Journal of Business, Economicsand Finance - (JBEF), ISSN: 2146 – 7943, , http://www.pressacademia.org/journals/jbef

PressAcademia

Journal of Business, Economics and Finance

Year: 2017 Volume: 6 Issue: 2

# OPTIMAL POLICY INSTRUMENT SELECTION IN MONETARY POLICY: ENDOGENEITY OF MONEY SUPPLY

**DOI: 10.17261/Pressacademia.2017.495**
**JBEF-V.6-ISS.2-2017(1)-p.61-69**

**Ahmet Incekara[1], Akmyrat Amanov[2]**
[1]Istanbul University, The Institute of Social Sciences. Istanbul, Turkey. incekara@istanbul.edu.tr
[2]Istanbul University, The Institute of Social Sciences. Istanbul, Turkey. akmyratamanov@gmail.com

**To cite this document**
Incekara, A and A. Amanov (2017). Optimal policy instrument selection in monetary policy: endogeneity of money supply. Journal of Business, Economics and Finance (JBEF), V.6, Iss.2, p.61-69.
**Permemant link to this document:**http://doi.org/10.17261/Pressacademia.2017.495


## ABSTRACT

**Purpose-** Nowadays, the central bank's primary objective is price stability which is defined as low and stable inflation. The central bank has to fulfill some institutional and operational conditions to achieve this goal. One of the operational conditions is the selection of the appropriate policy instrument to implement the monetary policy. The central bank can choose interest rate or monetary base as policy instrument. The main question of this paper is whether the monetary base the optimal instrument. The choice of monetary base as a policy instrument is dependent on the exogeneity of money supply, which means that the money supply is controllable by monetary base.

**Methodology-** This paper investigates endogeneity of money supply of Turkey for a sample period of 1990-2016 using Johansen cointegration test.

**Findings-** As a research method, the Johansen cointegration test and VECM is used to show long-run relationships and causality between variables and Granger causality test is used to examine short-run causality between the variables.

**Conclusion-** It is seen that CBRT has very limited control over money supply, thus monetary base may not be optimal policy instrument to ensure price stability.

**Keywords:** Endogenous Money Supply, Johansen Cointegration Test, Monetary Base, Monetary Policy Instrument
**JEL Codes:** C32, E51, E58

## 1. INTRODUCTION

The primary objective of the central bank is price stability, which is defined as low and stable inflation. Price stability: avoids excessive investment in the financial sector, stabilizes the real tax revenue, and reduces the uncertainty of the future price level (Sheshinski and Weiss, 1977; Fischer and Modigliani, 1978). Although there is a trade-off between inflation (wage inflation) and unemployment due to the supply curve that is flat in the short run, the long-run expectation shifts the supply curve to an upright position and the exchange relationship between inflation and unemployment is lifted (Phillips, 1958; Mankiw, 2001; Friedman, 1977). Price stability is consistent with long-run objectives such as high employment, stability in financial markets and stability in foreign exchange markets. Some problems facing the central bank in achieving price stability are the problems of time inconsistency and political pressure (Kydland and Prescott, 1977; Barro, Gordon, 1983; Alesina and Summers, 1993). The central bank has to meet certain conditions to minimize problems and ensure price stability. Institutionally the central bank should have goal/operational independence, accountability to officials, transparency in the policy-making process and open communication (Fischer, 1995; Geraats, 2002). Operationally the central bank should have to choose a clear primary objective and a policy instrument.

The central bank uses three criteria when choosing policy instruments (monetary base or interest rate): the instrument should be observable and measurable, controllable, and should have predictable influence on the targets (Poole, 1970, Friedman, 1990). The policy instrument should be quickly observable and accurately measurable so that the central bank's political stance can be reflected quickly. In order for the policy instrument to be able to see useful functions, the central bank must have effective control over the instrument. It is shown in the textbooks that monetary base is determined only by central bank, while post-Keynesians and institutionalists argue that monetary base is determined endogenously by the market rather than by the central bank (Moore, 1979; Niggle, 1991). On the other hand, the central bank can tightly determine short-run nominal interest rates with the channel system (Woodford, 2001). In terms of the usefulness of the policy instrument, the last key feature is that instrument should have a predictable effect on the target. According to monetarists who argue that monetary base should be used as policy instruments, there is causality from monetary base to money supply and from money supply to inflation (Friedman and Schwartz, 1975). According to some economists, the causality relation may be reversed (Tobin, 1970; Moore, 1979). If the causality relation is reversed, the usefulness of monetary base as policy instruments will not work for central banks. On the other hand, the effects of the interest rate on the final target are explained by the traditional interest rate channel, the exchange rate channel and the cash flow channel (Keynes, 1936; Taylor, 2001; Bernanke and Gertler, 1995).

