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Examination of money supply endogeneity in Turkey: Evidence from asymmetric causality test

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Abstract: In this study, we examine the money supply endogeneity in Turkish economy for the post crises period, between 2009.10 and 2016.12 by employing asymmetric causality test. Our results reveal that a positive credit shock will cause a positive shock in the money supply. That is, an increase in banking sector credit volume will cause an increase in money supply. However, such a causal impact for negative shocks is not found. Our findings show that the causality runs from bank loans to money supply for the positive components so credit cuts may not initiate a fall in money supply.

Subjects: Macroeconomics; Monetary Economics; Econometrics

Keywords: Money supply endogeneity; granger causality; asymmetry
Subjects: E12; E41; E42; E52; G21

1. Introduction

Theory of money supply is a key subject in economics with a dynamic literature. In his book *A Treatise on Money* (1930), Keynes points out that banks' money is created via debt. According to Keynes, the money (i.e. credit) that banks can securely create is unlimited (Keynes, 1930). He suggests that the credit demand of firms stemming from their capital requirements has an impact on the money supply. However, contrary to *A Treatise on Money* (1930) previous book, in *General Theory* (1936) Keynes focused on the situations in which monetary policy is not effective (i.e. liquidity trap). In this analysis, he defined the money supply as being directly determined by the actions of the monetary authority (Heron & Tarik, 2006). Later, Hicks (1937) based his analysis on *General Theory*: Money supply is treated as a quantity that is determined exogenously in the IS-LM analysis, and his view dominated the literature on money supply from neoclassical synthesis to monetarists. According to this mainstream view of money supply, central banks play a key role in the money supply process; accordingly, the money supply is assumed to be exogenous. This approach assumes that the central bank has full control over the monetary base,[1] which implies that the money multiplier [2] is stable. In other words, the central bank is able to control the monetary base exogenously to achieve the targeted money supply levels (Palley, 1998). On the other hand, according to the post-Keynesian view, the interactions between loan demand and bank lending practices determine

PUBLIC INTEREST STATEMENT

Understanding the money supply creation process is important for proper macroeconomic policy designation and implementation. According to the mainstream view, the central bank has full control over the money supply, whereas the post-Keynesian view propounds the role of bank loans on the determination of the money supply (endogeneity). The way of money supply creation process is crucial with regard to the implementation of explicit inflation targeting policy in an emerging country like Turkey. Many recent studies have proved that the relationship between many macroeconomic variables is nonlinear and asymmetric. This study, therefore, analyses the endogeneity of money supply for Turkey considering the asymmetry issue. The results showed that the effect of credits on money supply is not symmetric. The implication of the results is that credit cuts may not initiate a fall in money supply.

the money supply. In this approach, both commercial banks and the central bank contribute to the money supply process. Commercial banks grant loans and deposits have increased; consequently, central banks have accommodated all increases in demand for central bank money. The post-Keynesian endogenous money supply process has been studied under different views, such as the horizontalist, structuralist, and liquidity preference views. According to the horizontalist view, loans create deposits. This view implies that there is a unidirectional causality running from loans to monetary aggregates. In contrast, according to the structuralist and liquidity preference views, the causality between loans and monetary aggregates is bidirectional.

Examination of the literature reveals that the research on the endogeneity of money supply has extended to a broader research area by including household credits (Howells & Hussein, 1998). In addition, there is a related strand of literature investigating the relationship between credit and inflation (Atta-Mensah & Dib, 2008; Bikker, 2004; Gambetti & Musso, 2017; Groen, 2004; among others). The literature on credit-driven endogenous money supply is based on the idea of combining the Keynesian Phillips curve approach, which explains inflation through aggregate demand, and the mainstream approach, which explains inflation through the quantity of money. When consumption or investment expenditures are financed by credit, aggregate demand and money supply increase simultaneously.

The determination of the money supply is a tremendously important topic for proper macroeconomic policy designation and implementation. Turkey has been implementing explicit inflation targeting since 2006. The endogeneity issue is crucial with regard to the implementation of such a policy in an emerging country like Turkey. Hence, demonstrating the causality running from credit to money supply is crucial for an inflation-targeting central bank with regard to expectation formation. Because central banks are able to monitor the movements in bank credits almost simultaneously, they can foresee how the tendencies in these movements affect the money supply, and so inflation, and in what way. Accordingly, they conduct credit growth through adjusting the cost of making loans using tools such as policy rate and reserve requirement ratio.

The endogeneity of money supply makes the inflation-targeting strategy harder. However, because change in credit is the basic driver of money supply, credit movements would provide information about inflation to the monetary authority. The credit target set by the Central Bank of Turkey in 2011 is a measure used for this situation. The principal objective of this study is to investigate the money supply endogeneity in Turkey over the post-crisis period between 2009 and 2016.

