TESTING THE STABILITY OF MONEY MULTIPLIERS FOR CROATIA

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Abstract This paper analyses the stability of monetary multiplication process in Croatia and its forecasting ability. The money multiplier approach assumes that the monetary authorities are able to control the monetary base through money multipliers by affecting the money supply and the rate of inflation. Thus, by controlling the monetary base, monetary authorities can achieve the price stability. For implementing an effective and accurate monetary policy, money multipliers should be stable. The stability of money multipliers implies that different measures of money supply (i.e. different monetary aggregates) and reserve money are stationary or that different measures of money supply and reserve money are cointegrated. Therefore, the purpose of this paper is to test for the stationarity of money multipliers and to determine the long-run relationship between different monetary aggregates and reserve money for Croatia using monthly data in the period from 2011 to 2019 and the bounds testing (ARDL) approach for cointegration. The results of the unit-root tests indicate that money multipliers are non-stationary, therefore unstable and inappropriate for the short-run policy purpose. On the other side, the existence of stable cointegration relationships suggests the validity of the money multiplier model in the long-run.

Keywords: money multipliers, monetary aggregates, stationarity, cointegration, Croatia.

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1 Introduction

Most central banks conduct monetary policy based on manipulation of short-term interest rates in order to achieve a variety of economic objectives, hence to better control inflation and foster stable economic growth. In eclectic manner, central banks in fact manipulate changes in the growth rates of monetary aggregates which play a central role in explaining the dynamics of economic activity. With a growing awareness that monetary policy, if it is to be effective, should be directed towards controlling a monetary aggregate, rather than the interest rates (Bomhoff, 1977). This becomes even more important, considering the fact that many developing countries, such as Croatia, have problems with their money transmission channels. Thus, in countries that target level of monetary stocks, central banks ought to control the quantity of money as well as the changes in the factors that affect different monetary aggregates. By developing an effective procedure for controlling the rate of money stock growth and by identifying the nexus between money stock dynamics and preferred objectives (Hassan, Mustafa and Basher, 2003), namely by influencing the monetary multiplication process, central banks can evaluate the stability of money multiplier and the controllability of the monetary base i.e. the so-called reserve money.

Money multiplier reflects the amplified change in the money supply that ultimately results from the injection of additional reserves . In that manner, the money multiplier approach assumes that the monetary authorities are able to control the monetary base through money multipliers by affecting the money supply and the rate of inflation. That is, given a desired level for next period's money stocks and a prediction of what the level of the money multiplier next period will be, the level of the adjustment base needed to achieve the desired money stock is determined residually. For implementing an effective and accurate monetary policy, money multipliers should be also stable. Proponents of this 'money base approach' argue that the variations in money multiplier depend on the money in circulation, demand deposits, time deposits and bank reserves. Thereby, variations in these factors may dominate in money stock in the short-run and become stable and predictable over the long-run (Khan, 2010). Moreover, since other economic variables can affect variety of monetary aggregates, the stability of monetary multiplier process must be managed so that the impact of a controlled change in the reserve money on money supply can be separated from the impact resulting from changes in endogenous economic variables (Saatcioglu, Korap and Volkan, 2006). Analytical interpretation of the stability of money multipliers implies that different measures of money supply (i.e. different monetary aggregates) and reserve money are stationary or that different measures of money supply and reserve money are cointegrated.