In this study, it was questioned whether the monetary base was the optimal policy instrument. The choice of the monetary base as the optimal instrument depends on whether the central bank can exogenously control the money supply and whether the money supply has an estimated effect on the final target. If neither of these two conditions occurs, the monetary base won’t be optimal policy instrument anymore.

## 2. LITERATURE REVIEW

### 2.1. View of Economic Schools

According to monetarists, the rule-based monetary targeting strategy must be applied, and the monetary base is the optimal policy instrument to implement the monetary targeting strategy. They argued two basic arguments to defend these views. According to their first argument, all the cyclical fluctuations are due to instability in the rate of money growth. Because when the cyclical fluctuations in the US history are examined, the money supply falls before production. Due to the timing event previous event should be the cause of the lateral event, according to the ``post hoc ergo propter hoc`` principle (M. Friedman and A. Schwartz, 1963). According to the second argument, the money supply is exogenously controlled by the central bank. According to Philip Cagan's monetary base multiplier model, the cause-effect relationship is from the monetary base to the money supply, from the money supply to the prices. Increase in money supply leads directly to inflation. In the monetary multiplier model, money supply is determined by the monetary base, required reserves/deposits ratio, excess reserves/deposits ratio and currency/deposits ratio. If excess reserves/deposit ratio and currency/deposits ratio can be estimated, money supply can be determined exogenously by the central bank. For these reasons, the central bank should choose the monetary base as the policy instrument instead of choosing the interest rate as the policy instrument (Friedman, 1968 and 1960; Friedman and Schwartz, 1963; McCallum; 1988). The causality relation that monetarists advocate can be shown as follows:

$\Delta$ Monetary Base→ $\Delta$ Money Supply→ $\Delta$ Prices

Economists who oppose monetarists have stated that high correlations will not always bring causality and that even inverse causality can be encountered. They have argued that there may be causation from total production to money supply. Another criticism is that the deductions of monetarists according to timing event are wrong. The ''post hoc, ergo propter hoc'' principle finds validity only if the first event is exogenous. However, monetary quantities are not determined exogenously as in the monetary base multiplier model of monetarists. Monetary aggregates can be defined by the market through demand for bank credits, financial innovations, and budget deficit financing (Tobin, 1970; Moore, 1983; Lavoie, 1984).

The first school to oppose monetarists' view of exogenous money supply is post-Keynesians. Post-Keynesians have argued that the money supply has been determined endogenously by the credit demands. According to Moore (1979, 1983, and 1989) and Lavoie (1984 and 1985), economic actors demand credit in the production and investment process. To explain, the companies spend their expenditures at the beginning and middle of production to continue their production. Their revenues are obtained at the end of the production process by selling goods and services. Credits function as a buffer-stock to fulfill the resulting cost increase. Credit demands are generally accepted by commercial banks. These credits accepted by the banks, lead to the expansion of the money supply by creating new deposits. In addition, commercial banks apply to the central bank as they are obliged to keep a certain amount of the loans as reserves. Since the central bank is in the position of the last lender, it meets the reserve requirements of commercial banks from the discount window. In this way, the credit demands determine the money supply and monetary base. The causality relation is from the total production to money supply, rather than from money supply to total production. As a result the central bank cannot control the money supply and monetary base, although it can determine the interest rate. The causal relationship of horizontalist post-Keynesians can be illustrated as follows:

ΔCredit Demand→ ΔMoney Supply→ ΔMonetary Base (central bank)

Some of the post-Keynesians have argued against horizontalist view, and have come up with a model of structuralist view. According to Minsky and his followers, the central bank may not always meet the needs of commercial banks' reserve requirements. Nevertheless, commercial banks can meet their reserve requirements through new forms of liability management methods and financial innovations. In such a case, the money supply is determined by both credit demands and monetary base. Thus the power of central bank in determining interest rate is decreases (Pollin, 1991). Those who advocate structuralist view defend the following concept of causality:

