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Endogeneity of Money Supply: Evidence from Turkey

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Abstract

There is a long discussion among academics and central bankers about the theories of money supply. According to the exogenous view, central banks have the full control over money supply via policy actions including the adjustments of interest rates and reserve ratios, both of which alter commercial banks' lending decisions. However, the theory of endogenous money supply emphasizes the role of demand for bank loans in money creation. More specifically, banks create money by meeting the demand of economic agents. In this study, we investigate which of the money supply theories holds in Turkish economy for the period 2006-2015 by employing cointegration and causality tests. Our findings show that the causality runs from bank loans to money supply both in the short and long terms, which supports the endogenous view in a sense that central bank and the banks fully meet the total demand for money in Turkish economy.

Key Words: *Money Supply, Money Endogeneity, Granger Causality, Central Banks.*

JEL classification: *E12; E41; E42; E52; G21*

Introduction

Theoretical concept of money has been one of the most discussed topics in the field of economics. According to the modern central banking perspective, the definition of money is given as the liabilities of money creating sectors that are used as means of exchange in the economy. Bank money is defined as the sum of "deposits (sight+time)" while Central Bank money is the sum of "banknotes in circulation" and "bank reserves".

Although, there exists a vast literature on the theory of money supply, there is no consensus among academics and central bankers on the drivers of money creation. According to the classical view (i.e. Monetarist or neo-Keynesian view), money supply is assumed to be exogenous since the Central Bank

plays a crucial role on the growth of supply. This approach considers that the Central Bank has the full control over monetary base, which comprises its liabilities. Under the assumption that the money multiplier, defined as the ratio of money supply to the monetary base, is empirically stable, the proponents of this view assert that the Central Bank could exogenously control the monetary base to achieve the targeted money supply levels (Moore, 1998). However, starting with the seminal paper of Kaldor (1982), endogeneity of money supply has received considerable attention. The main idea behind the endogenous view is that the money supply is determined by the interaction of loan demand and the bank lending practices. In this approach, both commercial banks and the Central Bank create money. Commercial banks create money via granting loans and the Central Bank accommodates money demand of banks due to the illiquid nature of banking activity. Once loans have been granted and deposits have increased, central banks have no choice but to accommodate all increases in demand for central bank money to maintain the solvency and liquidity of the financial system. This obligation of central bank is called "**lender of last resort**".

Keeping these controversial money supply theories in mind; when we look at the year-on-year (yoy) percent change in total bank loans and the money supply (M2)[1] in Turkey, as seen in Figure 1, they have exhibited similar patterns in the last decade. Another striking observation is that funding needs of the Turkish banking system has been almost equal to the emission (i.e. Turkish Lira in circulation) in recent years. Table 1 summarizes net open market operations of the CBRT for the period July 2012 – July 2015. One can easily see that CBRT and Treasury operations have cancelled out each other and the increase in funding needs has been a result of the change in emission[2]. More specifically, it seems that the CBRT has met the funding needs of the banking system by increasing the emission.

