$+ \delta_2 i_{t-1} + \delta_3 \ln exch_{t-1} + \delta_4 infla_{t-1} + \varepsilon_t$$

A priori, it is assumed that the disturbance term, ε_t, is normally distributed and contains no serial correlation (Dagher & Kovanen, 2011) and for this purpose, after each estimation of the alternative ARDL representations, diagnostic checks are conducted. If serial correlation or heteroskedasticity indeed appears to be causing spurious regression problems, additional lags should be included. According to Pesaran et al. (2001), the inclusion of large numbers of lags could result in an over-parameterisation of the ARDL model, and should be met with caution, particularly in the case of small sample sizes. Therefore, experimentation is needed to determine the number of lags.

In determining whether the variables in the model are indeed cointegrated, critical values by Pesaran et al. (2001) are usually utilised. While the critical values in Pesaran et al. (2001) are only applicable to large samples, Narayan (2005) has provided new sets of critical values that are more appropriate for sample sizes of 30 to 80 observations. Narayan's (2005) critical values have been used in numerous studies to estimate the cointegrating relationships for small samples, including Dritsakis (2011) and Duasa (2007:89). Taking into account the critical values of Pesaran et al. (2001) and Narayan (2005), the null hypothesis of no cointegration can be rejected at a one per cent level of significance. The bounds test therefore confirms the existence of cointegration for both the M1 and M2 relationship.

One major advantage of the ARDL specification is that all the included variables are not required to exhibit the same lag length (Pesaran et al., 2001). Following the work of Dagher and Kovanen (2011), the bounds testing procedure's results in this study are only reported for the most significant number of lags included for each individual first differenced explanatory variable. The Wald test is conducted for the joint significance of the long-run variables for each incremental first differenced lagged money supply variable included in the ARDL specification. An ARDL (5,1,0,1,0) model was found to be the most appropriate in the case of the M1 money demand function in this study. The estimation results are

represented in Table 1. It should be noted that the M1 money demand ARDL specification for Hungary includes a shift dummy variable assuming values of one for the 2013 fiscal year and zero otherwise. This dummy was found to be positive and very significant in explaining M1 money demand. A possible reason could be because Hungary's economic growth recovered in 2013 after an economic recession of 1.7 per cent in 2012. Given this recovery, in a general economic climate, increasing aggregate consumption had the effect of raising the demand for money, and therefore the positive relationship.

Table 1: ARDL estimates for the M1 monetary aggregate

Long-run coefficients for the M1 money demand function					
Constant	Y	i	Exch	infla	DUM2013
1.252 (0.858)	**0.618 (2.098)	***-3.428 (-3.438)	***-0.476 (-3.118)	*-3.798 (-1.827)	***0.045 (3.362)
Short-run coefficients for the M1 money demand function					
Lag	$\Delta m1$	Δy	Δi	$\Delta exch$	$\Delta infla$
0		0.142 (1.073)	-0.751 (-2.521)	0.008 (0.141)	-0.811 (-1.851)
1	0.064 (0.546)	-0.144 (-1.014)		0.103 (1.858)	
2	0.190 (1.856)				
3	-0.072 (-0.698)				
4	-0.091 (-0.947)				
5	0.278 (2.912)				

t-statistics in parentheses
***p<0.01; **p<0.05; *p<0.1

A similar procedure is followed in the case of the M2 monetary aggregate and the results are exhibited in Table 2. In this instance, an ARDL (4,4,3,6,0) for the M2 money demand function was found to be the most appropriate specification. The long-run coefficients in Tables 1 and 2 are directly extracted from the ARDL specification by dividing the estimated coefficient of the ARDL specification for the long-run variables by the long-run multiplier's coefficient. From the ARDL equation mentioned above, this would imply that the long-run coefficient for the

scale variable in the form of the real GDP, for example, is calculated by $-\left(\frac{\delta_1}{\delta_0}\right)$.