Considering the situation of a highly open, indebted and euroized Croatian economy, reliance on 'managed' floating exchange rate regime, dynamic and strongly seasonal inflow of foreign currencies, and finally, very narrow monetary transmission mechanism (Benazić and Učkar, 2011) there is limited reasoning towards the stability of money multiplier in Croatia, which indirectly affects the question of controllability of the reserve money by the Croatian National Bank. Important features of the Croatian monetary system bear out the necessity to observe monetary multiplication process (Svilokos, 2012). First, Croatian National Bank increases/decreases reserve money by changing the level of its assets primarily upon foreign assets and claims on banks (open market operations are used mostly for short-term liquidity management). Next, Croatian kuna is constantly facing depreciation or appreciation pressures, whereas monetary policy has been substantially expansionary, especially during and after the economic crisis. Finally, limited impact on production and employment within the real sector, came out of distinct problems in transmission channels of monetary policy. Ditto, we are of thought that money multiplier model would provide a cornerstone for the assessment of the nexus between the reserve money and money supply in Croatia, hence would serve monetary authority as a signal for the severity and reach of its monetary actions. The goal of this paper is to test for the stationarity of money multipliers and to determine the long-run relationship between different monetary aggregates and reserve money for Croatia using monthly data in the period from 2011 to 2019 and the bounds testing (ARDL) approach for cointegration. The results indicate that money multipliers are unstable and inappropriate for the short-run policy purpose, however we find the validity of the money multiplier model in the long-run.

The rest of the paper is organized as follows. Following the elaborate Introduction, Section 2 contains a brief review of significant empirical literature. Methodology and results are provided in Section 3, while some concluding remarks are given in final Section 4.

2 Review of the relevant literature

Besides those seminal papers concerning the issue of stability of money multiplier made by Bomhoff (1977), Johannes and Rasche (1979) and Hafer and Hein (1984) there are a number of papers that dealt with this topic, concerning different countries, using the time series techniques (for an insightful systematization look at Khan (2010)). For example, Hossain (1993) developed a money multiplier model of the money supply for Bangladesh for 1972-1993 period by using a component approach of the money multiplier and found that only deposit-currency ratio equation was stable, but the narrow and broad money multiplier equations were found to be unstable. Zaki (1995) argued that forecasts of the aggregate money multiplier for Egypt provided more satisfactory results than the components of the money multiplier. Ford and Morris (1996) tracked a cointegrating nexus between various monetary aggregates and a high-powered money base for the UK within 1977-1994 period and found that high-powered money had strong predictive power (through interest rate) in regard to inflation and output. Darbha (2002) analyzed the cointegration between monetary aggregates and reserve money for India using residual-based cointegration test and found that there exist a stable, but time-varying, long-run relation between the measures of money stock and reserve money. Hassan, Mustafa and Basher (2003) examined both long-term and short-term dynamic relationships among money supply and its components for Bangladesh economy within an Engle-Granger error-correction framework, using the data for the period 1973-1997, and found that M1 and M2 money supply have very predictable long-run relationships with its components, with no short-term relationship. Khan (2010) tested the constancy and stationarity of the mechanic version of the money multiplier model for Pakistan over the period 1972-2009 and suggested that the model can serve as a framework for conducting short-run monetary policy in Pakistan. Hevia and Nicolini (2018) used a simple money demand to characterize the behaviour of monetary aggregates in the USA for the period 1960-2016 and suggested that specific measures by the FED to absorb that cash could be worth considering to make the future path of the price level consistent with the price stability mandate.

Interesting papers, directly or indirectly dealing with Croatia are those of Svilokos (2012, 2016), Benazić and Tomić (2014), and Vidaković and Zbašnik (2014). The most distinct one is that of Svilokos (2012) in which the author applied money multiplier method to assess the determinants of Croatian money supply. Dealing with problems of the monetary base and monetary sovereignty, monetary policy during and after the economic crisis, sustainability of foreign debt, the author also presented the calculation of the money multiplier for Croatia based on the Friedman-Schwartz approach and provided the analysis for the period of 2005-2012. Our analysis is, in that manner, a mere 'time' continuation on this topic.