ΔCredit Demand and ΔMonetary Base→ ΔMoney Supply→ ΔMonetary Base (financial innovations)

Other economists who oppose monetarists' view of exogenous money supply are the new-Keynesians. According to the new-Keynesians, monetary fluctuations are not the reason for the total output, but on the contrary the result (Fontana, Vera, 2003). In addition, according to the new-Keynesians, another source of the endogenous money supply is the central bank endogeneity. This kind of endogeneity depends on the policy implementation of the central bank. The central bank chooses an instrument, depending on whether the shocks originate from the money or goods market. According to Poole`s (1970) study, monetary targeting is the optimal strategy when shocks originate from the source goods market. When comparing interest rate targeting and money supply targeting results, total production fluctuates less if money supply targeting is applied. Interest rate targeting is the optimal strategy when shocks originate from the money market. In recent years, money market shocks have increased due to new management approaches in financial markets, financial innovations and instabilities in money demand. For this reason, central banks used the interest rate as an instrument in response to money market shocks and the money supply became endogenous. According to the new-Keynesian the causality is realized as follows:

ΔAggregate Demand → ΔMoney Supply

Another school that advocates money supply endogeneity is institutionalists. According to this school, the endogeneity and exogeneity of money supply change according to the development of the monetary/financial system of the economy. In the first stage, the economy has commodity money or strict gold backing rules. In this system, money supply is exogenous. In the second stage, small and non-organized banks are emerging and there is no legal requirement on the reserves. At this stage the money supply is endogenous. In the third stage, the central bank now imposes a legal obligation on the reserves and therefore the supply of money is exogenous. In the fourth stage, the banks find new techniques to relieve the need for reserves in the financial system. Also they can demand credit from international markets and the money supply becomes endogenous. Finally, the central bank fulfills the function of the last lender to ensure the stability of the financial markets and meets all the reserve needs, so the money supply becomes endogenous (Niggle, 1991). The concept of endogenous money supply that institutional economists advocate for developed economies is similar to post-Keynesians:

ΔCredit Demand→ ΔMoney Supply→ ΔMonetary Base (central bank, financial innovations)

### 2.2. Empirical Studies

Moore (1983) tested the endogeneity of the money supply for the USA for the period of 1964-1979. Study has indicated that banks demand for loans to finance working capital of companies. Credit demands affect the money supply, thus money supply is endogenous in USA. Kaldor (1985) then tested the endogeneity of money supply for the UK for a sample period of 1966-1979 by using the OLS method. The result was that the money supply was determined endogenously by demand for bank lending. Panagopoulos and Spiliotis (1998) tested the endogeneity of money supply for Greece. The result was that the money supply was determined endogenously by demand for loans. Vera (2001) tested the endogeneity of the money supply over the 1987-1998 period of the Spanish economy through the Granger causality test. According to the test, there is a one-way causality to the money supply and monetary base from the bank lending. Lavoie (2005) tested the endogeneity of money supply for the Canadian economy. According to his findings, the central bank accommodates to the fluctuations in money demand, and the monetary policy is carried out by the overnight interest rates. The money supply for the Canadian economy is therefore endogenous. Ahmad and Ahmed (2006) tested the endogeneity of money supply for the Pakistan economy for the period of 1980-2003. According to findings, money supply is determined endogenously in the short-run. But central bank base money has significant effects on money supply in the long-run. Howells and Hussain (1998) tested the endogeneity of money supply using the Johansen cointegration test and Granger-causality test. According to these tests, the money supply was found to be endogenous. Nayan, Kadir, Abdullah and Ahmad (2013) used panel data analysis to examine the endogeneity of money supply of 177 countries' economies for the period of 1970-2011. The money supply was found endogenous, as the central banks of these countries` started implementing interest rate targeting strategy. A number of studies have also been carried out on the endogeneity of the money supply for the Turkish economy. Aybar and Harris

(1998) show that money supply is structurally endogenous in the period 1987-1997. Işık (2000), in her doctoral thesis, examined the money supply endogeneity for the period of 1987-1999 by using VAR method and Granger-causality test. According to results, the money supply was found endogenous. Karabulut (2005) applied the Granger causality to test money supply endogeneity, and found causality between credit demands and M1. Çifter and Özün (2007) used cointegration test between credit demands and M2, credit demands and M2Y in their studies. They found that there is a relationship between credit demands and M2, and there is no relationship between credit demands and M2Y. Özgür (2011) applied cointegration test for the period of 1987-2009, and found a relation between credit demands and money supply.