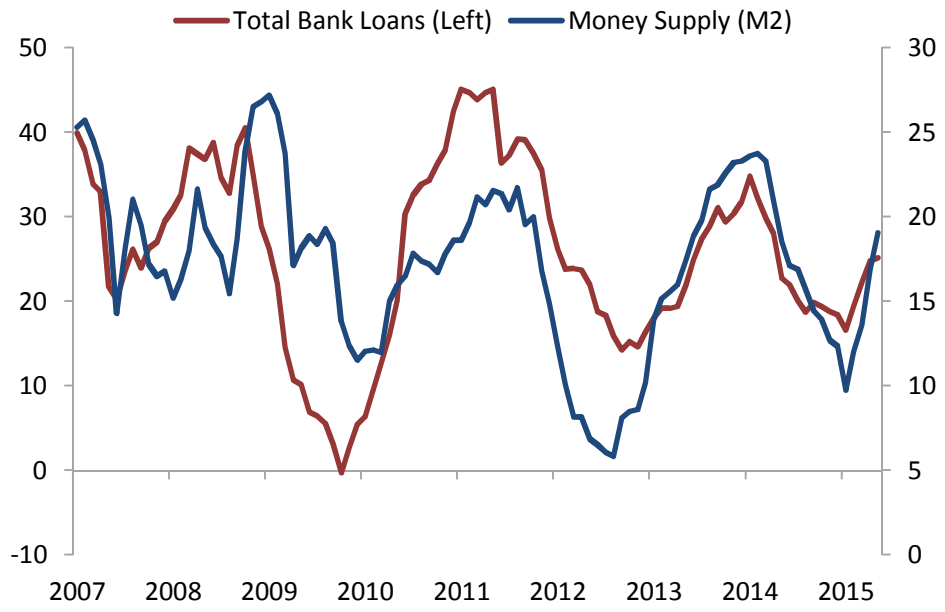


Figure 1: Total Banks Loans –Money Supply Relationship (YoY % Change)

[1] The majority of the existing literature use M2 as a representative of money supply. However, we also incorporate M1 and M3 to our empirical analysis.
[2] According to Article 87 of the Constitution of the Republic of Turkey, the privilege of issuing banknotes belongs to Grand National Assembly. This privilege was given to the CBRT and extended for an unlimited time.

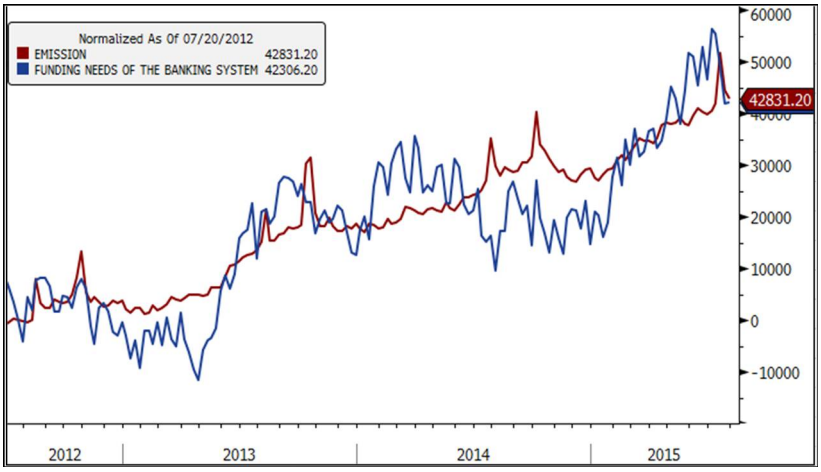
Table 1: Changes in the Funding Needs of the Banking System

(20.07.2012 - 31.07.2015)

Net Open Market Operations: *20.07.2012 (Million TL)*	**-21.446,40**
CBRT FX Operations	**-98.129,35**
CBRT Purchase of Government Bonds	**13.061,59**
Treasury Operations	**10.848,33**
Change in Turkish Lira in Circulation	**-42.145,00**
Change in Free Deposits	**258,00**
Rediscount Operations + CBRT Interest Payments	**73.775,83**
Net Open Market Operations: *31.07.2015 (Million TL)*	**-63.777,00**

Source: CBRT

Finally, to have more evidence on this observation, we look at the relationship between emission and the funding needs of the banking system in the same period. Figure 2 displays that the liquidity demand of Turkish banking system seems to be covered by CBRT in recent years.



Source: CBRT, Bloomberg

Figure 2: Emission-Funding Needs of the Banking System Relationship

Motivating from these two observations, in this note we test the endogeneity of money supply in Turkish economy with recent data by controlling structural changes in monetary base. In our empirical analysis, we test causality relation between loans and money supply. To this end, we apply cointegration and causality tests. Then, we check the robustness of our results by employing a trivariate Vector Auto Regression (VAR) methodology suggested by Badarudin et al. (2013). Our findings provide evidence for the endogeneity of money in Turkey. More specifically, we observe that the causality runs from bank loans to money supply both in the short and long runs, which implies that the CBRT accommodates all increases in liquidity demand of the banking system. In other words, CBRT only has an imperfect control over money supply. Therefore, the efficiency of inflation targeting policies, which uses short term interest rates as the main policy tool, may improve by clarifying the elasticity of credit demand to the interest rates in an economy with endogenous money supply.