3 Data, methodology and empirical results

3.1 Data

The main purpose of this paper is to test the stability and forecasting ability of money multipliers for Croatia by using the unit root tests and bounds testing (ARDL) approach for cointegration of time series. The analysis consists of two parts. The first part considers the ability of short-run forecasting possibilities while the second part analyses the long-run forecasting possibilities of the monetary multiplication process. Data for the first part include money multipliers *mm1*, *mm2* and *mm3*[1] while data for the second part include reserve money Mo, monetary aggregates M1, M2 and M3[2]. Data for all selected variables are observed on a monthly basis in the period from December 2010 to September 2019 and are taken from the Croatian National Bank (2019) database. To eliminate the influence of seasonal factors all series were seasonally adjusted using the ARIMA X-12 method[3].

[1] Money multiplier *mm1* is calculated as the ratio between the monetary aggregate M1 and reserve money Mo. Money multiplier *mm2* is calculated as the ratio between the monetary aggregate M2 and reserve money Mo. Money multiplier *mm3* is calculated as the ratio between the monetary aggregate M3 and reserve money Mo.
[2] According to Croatian National Bank (2019) »reserve money consists of currency outside credit institutions, cash in credit institutions' vaults, credit institutions' deposits with the CNB and deposits of other financial institutions with the CNB. From November 2015 on, the Croatian National Bank presents the monetary aggregates as defined by the European Central Bank (ECB). Monetary aggregates comprise monetary liabilities of monetary financial institutions to non-MFI Croatian residents excluding central government. Monetary aggregate M1 (a »narrow« monetary aggregate) comprises currency in circulation and overnight deposits in kuna and foreign currency. Overnight deposits comprise transaction accounts (including restricted deposits), savings deposits and overnight loans. Monetary aggregate M2 (an »intermediate« monetary aggregate) comprises monetary aggregate M1, time deposits in kuna and foreign currency with original maturity of up to and including two years (including loans received, except overnight loans and repurchase agreements) and deposits redeemable at a period of notice of up to and including three months. Monetary aggregate M3 (a »broad« monetary aggregate) comprises a monetary aggregate M2, repurchase agreements, money market fund shares and units as well as debt securities with original maturity of up to and including two years.«
[3] In the analysis, EViews (IHS Global Inc., 2019) econometric software is used.

3.2 Short-run analysis

Short-run analysis comprises of unit root tests to check whether money multipliers are stable, i.e. stationary and therefore appropriate for short-run policy purposes. To do so, ADF (Augmented Dickey and Fuller) test, PP (Phillips and Perron) test and KPSS (Kwiatkowski, Phillips, Schmidt and Shin) test are considered. Before applying stationarity tests, the development of money multipliers through time is analyzed by the insight in Figure 1.

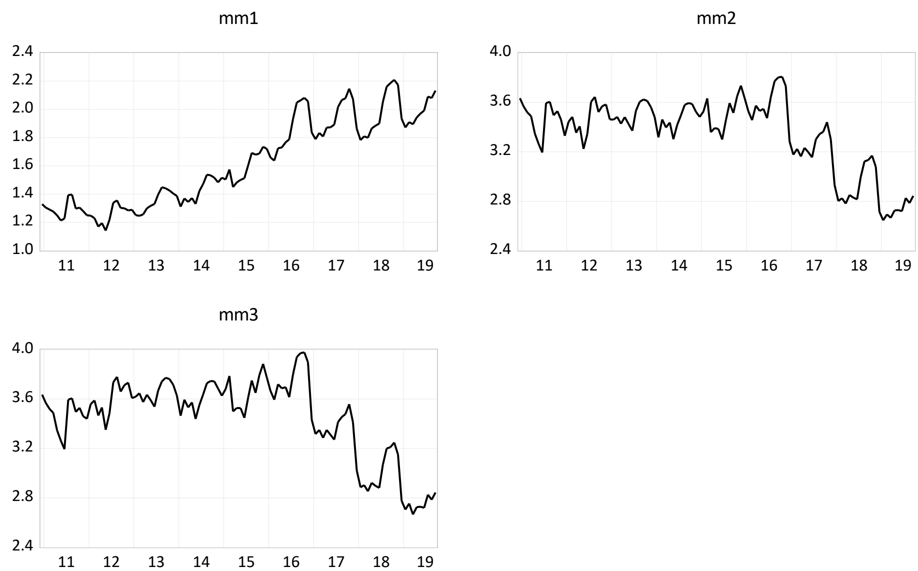

Figure 1: Money multipliers (non-seasonally adjusted)
Source: Croatian National Bank (2019) and research results