## 3. DATA AND METHODOLOGY

LNM2, LNRM, LNPSL and LNWPI were used as variables in the study. Reserve Money (RM) was used for the definition of the base money of the CBRT; Domestic Private Sector Loans (PSL) was used for the definition of credit demands of private sector; (M2) was used for the definition of liquidity in the market; and Domestic Wholesale Prices Index (WPI) was used for the definition of the general level of prices. The base year of (WPI) is 2003. The study covers periods of 1990q1-2016q4. Frequencies of time series are quarterly and each time series covers 108 observations. While (RM), (PSL) and (M2) time series are taken from CBRT Electronic Data Delivery System, (WPI) time series are taken from TurkStat. To find the relation of flexibility between variables, the logarithm of the variables is taken.

In order to find the appropriate model, it was first tested whether the variables contain unit root. Since the economic model generally has higher autoregressive processes, the ADF unit root test is applied. When this test is applied, the appropriate number of lags included in the model is determined with the help of the Akaike and Schwarz information criteria. In addition to the ADF unit root test, the Phillips-Perron unit root test was also applied. The results are shown in Table 1.

**Table 1: Unit Root Test Results for LNM2, LNRM, LNPSL and LNWPI Series**

| | **ADF** | | **Phillips-Perron** | |
|---|---|---|---|---|
| | **Level** | **1st Difference** | **Level** | **1st Difference** |
| **LNM2** | -0.917935 (1) | **-7.255241* (0)** | -0.688034 (6) | **-7.288101* (3)** |
| **LNRM** | -0.265434 (1) | **-11.96945* (0)** | -0.507381 (0) | **-11.96945* (0)** |
| **LNYİK** | -1.816585 (8) | **-7.456321* (0)** | -0.888141 (7) | **-7.872306* (7)** |
| **LNWPI** | -1.110194 (1) | **-7.374668* (0)** | -0.722053 (6) | **-7.440612* (4)** |
| **MacKinnon (1996) one sided p-values.** | | | | |

* Significant at 5% level.

According to the results of the unit root test, it is observed that when the first difference of the series is taken, they become stationary. Time series are integrated I (1) in the first degree. Although all series are not stationary at normal levels, there may be a long-run relationship between the variables due to being integrated at the first difference level. Thus Johansen approach (1988, 1995) was applied as a method of cointegration analysis.

## 4. FINDINGS AND DISCUSSIONS

The Johansen cointegration test accepts all variables in the model as endogenous. For this reason, estimates should be made with the help of vector and matrix. The VAR model was estimated, and the values of the lag length criteria were found. Three of these criteria (LR, FPE, AIC) showed that 3 lags of variables should be taken. According to these three criteria, the appropriate model is VAR (3) and the appropriate error correction model is VECM (2). The results of the information criteria are shown in Table 2.

**Table 2: Appropriate Lag Selection for VAR Model**

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 1 | 614.7472 | NA | 1.80e-10 | -11.08791 | -10.69056* | -10.92680 |
| 2 | 646.4606 | 58.72859 | 1.35e-10 | -11.37890 | -10.58419 | -11.05668* |
| 3 | 665.3696 | **33.61593*** | **1.28e-10*** | **-11.43277*** | -10.24071 | -10.94943 |
| 4 | 677.8362 | 21.23938 | 1.37e-10 | -11.36734 | -9.777925 | -10.72289 |
| 5 | 691.2442 | 21.85007 | 1.45e-10 | -11.31934 | -9.332573 | -10.51378 |

DOI: 10.17261/Pressacademia.2017.495 

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | 703.2152 | 18.62154 | 1.58e-10 | -11.24473 | -8.860609 | -10.27805 |
| 7 | 720.7954 | 26.04477 | 1.57e-10 | -11.27399 | -8.492519 | -10.14620 |
| 8 | 731.4000 | 14.92499 | 1.77e-10 | -11.17407 | -7.995251 | -9.885177 |

The appropriate model for deterministic components has been chosen according to the Pantula principle (1989). The Pantula principle deals with the prediction of three models and gives results starting from the most constrained hypothesis. Trace statistics and critical values are compared. Since the equation must be used in terms of the differences of the internal variables, it is transformed into the VECM (2) model.