Although the endogeneity of the money supply is the subject of a large number of theoretical studies, the number of empirical studies is rather limited. There are limited numbers of studies concerning emerging countries, especially Turkey. To the best of our knowledge, the literature that investigates the endogeneity issue mostly uses Granger causality or non-causality tests based on the traditional linear vector error correction (VECM) and vector autoregressive (VAR) models. Our study differs from previous studies in that, in this study we examine the endogeneity of money supply in Turkey through the use of the asymmetric version of the causality test (Granger, 1980), which is based on the VAR system, as proposed by Hatemi-J (2012), which allows for asymmetry in the relationship between variables. The asymmetry in the determination of the money supply may be an important topic for proper macroeconomic policy designation and implementation for a country such as Turkey. The main advantages of the method are as follows: First, it allows asymmetric causal effects, which better approximate the real world by separating the causal effects of positive shocks from those of negative shocks. However, the asymmetric causality test of Hatemi-J (2012) enables the full separation of the causal impacts of the positive alterations from the negative ones. Secondly, this test performs well when the sample size is small, the underlying data set is non-normally distributed, and

time-varying volatility (autoregressive conditional heteroscedasticity) is present. In addition, this study contributes to the research gap in the quantitative literature on money supply endogeneity.

The rest of the article is organized as follows. Section 2 presents brief information about recent Turkish monetary policy developments. Section 3 gives literature review. Section 4 describes the data. Section 5 presents the methodology. Section 6 provides the empirical results. Section 7 presents the concluding remarks.

2. Brief review of recent Turkish monetary policy developments

Following the 1999 stabilization program under the consultancy of the International Monetary Fund (IMF), Turkey adopted a stabilization policy based on the crawling exchange rate peg in 2000, and this resulted in twin (currency and banking) crises. The Central Bank of the Republic of Turkey (CBRT) responded to the crisis by unavoidably allowing the Turkish Lira to freely float in February 2001. Subsequently, in April 2001, The Central Bank Law was amended to ensure the independence, accountability, and transparency of the Central Bank and to give the CBRT the primary objective of price stability along with financial stability. Because the direct financing of budget deficits using CBRT sources was considered as the main reason behind the money growth and inflation linkage since the 1960s (Yilmaz, Akçay, & Alper, 2002), the new law (Law 4651) prohibited CBRT from granting advances or extending credits directly to the treasury and to the other public institutions and establishments (Kara, 2008). Moreover, this process was accommodated by the primary surplus policy of the government to limit debt accumulation (Sener, 2011). Coincidentally, in May 2001, Turkey adopted a new stabilization program called "Turkey's Transition Program: Strengthening The Turkish Economy" to achieve macroeconomic stability (Özatay, 2005). The program also included a strategy designed to rescue the collapsed banking sector. Unfortunately, this strategy inevitably led to *fiscal dominance*, i.e. an additional increase in public debt-to-GDP ratio, and placed constraints on the implementation of monetary policy. Therefore, in order to create a suitable environment for the adoption of an explicit fully fledged inflation-targeting regime, contractionary fiscal policy was considered as a necessary condition for Turkey. Thus, in the period between 2002 and 2006 prior to the explicit inflation-targeting regime, CBRT implemented an implicit inflation-targeting regime (Ersel & Özatay, 2008) and targeted the monetary base as a nominal anchor under the floating exchange rate regime (Keyder & Ertunga, 2012). At the beginning of 2006, CBRT moved from implicit inflation targeting to fully fledged inflation targeting.[3] After this policy shift, instead of focusing on monetary base targets, CBRT began setting the inflation targets directly (Ozsuca & Akbostanci, 2013). In the period from 2006 to 2010, CBRT practiced a conventional inflation-targeting framework in which the main tool was the policy interest rate. In addition, with the purpose of dampening FX volatility and accumulating FX reserves, CBRT intervened in the FX market (Alper, Kara, & Yörükoğlu, 2013). In the aftermath of 2008, a zero lower bound interest rate and Quantitative Easing (QE) policies of Federal Reserve (FED) triggered a new episode of capital flows to emerging market economies. In this low-interest environment, Turkish commercial banks preferred to borrow from foreign money markets and lend to the domestic market. This action in turn increased domestic credit growth. These developments put appreciation pressure on the Turkish Lira and forced the CBRT to accumulate more reserves. Since traditional interest rate policy failed to achieve price and financial stability[4] simultaneously, CBRT diversified its policy tools and adopted an unconventional approach instead of the conventional inflation-targeting regime (Kara, 2013). As of 2011, the current account deficit ratio to GDP corresponded to approximately 9% and the ratio of net credit use to GDP exceeded 14% with a really high credit growth rate (44%). It was clearly evident that the current account deficit and change in bank credits tended to move together. Thus, CBRT determined a 15% threshold for the credit growth rate to achieve a sustainable current account deficit and to avoid a potential increase in inflation. To reduce the credit growth rate, CBRT preferred to increase the required reserve ratio instead of increasing the policy interest rate because increasing the policy interest rate would likely stimulate more