Table 2: ARDL estimates for the M2 monetary aggregate

Long-run coefficients for the M2 money demand function				
Constant	Y	i	Exch	infla
2.277	***0.917	***-1.781	***-0.366	***4.955
(1.486)	(6.260)	(-3.049)	(-4.320)	(-6.109)
Short-run coefficients for the M1 money demand function				
Lag	Δm1	Δy	Δi	Δexch	Δinfla
0		0.013	-0.116	0.018	-1.197
		(0.125)	(-0.465)	(0.461)	(-2.803)
1	-0.073	-0.559	0.842	0.199	
	(-0.630)	(-4.299)	(2.989)	(3.839)	
2	0.208	-0.321	0.458	0.093	
	(1.992)	(-2.504)	(1.725)	(1.848)	
3	0.034	-0.263	0.544	0.106	
	(0.337)	(-2.099)	(2.149)	(2.383)	
4	-0.219	-0.299		0.123	
	(-2.011)	(-2.569)		(2.792)	
5				0.045	
				(1.148)	
6				0.121	
				(3.045)	

t-statistics in parenthese

***p<0.01; **p<0.05; *p<0.1

In order to examine the short-run dynamics of the money demand functions, it is necessary to estimate error correction models. Dritsakis (2011) notes that the deviations in the long-run equilibrium of the money demand function are as a result of short-run shocks. If a long-run cointegrating relationship truly exists, there should be an adjustment from these short-run shocks back to the long-run equilibrium relationship. This adjustment process is confirmed by a significant and negative error-correction term. In Tables 3 and 4 below, the result of the error correction estimation is illustrated for the M1 and M2 monetary aggregates, respectively.

Table 3: Error correction model of the ARDL specification for the M1 money demand function

Explanatory variables	Coefficients	t-Statistics
Constant	0.003	0.958
$\Delta m1(-1)$	**0.315	2.543
$\Delta m1(-2)$	**0.272	2.332
$\Delta m1(-3)$	-0.177	-1.50
$\Delta m1(-4)$	-0.145	-1.32
$\Delta m1(-5)$	***0.287	2.80
Δy	0.122	0.856
$\Delta y(-1)$	-0.168	-1.050
Δi	***-0.770	-2.485
$\Delta exch$	0.067	1.267
$\Delta exch(-1)$	0.009	0.158
$\Delta infla$	-0.682	-1.523
*ec(-1)	***-0.150	-2.853

[*]The error correction term can be calculated as lagging the residual of the long-run equation,

$$m = c + y - i - exch - infla + DUM2013$$

Table 4: Error correction model of the ARDL specification for the M2 money demand function

Explanatory variables	Coefficients	t-Statistics
Constant	***0.008	2.600
$\Delta m1(-1)$	0.212	1.544
$\Delta m1(-2)$	0.209	1.467
$\Delta m1(-3)$	-0.056	-0.403
$\Delta m1(-4)$	-0.134	-0.967
Δy	-0.032	-0.241
$\Delta y(-1)$	**-0.342	-2.125
$\Delta y(-2)$	-0.090	-0.580
$\Delta y(-3)$	-0.015	-0.100
$\Delta y(-4)$	-0.154	-1.030
Δi	-0.305	-0.999
$\Delta i(-1)$	0.429	1.236
$\Delta i(-2)$	0.1701	0.519
$\Delta i(-3)$	*0.539	1.743
$\Delta exch$	0.008	0.161
$\Delta exch(-1)$	*0.108	1.667
$\Delta exch(-2)$	-0.011	-0.175
$\Delta exch(-3)$	0.012	0.215
$\Delta exch(-4)$	0.047	0.814
$\Delta exch(-5)$	0.009	0.163
$\Delta exch(-6)$	0.008	0.880
$\Delta infla$	**-1.012	-2.410
$ec(-1)$	***-0.260	-3.460

***p<0.01; **p<0.05; *p<0.1

The error correction terms in both models are negative and significant at least at the five per cent level. This confirms the presence of a long-run equilibrium relationship between the variables included in the model. In the M1 money demand function, the error correction term is -0.1495. This implies that in each quarter, the disequilibrium caused by short-term shocks is corrected by 14.95 per cent. Likewise, the absolute value of the error correction term for the M2 money demand function is larger than that of the M1 money demand function, which implies a faster adjustment process during each quarter. In this instance, 26 per cent of the disequilibrium is corrected in each quarter. Similar to the results of Dritsakis (2011), not much inference can be drawn from the short-run variables of the M2 money demand function. This is not the case for the M1 money demand function, however, where there are numerous short-run variables that are found to be significant at least at the five per cent level.