It is visible that money multipliers are in fact non-stationary. Money multiplier *mm1* shows strong upward trend during the whole period, while money multipliers *mm2* and *mm3* exceed upward trend until 2016 and then the strong downward trend to the end of the observing period. This is further confirmed by the unit root tests shown in the Appendix. Test results show that all money multipliers are integrated of order I(1) indicating that are non-stationary, therefore unstable and inappropriate for short-run forecasting policy purposes.

3.3 Long-run analysis

The second part of the analysis is focused on the long-run forecasting possibilities of the monetary multiplication process. Therefore, to determine the long-run relationship between different monetary aggregates (M1, M2 and M3) and reserve money Mo the bounds testing (ARDL) approach for cointegration of time series is applied. Long-run analysis consists of three ARDL models. The first model analyses the relationship between base money Mo and monetary aggregate M1, the second model analyses the relationship between base money Mo and monetary aggregate M2 while the third analyses the relationship between base money Mo and monetary aggregate M3. Data on reserve money Mo, monetary aggregates M1, M2 and M3 used in the analysis are shown in Figure 2.

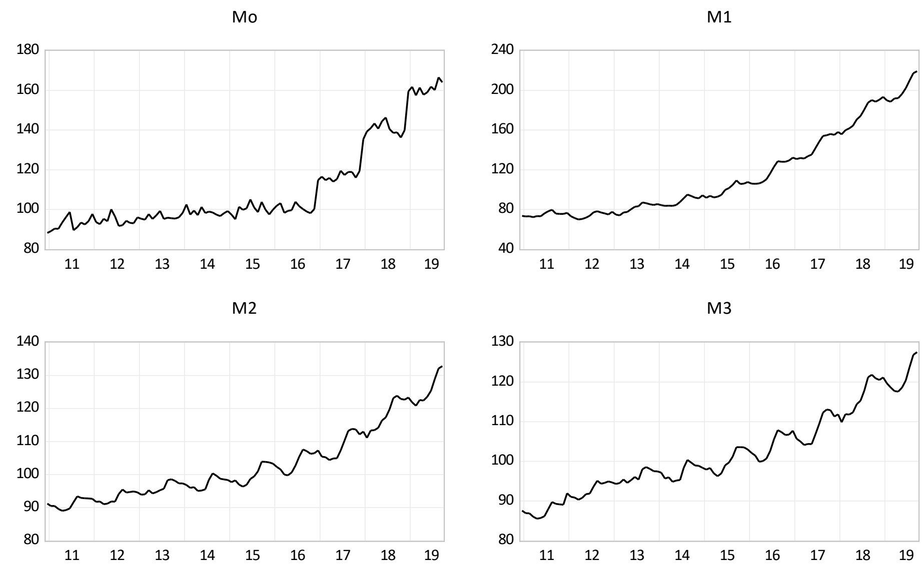

Figure 2: Reserve money Mo, monetary aggregate M1, monetary aggregate M2 and monetary aggregate M3 (indices, 2015=100, non-seasonally adjusted)

Source: Croatian National Bank (2019).

It is visible that all series show upward trend during the whole period. After 2016, a strong rise in reserve money Mo is achieved due to the increase of credit institutions' deposits with the CNB.