capital inflow, which in turn potentially deteriorates the current account via currency appreciation. After the CBRT gradually increased the required reserve ratio for Turkish Lira liabilities, the credit growth rate tended to decrease in the second quarter of 2011 Alper, Binici, Demiralp, Kara, and Özlü (2014). In the same period, policy instruments such as an interest rate corridor and the reserve option mechanism (ROM) were employed to absorb the shocks to reduce the need for FX intervention (Alper et al., 2013). The interest rate corridor lies between the overnight borrowing rate and the lending rate, and the 1-week repo interest rate fluctuates within the intervals of the corridor as a policy interest rate. The corridor strategy enables CBRT to change the short-term market interest rate (i.e. overnight interest rate) quickly without any official change in policy interest rate. With this tool, interbank market rates and the weighted average cost of central bank funding are changed on a daily or weekly basis, if necessary[5] (Alper et al., 2014). CBRT borrows from banks that have excess liquidity and lends money to banks that are short of liquidity. It is worth noting that the most important feature of the asymmetric interest rate corridor is its flexibility (Alper et al., 2013). As an additional reserve requirement tool, ROM allows banks to hold a part of their reserve requirements for Turkish Lira deposits in FX or gold. The amount of FX or gold corresponding to one unit of TL reserve is called the reserve option coefficient (ROC) (Aslaner, Çıplak, Kara, & Küçüksaraç, 2014). The ROM mechanism can be considered as an automatic stabilizer or an alternative tool to traditional FX intervention strategies. The main purpose of ROM is to reduce excessive capital flows. During periods of strong capital inflows because of the relatively high opportunity cost of holding TL reserves, banks would rather use the ROM. An increase in the ROM utilization ratio would be a sign of more capital inflow, thereby holding more FX in the central bank accounts helps prevent appreciation of the domestic currency. Conversely, during periods of capital outflow, the cost of FX borrowing would be relatively higher than the cost of domestic currency borrowing. Thus, banks would decrease the ROM usage and decrease the portion of FX that is held as required reserves in the bank's account at the central bank. This additional FX supply may help lower depreciation pressure on the domestic currency. The new instruments helped CBRT to control the effects of excess capital flows and to reduce the impact of credit growth and their effects on the current account balance.

3. Literature review

The ideas of Keynes (1930, 1936, 1972)) provided a base ground for the emergence of endogeneity of money supply process. Jacques Le Bourva set out the present theory of endogenous money (Lavoie, 1992; Moore, 1983) and provided foundation of money supply endogeneity in Jacques Le Bourva (1959), Bourva (1962)).

Several studies in the empirical literature investigated the nature of money supply for different countries, time periods, and data types using different methods. These studies aim at revealing the endogenous nature of the money supply process empirically. One of the important empirical studies in deciding the endogeneity nature of money supply is (Kaldor, 1982) empirically investigated endogeneity of money supply for the UK over the period between 1966 and 1979 by employing the Ordinary Least Square (OLS) method. He found evidence for the endogeneity of money supply for UK. The findings indicate that the demand for bank lending determines money supply. In another early empirical study Moore (1983) analyzed money supply endogeneity for the USA over the period between using Granger causality analysis. He indicates that bank lending has a relatively high degree of explanatory power. Pollin (1991) examined the endogeneity of money supply using monthly USA data over the period between 1953 and 1988. He found evidence in favor of the structural view. (Palley, 1998) analyzed the endogeneity issue for the USA over the period between 1973 and 1990. The findings of the study indicate that money supply is endogenous in the USA, supporting the structural view.

More recent evidence increasingly favors the endogenous view. Examination of the literature reveals that researchers analyze the relationship using monthly, quarterly, or annual data. (i.e. Cepni & Guney, 2017; Howells & Hussein, 1998; Nishiyama, 2014; Pollin, 1991; Tas & Togay, 2012; Vera, 2001. In addition, the majority of the studies used regression, cointegration, vector auto regressive model-based approaches such as the standard vector autoregressive model, autoregressive distributed lag model, Granger causality, as well as Toda and Yamamoto non-causality (i.e. Cepni & Guney, 2017; Howells & Hussein, 1998; Kaldor, 1982; Nishiyama, 2014; Tas & Togay, 2012 among others). Furthermore, there are studies that utilize panel data framework (i.e. Nayan, Kadir, Abdullah, & Ahmad, 2013 among others). Some of the studies provide evidence for the endogeneity of money supply for different countries (i.e. Cepni & Guney, 2017; Kingdom & Elhendawy, 2016 among others). Another group of studies reports the exogeneity of money supply, (i.e. Luo, 2013; Seyrek, Duman, & Sarıkaya, 2004 among others). A third group of studies divides the relationship into short run and long run and some of them report significant long-run relationship between money supply and relevant variables (i.e. Lopreite, 2012; Schady, 2012 among others). In order to preserve space, a detailed list of studies presenting the data period, method, variables, and result of the relevant studies belonging to this literature is provided in Appendix A1 in the appendix section.

4. The data

We chose the sample period in this study based on two considerations. First, our aim was examining the endogeneity of money supply over post crises-period. The recession period in Turkey is determined to be in 2008m7 to 2009m9,[6] accordingly the post-crisis period is assumed to start by 2009m10. Second, the beginning of the study period precedes the phase where CBRT adopted its unconventional approach in place of orthodox inflation targeting regime. In this study, we used the available monthly data covering the period 2009m10-2016m12. In our empirical analysis, total bank loans (BL), deposits and the money supply variables M2 are used. All variables are in logarithmic form. The descriptive statistics are provided in Table A2.