Literature Review

Three theoretical views in regards to endogenous money supply are proposed by the existing literature. According to the accommodationist view, once loans have been granted and deposits have increased, the Central Bank has no choice but to accommodate all increases in funding needs of commercial banks to maintain the solvency and liquidity of the financial system and to fulfill its role as the lender of last resort (Moore, 1989a, 1989b). Accommodationists believe that the Central Bank can only control interest rates but not the supply of reserves. However, structuralist view asserts that the Central Bank does not fully accommodate reserves demanded by commercial banks. As bank lending increases, the demand for reserves will rise, but there will only be a partial accommodation from the Central Bank. Therefore, commercial banks will be forced to look for external funding. As a second difference, structuralists believe that the Central Bank has some control over money supply as well. This view also proposes that banks could partly overcome reserve constraints imposed by the Central Bank via liability management (Pollin (1991), Palley (1994, 1998)). Liquidity preference view is the third approach, which questionizes the common feature of above approaches that the demand and supply functions of credit money are identical. Howells (1995) argues that increase in credits may not result in an identical increase in deposits since economic units have different liquidity preferences about the amount of money they wish to hold. More specifically, newly created deposits may be transformed at least partly into cash or some other assets. If the supply of deposits is insufficient to meet the demand for loans, relative interest rates will increase to fill the gap by raising the supply of deposits and reducing the demand for loans.

Several articles in the empirical literature investigated the nature of money supply for different countries. The recent evidence is increasingly in favor of the endogenous view. By using U.S. data for the period 1953-1988, Pollin (1991) found evidence similar to the arguments of structuralist view. Panagopoulos and Spiliotis (1998) supported the accommodationist view by revealing that credit money was primarily determined by the banking system in response to the demand for loans in Greece. In a contemporaneous study, Howells and Hussein (1998) found the endogeneity evidence of money for G7 economies. Nell (2000) also showed that all three theoretical views were empirically present in South Africa for the period 1987-1998. Vera (2001) used the Spanish data for the period 1987-1998 and showed that the money supply is credit driven. Evidence for endogenous money hypothesis was also found for Malaysia in a study done by Shanmugam et al. (2003). Moreover, Lavoie (2005) observed that in Canadian financial system credits rely on a fully endogenous supply of money and the Central Bank engages in tight liquidity policy operations. Haghighat (2011) found supportive evidence of endogenous money hypothesis for Iran. In another study, Tas and Togay (2012) used the data of GCC countries to apply a test of endogenous money supply. Granger causality test results showed that money is endogenous for all GCC countries except Bahrain and Kuwait. Recently, Badarudin et al. (2013) argued that monetary policies adopted by the G7 countries allows for the creation of money supply endogenously via the banking system.

Studies performed by international institutions such as BIS and also by Central Banks provide evidence supporting the endogeneity of money as well. For example, in a BIS (2008) working paper, Disyatat stated that the central bank's main liquidity management duty is to ensure a sufficient supply of balances for the system as a whole to maintain reserve requirements and the proposition that the monetary policy is implemented mainly by controlling quantity aggregates is a pervasive misconception. Another article was comprised in Bank of England's Quarterly Bulletin (2014 Q1). It elaborated on the money creation in England and indicated that most of the money in circulation is created by the commercial banks via lending activities or asset purchase programs. Hence, the Bank of England does not directly control the quantity of either base or broad money.

Similar to the above studies in literature, Çifter and Ozun (2007) tested the monetary transmission mechanism and endogeneity of money supply in Turkey for the sample period 1997-2006. They revealed that Central Bank and the banks could fully accommodate the demand for loans. However, the nature of money supply in Turkey could change significantly in the last decade with the unconventional monetary policy tools. Hence, we investigate the nature of money supply in Turkish economy for the period 2006-2015 by controlling structural changes in monetary base. By applying cointegration and causality tests and

using vector error correction (VECM) and vector auto regressive (VAR) models, we test and provide strong evidence for the endogeneity of money through accommodationist channel of transmission to the Turkish economy.