The ARDL model (Pesaran, Shin and Smith (2001) and Pesaran and Shin (1995)) is performed in two steps. The first step starts with conducting the bounds test for cointegration whereby in the second step, if cointegration is found, the long-run relationship and the associated error correction model (ECM) are estimated. Before proceeding with the bounds test, it is necessary to determine the degree of integration of time series because it is important to clarify whether the variables are integrated of order n = 0, 1, 2 as to avoid spurious results. Namely, in the presence of I(2) variables the computed F-statistic is not valid because the bounds test is based on the assumption that the variables are I(0) or I(1). As before, standard unit root tests are applied and shown in the Appendix. Data are seasonally adjusted using the ARIMA X-12 method and are expressed in logarithms. Obtained results indicate that all the series are integrated of order I(1), i.e. they are stationary in their first differences.

The first ARDL model tests the long-run relationship between the reserve money Mo and monetary aggregate M1. Since the observations are monthly given, the maximum order of lags in the ARDL model is 12. The model also includes several dummy variables to eliminate the non-normality in residuals. For the model selection criteria the Schwarz criterion is selected[4] whereby regarding deterministic trend specification, the restricted constant case is estimated[5]. The long-run relationship is tested by computing the F-statistic for testing the significance of the lagged levels of the variables in the error correction form of the underlying ARDL model. The results are summarized in Table 2.

[4] Despite the fact that model using the Schwarz criterion performs better, the Schwarz criterion is generally considered as a restrictive criterion and thus suitable for models with relatively short time series. The same is applied for all models.
[5] The comparison of the information criteria (Akaike, Schwarz and Hannan-Quinn) show that smaller values of the criteria achieves the model with the restricted constant trend specification.

Table 2: Testing for the existence of a level relationship among the variables in the ARDL (1, 1) M1 model (F-Bounds test)

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	32.56038	10%	3.02	3.51
k	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58
Actual Sample Size	105		Finite Sample: n=80	
		10%	3.113	3.61
		5%	3.74	4.303
		1%	5.157	5.917

Source: Research results. Note: Asymptotic: n=1000.

Since the computed F-statistic exceeds the upper bounds, the null hypothesis of no long-run relationship between the reserve money Mo and monetary aggregate M1 can be rejected irrespective of the order of their integration.

In the second step, the first ARDL long-run model is estimated. Table 3 summarizes the diagnostic tests of the selected ARDL (1, 1) M1 equation.

Table 3: Diagnostic tests of the ARDL (1, 1) M1 model

Serial correlation: Breusch-Godfrey	F-statistic=0.965057, Prob. F(12,86)=0.4882 Obs*R-squared=12.46120, Prob. Chi-Square(12)=0.4094
Normality: Jarque-Bera	JB=1.996789, Prob. = 0.368471
Heteroscedasticity: Breusch-Pagan-Godfrey	F-statistic=0.486626, Prob. F(6,98)=0.8169 Obs*R-squared=3.037806, Prob. Chi-Square(6)=0.8041 Scaled explained SS=3.223589, Prob. Chi-Square(6)=0.7803

Source: Research results.

Diagnostic tests suggest that the model is adequately estimated. The estimated long-run coefficients and the underlying ECM form of the ARDL (1, 1) M1 equation is presented in Table 4.

Table 4: Estimated long-run coefficients (levels equation) and ECM form of the ARDL (1, 1) M1 model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Levels equation				
LMO	1.405920	0.198402	7.086235	0.0000
C	-2.173882	0.891156	-2.439397	0.0165
ECM form				
D(LMO)	0.077834	0.046758	1.664626	0.0992
D1	0.044835	0.010090	4.443486	0.0000
D2	0.041132	0.009762	4.213252	0.0001
D3	-0.033172	0.009773	-3.394229	0.0010
CointEq(-1)*	0.033993	0.003405	9.983718	0.0000
R-squared	0.455009	Mean dependent var		0.010182
Adjusted R-squared	0.433210	S.D. dependent var		0.012947
S.E. of regression	0.009748	Akaike info criterion		-6.377154
Sum squared resid	0.009501	Schwarz criterion		-6.250775
Log likelihood	339.8006	Hannan-Quinn criter.		-6.325943
Durbin-Watson stat	2.243113			

Source: Research results. Note: "D" indicates first difference, while "L" indicates logarithm of the variable. * p-value incompatible with t-Bounds distribution.