5. Methodology

In Granger causality analysis researchers test whether the past values of a variable improve the forecast of another variable or not. The general wisdom in the literature is testing the Granger causality using the methods which base on the supposition that the causal impact of positive shocks negative shocks are similar. Hatemi-J (2012) suggests constructing the positive and negative shocks using the cumulative sums of the underlying shocks, which was first proposed by (Clive W. J. Granger & Yoon, 2002). In this article, we are interested in testing for causality between variables BL and M. Given that BL and M difference stationary, they can be presented as random walk processes as follows:

$$BL_t = BL_{t-1} + \varepsilon_{1t} = BL_0 + \sum_{i=1}^{t} \varepsilon_{1i} \tag{1}$$

$$M_t = M_{t-1} + \varepsilon_{1t} = M_0 + \sum_{i=1}^{t} \varepsilon_{2i} \tag{2}$$

Where $t = 1.2.3\ldots., T$. BL_0 and M_0 are the initial values. ε_{1t} and ε_{2t} are the white noise error terms. Identification of the positive and negative shocks is as follows: $\varepsilon_{1i}^{+} = \max(\varepsilon_{1i}, 0)$, $\varepsilon_{2i}^{+} = \max(\varepsilon_{2i}, 0)$,$\varepsilon_{1i}^{-} = \min(\varepsilon_{1i}, 0)$, $\varepsilon_{2i}^{-} = \min(\varepsilon_{2i}, 0)$. Thus each shock can be expressed as the sum of negative and positive parts as the following: $\varepsilon_{1i} = \varepsilon_{1i}^{+} + \varepsilon_{1i}^{-}$, $\varepsilon_{2i} = \varepsilon_{2i}^{+} + \varepsilon_{2i}^{-}$.

$$BL_t = BL_{t-1} + \varepsilon_{1t} = BL_0 + \sum_{i=1}^{t} \varepsilon_{1i} = BL_0 + \sum_{i=1}^{t} \varepsilon_{1i}^{+} + \sum_{i=1}^{t} \varepsilon_{1i}^{-}$$

$$M_t = M_{t-1} + \varepsilon_{1t} = M_0 + \sum_{i=1}^{t} \varepsilon_{2i} = M_0 + \sum_{i=1}^{t} \varepsilon_{2i}^{+} + \sum_{i=1}^{t} \varepsilon_{2i}^{-}$$

Finally, the positive and negative shocks of the variables can be expressed as cumulative sums (Positive and negative components).

$$BL_t^{+} = \sum_{i=1}^{+} \varepsilon_{1i}^{+}, \quad BL_t^{-} = \sum_{i=1}^{-} \varepsilon_{1i}^{-}$$

$$M_t^{+} = \sum_{i=1}^{+} \varepsilon_{2i}^{+}, \quad M_t^{-} = \sum_{i=1}^{-} \varepsilon_{2i}^{-}$$

These positive and negative components can be used to test the asymmetric causality between the variables by constructing a VAR model.

The VAR of order L can be presented as follows:

The VAR models of order L for both negative and positive parts can be written in the following way:

$$y_t^{+} = \upsilon + A_1 y_{t-1}^{+} + \ldots + A_L y_{t-L}^{+} + u_t^{+}$$

$$y_t^{-} = \varsigma + A_1 y_{t-1}^{-} + \ldots + A_L y_{t-L}^{-} + u_t^{-}$$

y_t^{+}: The vector containing the positive parts of the variables.

y_t^{-}: The vector containing the negative parts of the variables.

y_t^{+} and y_t^{-} are 2×1 vector of the positive (BL_t^{+}, M_t^{+}) and the negative parts (BL_t^{-}, M_t^{-}) of the variables, respectively. υ and ς are 2×1 vector of intercepts, u_t^{+} and u_t^{-} 2×1 vector of error terms. A_r^{+} and A_r^{-} are 2×2 matrix of parameters for lag order r where $r = 1, \ldots, p$

The null hypothesis for non-Granger causality for positive and negative parts is given as follows:

H_0: the row m, column n element in A_r^{+} equals zero for $r = 1, \ldots, p$. (The null for the positives)

H_0: the row m, column n element in A_r^{-} equals zero for $r = 1, \ldots, p$. (The null for the negatives)

The null of non-Granger causality is tested using the Wald statistic.[7] The Wald statistic follows an asymptotic χ^2 distribution with p degrees of freedom. In the presence of non-normality and time-varying volatility bootstrap simulation technique is employed as a remedy.[8]

6. Empirical results

Prior to the asymmetric causality analysis we conducted the standard causality testing procedure. In the first step of the analysis we conduct ADF and PP unit root tests. We found evidence that each of the series is difference stationary at 1% level of significance. The unit root test results are presented in Table 1.

After assessing the nonstationarity of the series we further conducted cointegration analysis using the VAR-based Johansen cointegration approach (Johansen, 1988). According to the results provided in Table 2, both trace and maximum Eigenvalue statistics exceed the critical values at conventional significance levels. We conclude that series are cointegrated.[9]

In the next step, we set up the vector error correction model. The results are provided in Table 3. According to Table 3, for the specification in which M2 is the dependent variable, error correction term denoted by δ is negative and significant. This is an indicator for long-run causality running from bank loans to money supply. In addition θ_1 and θ_2 are jointly different

Table 1. Unit root test results

	ADF	PP
	t-Statistic	t-Statistic
M2	−2.361[12]	−2.624
ΔM2	−3.227[12]*	−9.148***
BL	−2.397[3]	−1.517
ΔBL	−8.018[0]***	−8.064***

*** denotes significance at 1% level. For the case with constant, critical values for ADF test are −3.51, −2.89, −2.58 for 1 %, 5 %, and 10 % significance levels, respectively. For the case with constant and trend, critical values for ADF test are −4.06, −3.45, and −3.15 for 1 %, 5 %, and 10 % significance levels, respectively. The critical values for the ADF t-statistics are from the (Mackinnon, 1996) table. The critical values for the Phillips–Perron test are the same as those for the augmented Dickey–Fuller Test. The numbers in the parentheses of ADF are appropriate lag lengths selected by SIC. Max lag length is set to 12.