**Table 3: Pantula Principle Test Results**

| r | m-r | | Model 2 | | Model 3 | | Model 4 | |
|---|---|---|---|---|---|---|---|---|
| 0 (none) | 4 | | 69.717* | → | 62.454* | → | 78.631* | → |
| 1 (at most 1) | 3 | → | **30.835!** | | 28.394 | | 43.694* | |

Significance of trace statistic is determined according to Osterwald-Lenum (1992). `! ` Shows the point at which the null hypothesis cannot be rejected first. * Significant at 5% level.

The rank of the Π matrix is calculated by the λmax and λtrace statistics in the Model 2 frame and the results are given in Table 4 below.

**Table 4: Johansen (1988, 1995) Cointegration Test Results**

| $\lambda_{trace}$ *statistics* | | | |
|---|---|---|---|
| **Hypotheses** | **Eigenvalue ($\lambda_i$)** | $\lambda_{trace}$ | **Critical Value % 5** |
| $H_0 : r = 0, H_1 : r = 1$ | 0.302333 | **69.71746*** | 54.07904 |
| $H_0 : r \leq 1, H_1 : r = 2$ | 0.149899 | 30.83596 | 35.19275 |
| $H_0 : r \leq 2, H_1 : r = 3$ | 0.077049 | 13.29674 | 20.26184 |
| $\lambda_{max}$ *statistics* | | | |
| **Hypotheses** | **Eigenvalue ($\lambda_i$)** | $\lambda_{max}$ | **Critical Value % 5** |
| $H_0 : r = 0, H_1 : r \geq 1$ | 0.302333 | **38.88150*** | 28.58808 |
| $H_0 : r \leq 1, H_1 : r \geq 2$ | 0.149899 | 17.53922 | 22.29962 |
| $H_0 : r \leq 2, H_1 : r \geq 3$ | 0.077049 | 8.659337 | 15.89210 |

* Significant at 5% level.

Critical values are MacKinnon-Haug-Michelis (1999) p-values. When the above values are compared with these values, it is seen that the null hypotheses of the maximum eigenvalue and trace test statistics are rejected according to the level of 5% significance level. Variables in the model are cointegrated. Since the matrix of Π is equal to the rank one, there is one cointegrating relationship between our variables. While the trace statistics calculated for the three models, it was decided according to their significance level. The value in the second row of Model 2 is 30,835, where the null hypothesis cannot be rejected first. It is determined that the appropriate model is Model 2 and the rank of the Π matrix is equal to one. In model 2, there is no trend in the long-run cointegration model; there is no intercept and trend in the short-run VECM model. The VECM (2) model is written with Π = αβ 'components as shown below:

$$\begin{pmatrix} \Delta lnm2_t \\ \Delta lnrm_t \\ \Delta lnpsl_t \\ \Delta lnwpi_t \end{pmatrix} = \Gamma 1 \begin{pmatrix} \Delta lnm2_{t-1} \\ \Delta lnrm_{t-1} \\ \Delta lnpsl_{t-1} \\ \Delta lnwpi_{t-1} \end{pmatrix} + \Gamma 2 \begin{pmatrix} \Delta lnm2_{t-2} \\ \Delta lnrm_{t-2} \\ \Delta lnpsl_{t-2} \\ \Delta lnwpi_{t-2} \end{pmatrix} + \begin{pmatrix} a_{11} \\ a_{21} \\ a_{31} \end{pmatrix} (\beta_{11} \quad \beta_{12} \quad \beta_{13} \quad \beta_{14} \quad \beta_{15}) \begin{pmatrix} lnm2_{t-1} \\ lnrm_{t-1} \\ lnpsl_{t-1} \\ lnwpi_{t-1} \end{pmatrix} + \varepsilon_t$$

Weak exogeneity test was applied. In order to make LNM2, LNRM, LNPSL and LNWPI variables weakly exogenous: it is necessary that LNM2 variable in the first equation, LNRM variable in the second equation, LNPSL variable in the third equation and LNWPI variable in the fourth equation be a function of their own lagged values respectively. Thus, if the matrix α is zero, then the variables are weakly exogenous because the effect of the parameters of the cointegration vector will be reduced from the corresponding equation. The results of the weak exogeneity test are given in Table 5.