In Table 5, results of various diagnostic checks are reported. It is important that the estimated money demand functions pass all of the appropriate diagnostic checks in an effort to ensure that the results represented by the demand functions are not spurious.

Table 5: Diagnostic checks for potential spurious regression results

	M1		M2	
Diagnostic	χ^2	p-value	χ^2	p-value
χ^2_{SC}	4.35	0.360	2.63	0.269
χ^2_{BP}	16.37	0.175	23.99	0.348
$\chi^2_{Normality}$	0.49	0.783	5.04	0.081
χ^2_{ARCH}	0.41	0.982	2.63	0.622
χ^2_{RESET}	0.00	0.969	0.97	0.436

The diagnostic tests generally confirm that both the M1 and M2 money demand functions do not suffer from spurious regression results at the 5 per cent level of significance. However, it could be inferred that, at the 10 per cent level, the M2 money demand function's residuals could potentially suffer from non-normality. There is no uncertainty regarding the authenticity of the M1 money demand function's results, as it is not possible to reject the null hypotheses of no

heteroskedasticity, no serial correlation and residual normality. According to the results of the Ramsey RESET test, there is no evidence of misspecification in any of the models.

Before concluding that both monetary aggregates are appropriate for formulating monetary policies in Hungary, it becomes necessary to ascertain whether the error correction models are stable. For this purpose, the CUSUM and CUSUMSQ stability testing procedures are used. It is important to determine whether the error correction models are stable, as it could impact on the viability of basing monetary policy on the estimated money demand functions.

From Figures 1 and 2, it is possible to draw the inference that the M1 money demand function is relatively more stable than the M2 money demand function in the case of Hungary. The practical implication is a relative more stable relationship between the M1 money stock and the key macroeconomic variables included in the analysis, making M1 the preferred measure for monetary policy. This result is consistent with that of Dritsakis (2011), who, instead of also including the deposit rate among his opportunity cost variables, included only the CPI inflation rate. The similar result while using a different specification as compared to that of Dritsakis (2011) corroborates his findings that the M1 money demand function is a more appropriate measure to base monetary targeting policies upon.