Table 2. Johansen cointegration test results

Test		Critical value		
		10%	5%	1%
λ_{trace}				
$r = 1$	0.119	2.706	3.841	6.635
$r = 0$	33.208***	13.429	15.495	19.937
λ_{max}				
$r \leq 1$	0.119	2.706	3.841	6.635
$r = 0$	33.089***	12.297	14.265	18.520

Notes: ***,**, and * denote significance at 1%, 5%, and 10% level. Max lag length is set to 12 and lag length is determined to be 2 according to AIC.

Table 3. Results of vector error correction models

	M2		BL	
Item	Estimate	t-stat	Estimate	t-stat
θ	0.008	2.773***	0.018	5.518***
α_1	−0.350	−2.377**	0.034	0.206
α_2	−0.164	−1.1497	0.084	0.530
β_1	0.429	3.256***	0.095	0.650
β_2	0.136	0.993	−0.088	−0.583
δ	−0.003	−1.930*	0.005	2.894***
R^2	0.126	_	0.158	_
AIC	−6.045	_	−5.839	_
SIC	−5.871	_	−5.665	_
SC_LM	3.779 [0.151]	_	2.18[0.336]	_
BPG	4.337[0.631]	_	6.004[0.423]	_
$J - B$	1.366[0.505]	_	1.541[0.463]	_
$H_1 : \alpha_1 = \alpha_2 = 0$	_	_	0.285[0.867]	_
$H_2 : \beta_1 = \beta_2 = 0$	10.943[0.004]	_	_	_

Notes: ***, **, and * denote significance at 10%, 5%, and 1% level. The numbers in the brackets are *p*-values. AIC: Akaike Information Criteria, SIC: Schwarz Information Criteria, SC_LM: Serial Correlation LM test statistic (Chi square-stat), BPG: Breusch Pagan Godfrey Heterosticedasticity test statistic(χ^2—stat). The lag length of 2 is determined using AIC. H_1 : BL does not Granger cause M2 in the short-run, H_2 : M2 does not Granger cause BL in the short-run.

than zero. This is a sign for short-run monetary endogeneity. The model is free of serial correlation and heteroscedasticity. In addition, residuals are normally distributed. For the second specification where BL is the dependent variable we conclude that there is no short-run or long-run causality running from M2 to BL.

To crosscheck our results we also applied Toda and Yamomoto procedure. The results are provided in Table 4. We reject the null hypothesis of BL does not Granger cause M2, however, we cannot reject the opposite hypothesis.

After obtaining empirical evidence in favor of money supply endogeneity for the post-crisis period in Turkey using standard methods we further analyzed the endogeneity issue using asymmetric causality procedure of Hatemi-J (2012). We began our analysis by conducting a battery of diagnostic and specification tests and the results for the VAR model are shown in Table 5. The null hypothesis of no serial correlation and no multivariate autoregressive conditional heteroscedasticity is rejected for three cases. Thus, it is important to make use of the bootstrap test to obtain reliable critical values for the causality tests and correct inference.

The results of the symmetric and asymmetric causality tests are presented in Table 6. Based on the symmetric causality test results, the null hypothesis that BL do not Granger-cause the M2 is rejected at 1% significance level. This is also the case for positive cumulative BL shocks. In addition, the null hypothesis that negative component of BL does not Granger-cause the positive component of M2 is rejected at 10% significance level. The null of no Ganger causality cannot be rejected for the remaining seven cases.

7. Conclusion

The empirical goal of this study is to investigate the money supply endogeneity in Turkey over the post-crisis period of 2009 to 2016. We use a recently developed test by Hatemi-J (2012) that allows for asymmetries in the causality testing. The results reveal that a positive credit shock will cause a positive shock on the money supply. This means if banking sector credit volume increases, then the money supply will also increase. However, we cannot find such a causal impact for

Table 4. Toda and Yamomoto Granger non-causality test

Null Hypothesis	MWALD χ^2 Test Statistic
BL ≠> M2	10.831***
M2 ≠> BL	0.342

Notes: *** denotes significance at 10% level. The denotation BL ≠> M2 means that variable BL does not Granger cause M2. Maximum lag is set to 12.

Table 5. Diagnostic and specification test results for the VAR model

Variables in the VAR model	Multivariate normality	Multivariate ARCH
(M2,BL)	0.000	0.014
(M2+,BL+)	0.000	0.041
(M2-,BL-)	0.827	0.155
(M2+,BL-)	0.157	0.153
(M2-,BL+)	0.009	0.0162

Notes: The provided values are *p*-values for multivariate normality and multivariate ARCH tests. The optimal lag order in the VAR model is one and was selected based on the minimization of the HJC information criterion. Maximum lag length is set to 12. The (Doornik & Hansen, 2008) statistic is applied to test the null hypothesis of multivariate normality. A test provided by (Scott Hacker & Hatemi-J *, 2005) was implemented for the multivariate ARCH effects using the statistical software produced by Hacker and Hatemi-J. The number of bootstrap simulations is set to 10,000.