Data and Methodology

The data sample used in our study is extracted from Bloomberg and the electronic data delivery system of the CBRT. We utilize monthly data over the period of January 2006 to May 2015. Total bank loans (BL), deposits (DEP), monetary base (MB) and the money supply variables (M1, M2, M3) are used in our empirical analysis. All variables are seasonally adjusted where available and transformed to a logarithmic form.

In line with the literature, we employ vector error correction (VECM) and vector autoregressive (VAR) models in our empirical analysis. Johansen (1988) cointegration and Granger (1969) causality tests are applied to determine the causality relationships between variables. In order to check stationarity, we start with an augmented Dickey–Fuller (ADF) unit root test. As a robustness check, Phillips and Perron (1988) test is also used since it is relatively more powerful than ADF test[3]. Next step is to check cointegration between variables. There is no cointegration for the variables, one of which is stationary and the other is nonstationary. However, when the variables are found to be I(1) nonstationary, Johansen cointegration test (1988) is conducted. The optimum lag lengths of the VAR are determined by minimizing the Akaike (1974) and Schwarz (1978) Bayesian Information Criteria (SBC). After selecting the optimal lag length, VAR residual serial correlation Lagrange Multiplier (LM) test is implemented. When there is no cointegration between variables which are I(1) nonstationary, the standard Granger causality test is applied. However, for the cointegrated variables, the causality is checked by using the Vector Error Correction (VECM) model given as follows:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i}\ \Delta y_{t-1} + \sum_{i=1}^{n} \beta_{2i}\ \Delta x_{t-1} + \sum_{i=1}^{n} EC_{\mathrm{t-n}} + \epsilon_t$$

where $\mathrm{y_t}$ is the dependent variable; $\mathrm{x_t}$ is an independent variable; $\mathrm{EC_{t-n}}$ is the error correction term, and ϵ_t is the error term. In this model, the short run causality is found by checking the joint significance of the lagged coefficients of $\beta_{2\mathrm{i}}$ based on a standard Wald test. On the other hand, the long run causality is determined by examining whether the error correction term is significantly different from zero. However, in the presence of non-stationary variables, Wald test statistic does not follow its standard asymptotic chi-square distribution under the null hypothesis. In these cases, Toda and Yamamoto (1995) proposed a procedure for causality testing. After having determined an optimal lag length k with the usual lag selection methods, this procedure requires the estimation of a $(\mathrm{k}+\mathrm{d_{max}})$ th-order of VAR in levels by adding extra $\mathrm{d_{max}}$ lags, where $\mathrm{d_{max}}$ is the maximal order of integration between variables. Thus, a level VAR model augmented by an extra redundant lag is estimated and a Wald test is performed by ignoring the coefficient of the last $\mathrm{d_{max}}$ lagged variables in the model.

Finally, to verify the validity of causal relationships between variables, trivariate VAR model is applied as a robustness check. In the context of trivariate systems, the omission of a third relevant variable in the model can alter the causal inference based on the simple bivariate system. In order to explore the possibility that earlier inferences are invalid, causality test is implemented between variables bank loans (BL), deposits (DEP), monetary base (MB) and money supply (M1, M2, M3) by applying a trivariate VAR model given as follows:

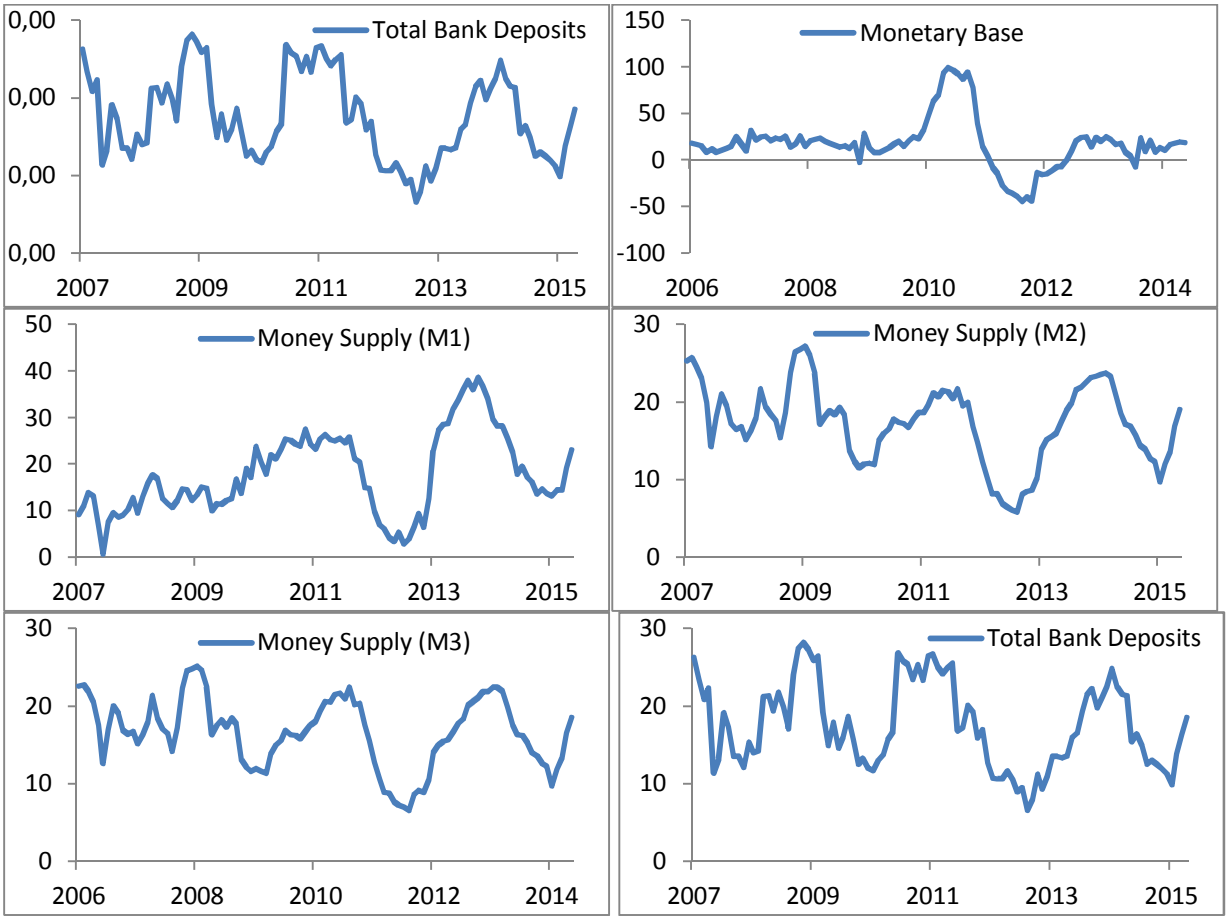
$$\begin{bmatrix} BL_t \\ DEP_t \\ MS_t \end{bmatrix} = \beta_0 + \sum_{i=1}^{k} \left(\beta_{\mathrm{i}} \begin{bmatrix} BL_{t-i} \\ DEP_{t-i} \\ MS_{t-i} \end{bmatrix} \right) + \sum_{j=k+1}^{k+d_{max}} \left(\beta_{\mathrm{j}} \begin{bmatrix} BL_{t-i} \\ DEP_{t-i} \\ MS_{t-i} \end{bmatrix} \right) + \begin{bmatrix} \varepsilon_{BL_t} \\ \varepsilon_{DEP_t} \\ \varepsilon_{MS_t} \end{bmatrix}$$

[3] See Davidson and MacKinnon (1993) for details.

where β_0 is a 3x1 constant vector, β_i and β_j are 3x3 coefficient matrices, and ε is a 3x1 white noise error term vector.

Empirical Findings

We start the empirical analysis with descriptive graphs. Figure 3 exhibits the evolution of all variables over the observation period 2006-2015.



Source: CBRT

Figure 3: Descriptive Graphs (YoY % Change)

The key observation here is that all variables follow an increasing trend. However, we observe a structural break for the monetary base, which is equal to the sum of Turkish Lira in circulation and commercial bank deposits held in the CBRT's reserves. The reason behind the dramatical increase in monetary base at the end of 2010 was the reserve requirement decision of CBRT. With the effect of that decision, commercial bank deposits held in the CBRT's reserves increased rapidly. However, CBRT introduced reserve option mechanism in the following period, which provides banks the option to hold their required reserves in FX or gold. Banks utilized that mechanism by withdrawing some portion of their Turkish Lira reserve requirement, which in turn decreased monetary base. We also check whether this structural break is statistically significant by applying a Chow (1960) Test.