Estimated long-run coefficient is statistically significant, indicating that an increase in the reserve money Mo increases monetary aggregate M1 in the long-run. Although almost insignificant, in the short-run, a positive change in the current lag of reserve money Mo has a positive effect on the change in the monetary aggregate M1. The error correction coefficient is statistically significant, relatively small and has the incorrect positive sign indicating slight "overshooting"[6].

The second ARDL model tests the long-run relationship between the reserve money Mo and monetary aggregate M2. The maximum order of lags in the ARDL model is 12. The model includes several dummy variables to eliminate the non-normality in residuals. For the model selection criteria the Schwarz criterion is selected whereby regarding deterministic trend specification, the restricted trend case is estimated[7]. Table 5 shows the results of testing for the existence of a level relationship between variables.

[6] Howhever, when the model is estimated with the shorter time period, the error correction coefficient becomes correctly negative.
[7] The comparison of the information criterions (Akaike, Schwarz and Hannan-Quinn) show that smaller values of the criterions achieves the model with the restricted trend specification.

Table 5: Testing for the existence of a level relationship among the variables in the ARDL (1, 2) M2 model (F-Bounds test)

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	8.442235	10%	4.05	4.49
k	1	5%	4.68	5.15
		2.5%	5.3	5.83
		1%	6.1	6.73
Actual Sample Size	104		Finite Sample: n=80	
		10%	3.113	3.61
		5%	3.74	4.303
		1%	5.157	5.917

Source: Research results. Note: Asymptotic: n=1000.

Computed F-statistic exceeds the upper bounds indicating that the null hypothesis of no long-run relationship between the reserve money Mo and monetary aggregate M2 can be rejected irrespective of the order of their integration.

In the second step, the second ARDL long-run model is estimated. Table 6 summarizes the diagnostic tests of the selected ARDL (1, 2) M2 equation.

Table 6: Diagnostic tests of the ARDL (1, 2) M2 model

Serial correlation: Breusch-Godfrey	F-statistic=1.522018, Prob. F(12,86)= 0.1327 Obs*R-squared=18.75765, Prob. Chi-Square(12)= 0.0945
Normality: Jarque-Bera	JB=3.417522, Prob. = 0.181090
Heteroscedasticity: Breusch-Pagan-Godfrey	FF-statistic=1.764344, Prob. F(6,98)= 0.0938 Obs*R-squared=13.45312, Prob. Chi-Square(6)= 0.0972 Scaled explained SS=15.91460, Prob. Chi-Square(6)= 0.0436

Source: Research results.

Diagnostic tests suggest that the model is adequately estimated. The estimated long-run coefficients and the underlying ECM form of the ARDL (1, 2) M2 equation is presented in Table 7.

Table 7: Estimated long-run coefficients (levels equation) and ECM form of the ARDL (1, 2) M2 model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Levels equation				
LMO	0.366165	0.035204	10.40111	0.0000
@TREND	0.001587	0.000186	8.538000	0.0000
ECM form				
C	0.545872	0.106812	5.110573	0.0000
D(LMO)	0.086237	0.024085	3.580462	0.0005
D(LMO(-1))	-0.063813	0.025042	-2.548273	0.0124
D1	0.017858	0.005336	3.346779	0.0012
D2	-0.014395	0.005160	-2.789671	0.0064
D3	0.019018	0.005122	3.713101	0.0003
CointEq(-1)*	-0.191682	0.037694	-5.085263	0.0000
R-squared	0.497014	Mean dependent var		0.003362
Adjusted R-squared	0.465902	S.D. dependent var		0.006954
S.E. of regression	0.005082	Akaike info criterion		-7.661361
Sum squared resid	0.002505	Schwarz criterion		-7.483373
Log likelihood	405.3908	Hannan-Quinn criter.		-7.589253
F-statistic	15.97475	Durbin-Watson stat		2.077951
Prob(F-statistic)	0.000000			

Source: Research results. Note: "D" indicates first difference, while "L" indicates logarithm of the variable. * p-value incompatible with t-Bounds distribution.