Table 6. Asymmetric causality test results

Null Hypothesis	MWALD Test Value	Critical Value		
		1%	5%	10%
BL ≠> M2	8.860***	7.336	4.082	2.82
M2 ≠> BL	0.021	7.224	4.187	2.89
BL+ ≠> M2+	12.441***	7.053	3.989	2.806
M2+ ≠> BL+	0.171	7.2	3.967	2.782
BL- ≠> M2-	0.145	12.164	4.688	2.388
M2- ≠> BL-	0.021	15.414	5.565	2.759
BL+ ≠> M2-	0.208	7.271	3.947	2.766
M2- ≠> BL+	2.379	7.732	4.131	2.89
BL- ≠> M2+	3.627	6.474	3.703	2.64
M2+ ≠> BL-	0.049	7.052	3.877	2.74

Notes: *** and ** denote significance at 1% and 5%. The denotation BL ≠> M2 means that variable BL does not cause M2. CV stands for critical value. The optimal lag order in the VAR model is one and was selected based on the minimization of the HJC information criterion. Maximum lag length is set to 12. The critical values are bootstrapped critical values. The number of bootstrap simulations is set to 10,000.

negative shocks. The monetary authority may intervene by taking action during times of positive credit growth. On the contrary, in the periods when credit growth slows down, there is no conclusion as to whether it is necessary to implement an expansionary policy by decreasing interest rates. In other words, credit cuts may not initiate a fall in money supply.

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Notes

1. Monetary base comprises the liabilities of the Central Bank.
2. $\text{MoneyMultiplier} = \frac{\text{moneysupply}}{\text{monetarybase}}$
3. The inflation targeting regime is based on the idea that the main source of inflation is excess demand and it tries to manage the components of aggregate demand through changing interest rates (Ersel & Özatay, 2008). Furthermore, the exchange rate pass-through to inflation might be another key factor to explain Turkey's post 2001 episode. Besides, there is supporting evidence about the role of supply side factors, such as the price of oil and global intermediate goods.
4. The main indicators of financial instability are credit growth rate and exchange rate volatility.
5. CBRT changes the amount of liquidity and interest rates on the interbank money market by altering the weights of daily and weekly funding.
6. Pagan (2010) determines the recessions in Turkey using BBQ method. He uses quarterly GDP data over the period 1987Q4-2010Q1. (Pagan, 2010) finds six recessions which are; 1988Q4-1989Q2, 1991:Q1-1991:Q2, 1994:Q2-1995:Q1, 1998:Q4-1999:Q4, 2000:Q12001:Q4 and 2008:Q4-2009:Q3. In line with Pagan (2010) (Kaya, 2013) employs the BBQ method to determine recessions in Turkey over the period of 1986:M1 to 2011:M8 using monthly data. Kaya (2013) finds five recessions over the given period. 1988M8-1989M4, 1994:M1-1995:M3, 1998:M9-1999:M11, 2001:M12-2002:M02, 2008:M7-2009:M9.
7. For the details of the calculation please see (Hatemi-J, 2012)
8. For the steps and details of the bootstrap method please see (Hatemi-J, 2012). Hatemi-J (2012) stated that causality tests based on the bootstrap distribution have better size and power properties in comparison to the counterparts based on asymptotic distributions.
9. Hatemi-J (2012) mentioned that according to (Toda & Yamamoto, 1995) cointegration is not a prerequisite for causality testing between integrated variables within the VAR framework as long as the model is augmented by the additional unrestricted lags.

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Appendix

Appendix.A1. Empirical literature on money supply endogeneity

Author(s)/Publication Year	Data Period and Frequency	Econometric Method(s)	Variables Included in the Model	Empirical Results
(Howells & Hussein, 1998)	Quarterly, 1957(1) to 1992(4): Canada, Italy, Japan, and the USA. 1969(1) to 1992(4) Germany. 1977 (4) to 1992(4): UK. 1975(1) to 1993 (4): France	Cointegration, Granger Causality	Broad measures of money and the lending counterparts. M2 (Canada, Italy, and USA); M3 (Germany, France, and Japan). UK M4 (UK),	For G7 economies money is endogenous.
(Panagopoulos & Spiliotis, 1998)	Quarterly: 1971Q1 to 1993Q2	Engle and Granger and Johansen cointegration Error Correction model	The actual nominal stock of bank lending to IHT firms	Supports the accommodationist view. Credit money was primarily determined by the banking system in response to the demand for loans in Greece
(Günal, 1999)	1987–1997	Johansen Cointegration	The bank loans granted to the private and the public sector, the various money supply definitions	Money supply is endogenous in Turkey
(Işık, 2000)	Quarterly:1987Q1-1999Q4	VAR, Granger Causality	Total loans, monetary base and money multiplier	Supports the structural endogeneity approach.
(Nell, 2000)	Quarterly: 1966Q1-1997Q4	Granger causality, ARDL, Johansen cointegration, Error correction mechanism	Total bank credits, monetary base (currency and reserves held by commercial banks), M3, money multiplier, money income (nominal GDP)	Showed that all three theoretical views were empirically present in South Africa for the period 1987–1998.
(Vera, 2001)	Monthly: 1987:01–1998:10	Granger causality, the autoregressive distributed lag model	Monetary base, M1 money multiplier (M1/B), M2 money multiplier (M2/B), M3 money multiplier (M3/B), loans (L)	Money supply is credit driven. Bank lending causes money supply and money is endogenous in Spain.
(Karaduman, 2003)	Quarterly: 1987–2002	Granger Causality	Bank loans, money supply, monetary base	Money supply is endogenous in Turkey