The results given in Table 2 verify that there is a structural break in MB as shown by F-statistic and the log likelihood ratio test value, which are statistically significant at %1 level. Accordingly, monetary base series is divided into two parts. The split series are labelled as follows: MB1 (January 2006 – November 2010) and MB2 (December 2010 – May 2015).

Table 2: Chow Breakpoint Test: 2010 M11

	F-Test		Log Likelihood Ratio	
Equation Sample	**t-statistic**	**P-Value**	**t-statistic**	**P-Value**
2006M01 2015M05	*330,988*	*< 0,001*	*156,138*	*< 0,001*

Secondly, the stationarity of data series is checked with augmented Dickey–Fuller (ADF) and Phillips-Perron unit root tests. The results given in Table 3 show that the null hypothesis, existence of a unit root, could not be rejected for all variables except DEP and MB1 at levels. More specifically, DEP and MB1 are trend-stationary but the remaining variables are nonstationary. Therefore, we detrend DEP and MB1 and take the first difference for the other variables in our empirical analysis.

Table 3: Unit Root Tests

	ADF Test		P-P Test	
Variables	**Lag**	**t-statistic**	**t-statistic**	**Result**
Bank Loans (BL)	*2*	*-4,152****	*-8,457 ****	*I(1) Non-Stationary*
Deposits (DEP)	*0*	*-3,586 ***	*-3,491 ***	*I(0) Trend-Stationary*
MB1	*0*	*-7,061****	*-7,153 ****	*I(0) Trend-Stationary*
MB2	*0*	*-9,722****	*-9,551****	*I(1) Non-Stationary*
M1	*0*	*-10,487 ****	*-10,488****	*I(1) Non-Stationary*
M2	*2*	*-2,465 ***	*-4,793****	*I(1) Non-Stationary*
M3	*0*	*-8,853****	*-8,778****	*I(1) Non-Stationary*

Next, we perform pairwise cointegration tests. There is no cointegration between BL and MB1 since one of them is I(1) nonstationary and the other is trend-stationary. For the remaining variables, Johansen cointegration test results displayed in Table 4 indicate that there exist long run relationships between bank loans and money supply variables. However, the null hypothesis of no cointegration between BL and MB2 could not be rejected based on maximal eigenvalue and trace tests.

Table 4: Johansen Cointegration Test Results

Variables	**Lag**	**Trace**	**Eigenvalue**	**Co-integration**
BL and MB2	*2*	*5,134*	*4,956*	*NO*
BL and M1	*6*	*31,068***	*24,361****	*YES*
BL and M2	*11*	*29,466***	*24,802****	*YES*
BL and M3	*11*	*27,611***	*23,206***	*YES*

Given these findings, we proceed with Granger causality tests for the variables BL, MB1 and MB2, for which we could not find an evidence of cointegrating relationship. The results are summarized in Table 5.

Table 5: Granger Causality Test Results

DV	**INDV**	**Chi-square**	**Conclusion**	**Lag**
BL	MB1	*2,464*	-	*3*
MB1	BL	*14,644****	*BL → MB1*	*3*
BL	MB2	*1,586*	-	*3*
MB2	BL	*8,369***	*BL → MB2*	*3*

We observe short run causality from bank loans to monetary base variables, which is supportive of endogenous money supply.

As a next step, in order to check short and long run causalities between bank loans and money supply variables, VECM tests are implemented. The results of VECM model are given in Table 6. Long run causalities are determined by the significance of error correction term (ECT). Short run causalities are identified by the joint significance of lagged explanatory variables using a Wald Test.