Estimated long-run coefficient is statistically significant, indicating that an increase in the reserve money Mo increases monetary aggregate M2 in the long-run. In the short-run, a positive change in the current lag of reserve money Mo has a positive effect on the change in the monetary aggregate M2. Furthermore, a positive change in the first lag of reserve money Mo has a negative effect on the change in the monetary aggregate M2. The error correction coefficient is statistically significant, has the correct negative sign and suggests a moderate speed of adjustment to the long-run equilibrium. Nearly 20% of the disequilibria of the previous month's shock adjust back to the long-run equilibrium in the current month.

The third ARDL model tests the long-run relationship between the reserve money Mo and monetary aggregate M3. The maximum order of lags in the ARDL model is again 12. The model also includes several dummy variables to eliminate the non-normality in residuals. For the model selection criteria we evaluated the Schwarz criterion based on the no constant and no trend case[8]. Table 8 shows the results of testing for the existence of a level relationship between variables.

Table 8: Testing for the existence of a level relationship among the variables in the ARDL (1, 1) M3 model (F-Bounds test)

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	8.651041	10%	2.44	3.28
k	1	5%	3.15	4.11
		2.5%	3.88	4.92
		1%	4.81	6.02

Source: Research results. Note: Asymptotic: n=1000.

Computed F-statistic exceeds the upper bounds indicating that the null hypothesis of no long-run relationship between the reserve money Mo and monetary aggregate M3 can be rejected irrespective of the order of their integration.

In the second step, the third ARDL long-run model is estimated. Table 9 summarizes the diagnostic tests of the selected ARDL (1, 1) M3 equation.

Table 9: Diagnostic tests of the ARDL (1, 1) M3 model

Serial correlation: Breusch-Godfrey	F-statistic=1.205705, Prob. F(12,88)=0.2920 Obs*R-squared=14.82591, Prob. Chi-Square(12)=0.2511
Normality: Jarque-Bera	JB=5.678619, Prob. = 0.058466
Heteroscedasticity: Breusch-Pagan-Godfrey	F-statistic=1.467373, Prob. F(5,99)=0.2073 Obs*R-squared=7.244625, Prob. Chi-Square(5)=0.2031 Scaled explained SS=9.040066, Prob. Chi-Square(5)=0.1075

Source: Research results.

Diagnostic tests suggest that the model is adequately estimated. The estimated long-run coefficients and the underlying ECM form of the ARDL (1, 1) M3 equation is presented in Table 10.

[8] The comparison of the information criterions (Akaike, Schwarz and Hannan-Quinn) show that smaller values of the criterions achieves the model with no constant and no trend specification.

Table 10: Estimated long-run coefficients (levels equation) and ECM form of the ARDL (1, 1) M3 model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Levels equation				
LMO	1.096477	0.152617	7.184515	0.0000
ECM form				
D(LMO)	0.115138	0.027035	4.258913	0.0000
D1	0.031758	0.006014	5.280871	0.0000
D2	-0.023213	0.006004	-3.866302	0.0002
CointEq(-1)*	-0.004916	0.001176	-4.180323	0.0001
R-squared	0.390899	Mean dependent var		0.003344
Adjusted R-squared	0.372807	S.D. dependent var		0.007557
S.E. of regression	0.005984	Akaike info criterion		-7.361942
Sum squared resid	0.003617	Schwarz criterion		-7.260839
Log likelihood	390.5020	Hannan-Quinn criter.		-7.320973
Durbin-Watson stat	2.135404			

Source: Research results. Note: "D" indicates first difference, while "L" indicates logarithm of the variable. * p-value incompatible with t-Bounds distribution.