Figure-1: CUSUM (left) and CUSUMSQ (right) test for stability of the M1 money demand function of Hungary
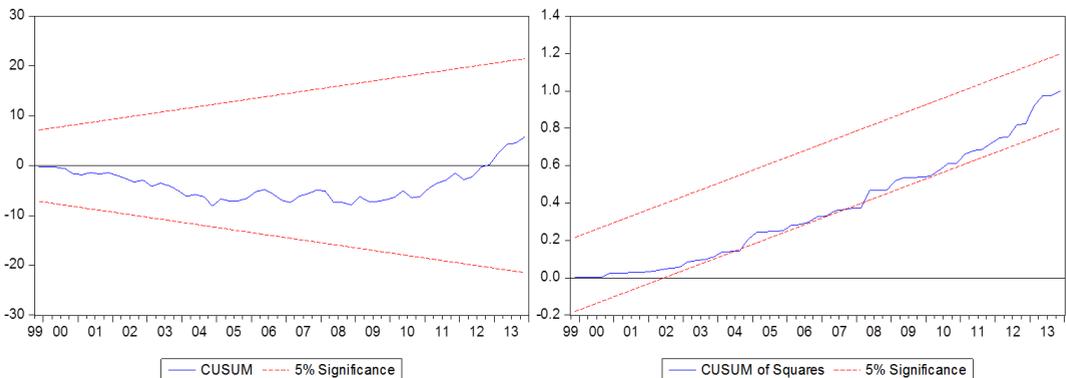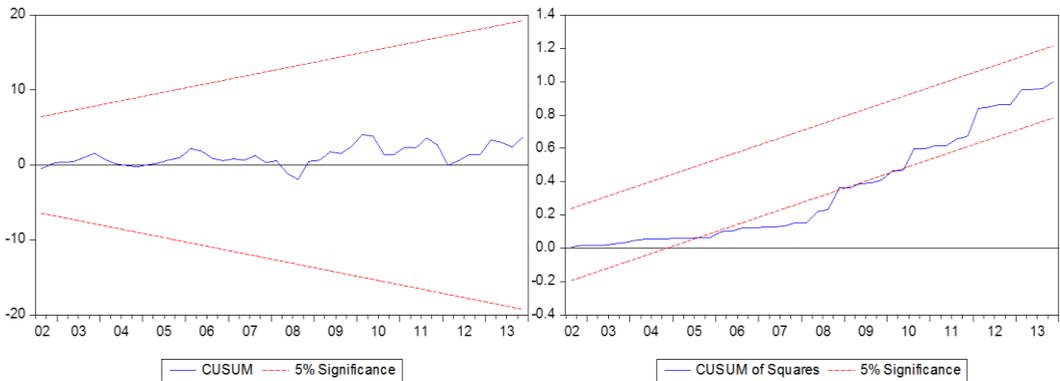
Figure-2: CUSUM (left) and CUSUMSQ (right) test for stability of the M2 money demand function of Hungary

4.2. The Johansen approach to cointegration and the one-step error correction model

In estimating a money demand function for Hungary, the ARDL approach is perhaps the more appropriate estimation method. Firstly, not all of the proposed explanatory variables are integrated of the same order, a prerequisite for the Johansen approach (Johansen & Joselius, 1990); and secondly, the Johansen approach and the VECM do not account for the fact that different variables may require different optimal lags to yield the most significant estimation results. However, as a robustness check – and following on the work of Achsani (2010:54) that included only 64 observations in his study on Indonesia – this study also estimates both money demand functions by means of the VECM procedure and the one-step error correcting model proposed by Wesso (2002). Due to limiting space, only summaries of these results are reported, with the complete set available from the authors on request.

The error correction terms in the VECM estimations of both money demand functions are negative and statistically significant at 5 per cent, confirming a long-run cointegrating relationship between the dependent variables and explanatory variables. This is further a corroboration of what was found in the case of the ARDL procedure. The speed of adjustment to long-run equilibrium is estimated at 24 per cent per quarter for M1 and 33 per cent for M2 compared to 15 per cent and 26 per cent of the ARDL procedure. The long-run coefficients in the cointegrating equations display the required signs and are significant. The

magnitudes of the coefficients are also similar, especially with regard to the respective scale variables. The various opportunity cost variables also display the appropriate signs with magnitudes relatively similar.

The single-equation one-step error correction technique is quite similar to ARDL and also does not require all variables to be integrated of the same order. From these results, it is evident that the adjustment coefficients for both money demand functions are negative and significant –confirming adjustment towards the long-run equilibrium. The speed of adjustment coefficients is again similar to that of the previous two estimation methods, with 23 per cent of disequilibrium corrected in each period for the M1 money demand function and 34 per cent in the case of M2. The calculated long-run coefficients are also similar to that of the previous two methods. Diagnostic testing after the one-step procedure alludes to potential spurious regression results in the M2 function, while the M1 money demand function is regarded as more reliable. We acknowledge that our analysis is not without its limitations. It may for example be quite possible that we were not able to identify all prior research on the topic. However, thecomparable results, obtained from three different estimation techniques, confirm the robustness of the results.