Table 6. Results of vector error correction models

Long Run Coefficients				**Long Run**	**Short Run Coefficients**			**Short Run (Wald Test)**	
DV	**INDV**	**ECT**	**t-stat**	**Conclusion**	**DV**	**INDV**	**Chi-square**	**Conclusion**	**Lag**
BL	**M1**	*-0,019*	*-1,052*	--	**BL**	**M1**	*3,308*	--	*4*
M1	**BL**	*0,067*	*2,659****	*BL → M1*	**M1**	**BL**	*12,869***	*BL → M1*	*4*
BL	**M2**	*-0,033*	*-1,121*	--	**BL**	**M2**	*5,847*	--	*3*
M2	**BL**	*0,026*	*1,641**	*BL → M2*	**M2**	**BL**	*52,236****	*BL → M2*	*3*
BL	**M3**	*-0,034*	*-1,182*	--	**BL**	**M3**	*6,331**	*M3→ BL*	*3*
M3	**BL**	*0,029*	*1,701***	*BL → M3*	**M3**	**BL**	*52,860****	*BL → M3*	*3*

Main observations from Table 6 are: the speed of adjustment of money supply to bank loans, which is measured by the coefficient of ECT, varies from 2.6% to 6.7%. In other words, money supply reacts with a deviation from long run relationship between 2.6% for M2 to 6.7% for M1. In addition, long run causality from bank loans to money supply variables provides evidence for the endogeneity in a sense that CBRT and the commercial banks fully meet the demand for money. Moreover, Wald test results suggest that the long run causalities from bank loans to M1 and M2 also hold in the short run. However, we observe a bidirectional causality between bank loans and M3 in the short run, which indicate that liquidity channel has also an effect on endogenous money supply.

Finally, we apply trivariate VAR model of Toda and Yamamoto (1995) in order to check the robustness of earlier inferences between bank loans and money supply. For this purpose, we incorporate deposits (DEP) as a third variable to our model. The underlying reason behind this choice is that bank deposits may have an impact on both bank loans and money supply, which may drive our earlier inferences. Also, we examine bivariate causalities between deposits and the other variables. The results are summarized in Table 7. First observation from trivariate VAR model is that causalities between bank loans and the money supply variables are preserved in the new framework as well. This result confirms the robustness of above findings. Second, we observe a bidirectional causality between bank loans and deposits, which is an expected result due to the accounting operations of commercial banks. Moreover, the observed causality from bank loans to deposits together with the causality from deposits to money supply approve also the endogenous nature of money in Turkey.

Table 7. Trivariate VAR results

DV	**INDV**	**Result**	**DV**	**INDV**	**Result**	**DV**	**INDV**	**Result**
BL	DEP	*DEP→ BL*	BL	DEP	*DEP→ BL*	BL	DEP	*DEP→ BL*
BL	M1	---	BL	M2	---	BL	M3	*M3→ BL*
BL	DEP&M1	*DEP → BL*	BL	DEP&M2	*DEP → BL*	BL	DEP&M3	*DEP → BL*
DEP	BL	*BL→ DEP*	DEP	BL	*BL→ DEP*	DEP	BL	*BL→ DEP*
DEP	M1	----	DEP	M2	----	DEP	M3	----
DEP	BL&M1	*BL→ DEP*	DEP	BL&M2	*BL→ DEP*	DEP	BL&M3	*BL→ DEP*
M1	BL	*BL → M1*	M2	BL	*BL → M2*	M3	BL	*BL → M3*
M1	DEP	*DEP → M1*	M2	DEP	*DEP → M2*	M3	DEP	*DEP → M3*
M1	BL&DEP	*BL → M1*	M2	BL&DEP	*BL→M2*	M3	BL&DEP	*BL→M3*

Conclusions

In this study, we empirically test the endogenous money supply hypothesis for the Turkish economy. Using time series data for the period 2006-2015, we employ Johansen cointegration and Granger causality tests between total bank loans, monetary base and money supply variables. The empirical evidence is strongly supportive of the hypothesis that money supply is loan-driven and demand-determined in Turkey. More specifically, loans granted by banks to meet the public demands for money construct the basis for money supply. For robustness check, we also include deposits to our empirical analysis. Endogenous nature of money supply still exists and the deposits are found to be significant in our framework. Our findings suggest that the impact of bank loans on the monetary transmission mechanism should be taken into consideration for a proper formulation of monetary policy.

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