Estimated long-run coefficient is statistically significant, indicating that an increase in the reserve money Mo increases monetary aggregate M3 in the long-run. In the short-run, a positive change in the current lag of reserve money Mo has a positive effect on the change in the monetary aggregate M3. The error correction coefficient is statistically significant, relatively small, has the correct negative sign and suggests a slow speed of adjustment to the long-run equilibrium. Nearly 0.5% of the disequilibria of the previous month's shock adjust back to the long-run equilibrium in the current month.

Overall, the money multiplier model holds true only in the long-run. All three ARDL models suggest that all monetary aggregates have very predictable long-run relationship with the reserve money. The unit-root results, however, suggest that money multipliers are not useful for the short-run policy purpose.

4 Conclusion

The money multiplier is an integral part of macroeconomics and monetary economics for it determines the money supply, which then affect interest rates and other monetary variables. It is also important in banking because it determines monetary policy and the stability of the banking sector. Our paper analyzed both, short- (unit root testing) and long-term (ARDL modeling), dynamics of the monetary multiplier for Croatia by including three monetary aggregates. Overall results suggest that the money multiplier model holds true only in the long-run. Namely, the existence of stable cointegration relationships in all three ARDL models suggests the validity of the money multiplying process in the long-run with unstable short-run dynamics, therefore decreasing the possible effectiveness of monetary policy in the short-run. It means that central bank should be able to control the money supply growth by controlling the reserve money to achieve its objective, but only with long-term perspectives. In the short-run, monetary policy would be still able to act by open market operations with foreign assets, namely currencies.

Though the paper deals with relatively short time series, we are of thought that future research endeavours should include methodological endorsements and reassessments of the money multipliers. Additional contribution could include the evaluation of the effect of the reserve money on other monetary variables, such as interest rates. Our approach and deductions made above present only our research logic and could/should be subject to revision in the future.

Appendix

Table 1: Unit root tests

Variables and test	Level		First difference	
	Intercept	Intercept and trend	Intercept	Intercept and trend
ADF test	t-Statistic			
mm1	0.9034	0.3424	0.0000	0.0000
mm2	0.9063	0.8542	0.0000	0.0000
mm3	0.9749	0.9574	0.0000	0.0000
LMo	0.9999	0.9971	0.0000	0.0000
LM1	1.0000	0.3980	0.0000	0.0000
LM2	1.0000	0.9759	0.0000	0.0000
LM3	0.9909	0.7511	0.0000	0.0000
PP test	Adjusted t-Statistic			
mm1	0.9245	0.4477	0.0000	0.0000
mm2	0.9609	0.9119	0.0000	0.0000
mm3	0.9875	0.9801	0.0000	0.0000
LMo	0.9999	0.9960	0.0000	0.0000
LM1	1.0000	0.6810	0.0000	0.0000
LM2	1.0000	0.9953	0.0000	0.0000
LM3	0.9982	0.8202	0.0000	0.0000
KPSS test	LM-Statistic			
mm1	1.101333	0.162099	0.190068	0.177090
mm2	0.795629	0.274251	0.245272	0.101085
mm3	0.706175	0.288718	0.306242	0.094071
LMo	0.969143	0.270052	0.650466	0.127148
LM1	1.116170	0.285860	0.920786	0.127558
LM2	1.094441	0.304727	0.828689	0.100972
LM3	1.125936	0.238292	0.265520	0.088098

Source: Research results. Note: "L" indicates logarithm of the variable. For the implementation of ADF and Perron test, the Schwarz information criterion has been implemented. Probabilities for ADF and PP tests are taken from MacKinnon (1996). KPSS test asymptotic critical values are taken from Kwiatkowski, Phillips, Schmidt and Shin (1992) (intercept: 1% level (0.739), 5% level (0.463), 10% level (0.347); intercept and trend: 1% level (0.216), 5% level (0.146), 10% level (0.119).

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