5. CONCLUSION

The importance of estimating a stable and well-defined money demand function can be a daunting task in the case of developing countries in which limited data availability, hyperinflation and undeveloped financial systems could prove to be significant constraints. In this study, however, encouraging empirical results were found. Moreover, we argue that the results obtained could be robust given the great similarities between the results of the various empirical approaches. This strengthens the argument of this and previous studies, that a stable money demand function could well exist for Hungary. It is suggested, as was also argued by Dritsakis (2011), that the M1 money demand function might be the most appropriate model on which monetary policy decisions should be based. This argument is made given the relative stability of the ARDL specification of the M1 money demand function. What could be a disrupting finding is that the M1 variable was found to be weakly exogenous, which means that causality possibly runs in the opposite direction than what is theorised. It is suggested that further research be conducted utilising this approach in an effort to rule out uncertainty. Nevertheless, the speed of adjustment for both the M1 and M2 money demand functions was found to be slightly greater in the case of the VECM compared to

the ARDL model. The speed of adjustment for the one-step error correction model and that of the VECM is more similar compared to the ARDL model. This would suggest that the disequilibrium is actually corrected faster than what is proposed by the ARDL procedure.

REFERENCES

Achsani, N.A. (2010). Stability of money demand in an emerging market economy: An error correction and ARDL model for Indonesia. *Research Journal of International Studies,* 13, 54-62.

Andronescu, A., Mohammadi, H. & Payne, J.E. (2004). Long-run estimates of money demand in Romania. *Applied Economics Letters,* 11(14), 861-864.

Arango, S. & Ishaq Nadiri, M. (1981). Demand for money in open economies. *Journal of Monetary Economics,* 7(1), 69-83.

Bahmani-Oskooee, M. & Ng, R.W. (2002). Long-run demand for money in Hong Kong: An application of the ARDL model. *International Journal of Business and Economics,* 1(2), 147-155.

Buch, C.M. (2001). Money demand in Hungary and Poland. *Applied Economics,* 33(8), 989-999.

Calza, A. & Zaghini, A. (2010). Sectoral money demand and the great disinflation in the United States. *Journal of Money, Credit and Banking,* 42(8), 1663-1678.

Cziráky, D. & Gillman, M. (2006). Money demand in an EU accession country: A VECM study of Croatia. *Bulletin of Economic Research,* 58(2), 105-127.

Dagher, J. & Kovanen, A. (2011). On the stability of money demand in Ghana: A bounds testing approach. New York: International Monetary Fund (IMF).

Dritsakis, N. (2011). Demand for money in Hungary: An ARDL approach. *Review of Economics and Finance,* 1(5), 1-16.

Duasa, J. (2007). Determinants of Malaysian trade balance: An ARDL bound testing approach. *Global Economic Review*, 36(1), 89-102.

Fisher, I. (1911). *The Purchasing Power of Money: Its Determination and Relation to Credit Interest and Crises*. New York: Macmillan.

Friedman, M. (1956). The Quantity Theory of Money – A Restatement. In M. Friedman (Ed.) *Studies in the Quantity Theory of Money.* Chicago: University of Chicago Press.

Johansen, S. (1992). Testing weak exogeneity and the order of cointegration in UK money demand data. *Journal of Policy Modelling,* 14(3), 313-334.

Johansen, S. & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration – with applications to the demand for money. *Oxford Bulletin of Economics and Statistics,* 52(2), 169-210.

Korap, H.L. (2011). Multirank cointegration analysis of Turkish M1 money demand (1987Q1-2006Q3). *Ekonometri ve Istatistik e-dergisi,* (6), 1-28.

Narayan, P.K. (2005). The saving and investment nexus for China: Evidence from cointegration tests. *Applied Economics*, 37(17), 1979-1990.

Payne, J.E. (2000). Post stabilisation estimates of money demand in Croatia: The role of the exchange rate and currency substitution. *Ekonomski Pregled,* 51, 1352-1368.

Pesaran, M.H., Shin, Y. & Smith, R.J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics,* 16(3), 289-326.

Sun, Z., Sun, B. & Lin, S.X. (2013). The impact of monetary liquidity on Chinese aluminium prices. *Resources Policy,* 38(4), 512-522.

Wesso, G.R. (2002). Broad money demand and financial liberalisation in South Africa. *South African Reserve Bank Occasional Paper 18.* Pretoria: South African Reserve Bank.