(*Continued*)

Appendix.A1. (*Continued*)

Author(s)/Publication Year	Data Period and Frequency	Econometric Method(s)	Variables Included in the Model	Empirical Results
(Shanmugam, Nair, & Li, 2003)	Quarterly: 1985Q1 to 2000Q4	Granger Causality, Cointegration, Error Correction Mechanism	Total commercial bank loans, monetary base, M3 money supply, M3 money multiplier, nominal GNP (money income)	Money supply is endogenous in Malaysia
(Seyrek et al., 2004)	1968–1996	SEM based exogeneity test	Money supply, total credits, interest rates, price changes and changes in GNP	Money supply is exogenous in Turkey
(Panagopoulos & Spiliotis, 2006)	Monthly: 1975.01–1998.02	VAR, Granger Causality	Industrial production index, the high powered money (monetary base, MB), the narrow money (M1) and two broad money variables (M3, M4).	Money in Greece is endogenously determined. M3 and M4 Granger cause MB.
(Cifter & Ozun, 2007)	Monthly: 1997.01–2006.06	The vector error correction model based causality test	Reserve Money, Emission, Monetary Base, Credit Capacity, Real exchange rate, Industrial Production Index, Interest, Manufacturer Price Index	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.
(Tokucu, 2008)	Quarterly: 1987:1–2005:4	VAR analysis	Credits granted to private sector, money supply, monetary base	There is a causality relation from the loans to the money supply. It suggests that the money supply is endogenous in Turkey.
(Işık & Kahyaoğlu, 2009)	Quarterly: 1987:1–2007:3	VAR analysis	Credit stock of the banking sector, monetary base	In Turkey money is perfectly endogenous
(Rachma, 2010)	Monthly: 1997.05–2010.06	VAR, Granger Causality	Base money, narrow money, broad money supply, consumer price index, industrial price index	Money supply is endogenous in Indonesia
(Özgür, 2011)	Quarterly:1987Q1-2009Q2	Cointegration, Vector error correction model(VECM)	Bank loans granted to private sector, broad money supply (M2, M3, M3A, M2Y ve L0)	There is a long-run relationship between loans and M2, M3, M3A. However, there is no relationship between M2Y and L0.

(*Continued*)

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Appendix.A1. (*Continued*)

Author(s)/Publication Year	Data Period and Frequency	Econometric Method(s)	Variables Included in the Model	Empirical Results
(Haghighat, 2011)	Annual: 1968–2009	Johansen cointegration tests, vector error-correction models (VECM) and Granger causality tests	Bank credit, monetary base, money supply and income	The empirical result is strongly consistent with a post-Keynesian hypothesis that indicates the money supply is endogenous.
(Haghighat, 2012)	1999:02 to 2010:12, logarithmic, Euro area	Vector Autoregression models (VAR) with Granger causality procedure to analyze non-cointegrated series and Vector Error Correction models (VECM) for cointegrated series.	The variables are: loans (L), M1 money supply (M1 t), M2 money supply (M2 t c), M3 money supply (M3) and monetary base (BM t). 2 Following Vera (2001), I decompose money supply into monetary base (BM) and money multipliers (M1_B, M2_B, M3_B). This helps testing the significance of liability management as a source of loan demand accommodation.	The cointegration analyses reveal a bidirectional causality between loans and M1 both in the short and long run, whereas loans cause variations in the M2 mainly in the short run. However, according to Granger causality test there is a one-way causality from loans to M3 but not from loans to industrial production index. The results are confirmed by adjusting the loans series for securitization activity in the Euro Area and partially support the accommodationist view.
(Schady, 2012)	Quarterly: 2000Q1 to 2010Q4	Johansen cointegration, Vector Error Correction Models (VECMs) and Granger causality	Monetary base, domestic credit extension, M3, and gross national product.	Causality between loans and M1 both in the short and long run, whereas loans cause variations in the M2. Money supply is endogenous in South Africa
(Tas & Togay, 2012)	Monthly, quarterly and annual data.	A direct test(IV method) for endogenous money theory along, granger causality	Nominal gross domestic product, Monetary base, Reserve money, Narrow and broad money aggregates (M1 and M2), Total bank credit, Money multipliers (M1 = M1/MB, MM2 = M2/MB).	Granger causality test results showed that money is endogenous for all **GCC countries except Bahrain and Kuwait.**
(Badarudin, Ariff, & Khalid, 2013)	Quarterly	Cointegration, vector error-correction models (VECM) and Granger causality	Monetary base, bank loans, money supply, money multiplier, deposits, income.	According to Granger causality test there is a one-way causality. Money supply is endogenous.

(*Continued*)

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Appendix.A1. (*Continued*)

Author(s)/Publication Year	Data Period and Frequency	Econometric Method(s)	Variables Included in the Model	Empirical Results
(Bozoklu, 2013)	Quarterly: 1987Q1 to 2011Q2	Granger non-causality based on VAR model	The real gross domestic product, the broad money supply, the three months deposit rate as short-term interest rate, and the consumer price index.	There is causality running from loans to M3 but not from loans to industrial production index.
(Luo, 2013)	Quarterly: 1982Q1 to 2012Q4,	Granger causality, VECM, and the Trivariate VAR	Deposits, loans, real national income, broad money supply, money base	In four countries: Brazil, China, Russia (the period of 2004–2012) and South Africa (1982–1993), money supply is endogenous. In India and Russia (the period of 1982–2003) money supply was found to be exogenous, i.e. money supply cause bank loans.
(Chigbu & Okorontah, 2013)	Annual: 1970–2008	Two stage least square, Johansen cointegration Granger causality	Money supply, value of money, bank rate (rate of interest), real income, liquidity ratio	The findings show that there exists a long-run relationship between money supply and the included variables. The real interest rate and real income Granger cause the growth of money. Moreover, Granger's causal relation between them was unidirectional from real interest rate, real income to money supply. Money supply is endogenous with respect to the value of money, real income and real interest rate meaning that the monetary policy had influence to some extent on money supply but economic activities had greater influence in determining the rate of money growth.

(*Continued*)

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Appendix.A1. (*Continued*)

Author(s)/Publication Year	Data Period and Frequency	Econometric Method(s)	Variables Included in the Model	Empirical Results
(Nayan, Kadir, Yusof, Azillah, & Ali, 2015)	Panel data of 177 countries from year 1970–2011	Dynamic panel data analysis, System GMM	Money supply, real GDP per capita, domestic credit inflation.	Money supply is endogenous as proposed by Post Keynesian theorists.
(Nishiyama, 2014)	Quarterly:1984Q1-2000Q3	Granger causality	Nonborrowed reserves, the sum of n largest New York banks' transaction deposits, demand deposits plus other checkable deposits, The sum of quarterly transaction deposits.	Supports the accommodationist view of endogeneity.
(Aktakas, Akın, & Uçan, 2015)	Quarterly: 1987Q1-2011Q1	VECM	Money supply (M2), private sector credits, private sector investment	The findings are consistent with thePost-Keynesian institutionalist approach.
(Almutair, 2015)	1997.01–2015.02	The study uses Johansen cointegration technique and Vector ErrorCorrection models (VECM) for cointegrated series.	Money supply in the form of M1 and M2, and demand deposit (DD), total deposit (TD) and bank loans (BL)	The long-run causality was found to run from bank loans and from demand deposit to the money supply (MS1), and not from MS1 to BL, as the mainstream view. The endogenious money supply hypothesis is reinforced by the long-run causality running from BL to TD. For MS2, the study verifies a long-run causality running from BL and TD to MS2. Therefore, the money supply of Saudi Arabia whether using MS1 or MS2 is endogenous in the long run. The result of short-run causality with regard of MS1 using Wald Test does not confirm money supply endogeneity in the short run. Short-run causality using Granger with regard to MS2 assures short-run causality running from TD and BL to MS2. In the long run money supply is endogenous whereas monetary authority has some influence on MS1 in the short run.

(*Continued*)

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Appendix.A1. (*Continued*)

Author(s)/Publication Year	Data Period and Frequency	Econometric Method(s)	Variables Included in the Model	Empirical Results
(Kingdom & Elhendawy, 2016)	Annual: 1990–2014	VECM	Money supply, domestic credit (%of GDP), total deposits in local currency, consumer price index.	There is a positive long-run relationship between domestic credit, Inflation and money supply, and there is a negative long-run relationship between Deposits and money supply. The causal relationship results refer to, there is a causal relationship from the domestic credit to deposits, monetary base and the money supply in two lag, Which indicates that the money supply in Egypt is endogenous according to accommodationist view of endogeneity. There is a bidirectional causality between domestic credit and money supply, the central bank influences the money supply through the short-term interest rate. The liquidity preference view also supported.
(Köksel, 2016)	Monthly: 2006:1–2014:11	Johansen Cointegration	Total bank loans granted to private sector, money supply	Money supply is endogenous in Turkey
(Köksel, 2016)	Monthly: 2006:1–2015:11	Johansen Cointegration	The total bank credits to the private sector, money supply in the form of M2	There is a causality from bank credits to money supply in short run. But in the long run there is a bidirectional causality between the variables.
(Cepni & Guney, 2017)	Monthly: 2006.01–2015.05	Vector error correction (VECM), vector autoregressive (VAR) models, Johansen cointegration, Granger causality tests	Total bank loans, deposits, monetary base, the money supply variables (M1, M2, M3).	There is strong evidence for the endogeneity of money through accommodationist channel of transmission to the Turkish economy.

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Appendix A2. Descriptive statistics

item	M2	BL
Mean	20.515	20.530
Std. dev.	0.309	0.482
Max.	21.065	21.246
Min.	19.972	19.590
Obs. no.	87	87

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