**Table 5: Weak Exogeneity Test Results**

| Variables | Null Hypothesis | LR (rank=1) | Prob. |
|---|---|---|---|
| LNM2 | $\mathbf{H_0 : a_{11} = 0}$ | 20.84298* | 0.000005 |
| LNRM | $\mathbf{H_0 : a_{21} = 0}$ | 7.664555* | 0.005632 |
| LNPSL | $\mathbf{H_0 : a_{31} = 0}$ | 4.579045* | 0.032365 |
| LNWPI | $\mathbf{H_0 : a_{41} = 0}$ | 0.941251 | 0.331956 |

* Significant at 5% level.

The next step is to test whether the cointegration vector is in cointegration space. For this purpose, necessary constraints have been applied on the parameters of the cointegrating vector. The null hypothesis has been rejected according to the tests carried out, with the result that the cointegrating vector between the variables is in the cointegration space. The results are given in Table 5.

**Table 6: Cointegration Space Test Results**

| Variables | Null Hypothesis | LR (rank=1) | Prob. |
|---|---|---|---|
| LNM2 | $\mathbf{H_0 : \beta_{11} = 1, \beta_{12} = 0, \beta_{13} = 0, \beta_{14} = 0}$ | 22.56643* | 0.000050 |
| LNRM | $\mathbf{H_0 : \beta_{11} = 0, \beta_{12} = 1, \beta_{13} = 0, \beta_{14} = 0}$ | 21.22445* | 0.000095 |
| LNPSL | $\mathbf{H_0 : \beta_{11} = 0, \beta_{12} = 0, \beta_{13} = 1, \beta_{14} = 0}$ | 22.04299* | 0.000064 |
| LNWPI | $\mathbf{H_0 : \beta_{11} = 0, \beta_{12} = 0, \beta_{13} = 0, \beta_{14} = 1}$ | 24.01905* | 0.000025 |

* Significant at 5% level.

According to the above results, it has been found that there is a long-run relationship between LNM2, LNRM, LNPSL and LNWPI and that this relationship can be presented with a single cointegrating vector. Since the variables LNM2, LNRM and LNPSL are endogenous and LNWPI is exogenous, three equations are established. The long-run relationship is normalized by multiplying the coefficient of the endogenous variable by the opposite sign. Normalized coefficients show long-run relationship as well as long-run elasticity.

**Table 7: Normalized Cointegrating Coefficients (long-run elasticity)**

| | M2 | RM | PSL | WPI | INTERCEPT |
|---|---|---|---|---|---|
| | | | M2 MODEL | | |
| Normalized Coefficients | 1.000000 | 0.279170* | -0.539322* | -0.842256* | -10.22356* |
| Standard Error | | (0.10169) | (0.06014) | (0.05423) | (0.65853) |
| | | | RM MODEL | | |
| Normalized Coefficients | 3.582049* | 1.000000 | -1.931878* | -3.017003* | -36.62130* |
| Standard Error | (0.80324) | | (0.33460) | (0.60105) | (6.91172) |
| | | | PSL MODEL | | |
| Normalized Coefficients | -1.854180* | -0.517631* | 1.000000 | 1.561695* | 18.95632* |
| Standard Error | (0.25806) | (0.18177) | | (0.16912) | (1.88036) |

* Significant at 5% level.

When M2 model was examined, all variables were statistically significant. A 1% increase in the RM decreases the M2 by 0.27%, a 1% increase in the PSL increases the M2 by 0.53%, a 1% increase in the WPI increases the M2 by 0.84%. In this model there is an inflexible case between variables. While RM has a negative effect on M2, PSL and WPI have a positive effect on M2.

When the RM model was examined, all variables were statistically significant. A 1% increase in M2 decreases RM by 3.57%, a 1% increase in PSL increases 1.93% RM, a 1% increase in WPI increases RM by 3.01%. In this model there is a situation that is flexible among the variables. While M2 has a negative effect on PSL and WPI have a positive effect on RM.

All of the variables were statistically significant when the PSL model was examined. A 1% increase in M2 increases the PSL by 1.85%, a 1% increase in RM increases PSL by 0.51%, a 1% increase in WPI reduces PSL by 1.56%. In this model, while M2 and WPI variables were found flexible, RM was found inflexible. While WPI has a negative effect on PSL, M2 and RM have a positive effect on PSL.

**Table 8: Vector Error-Correction Model Prediction Results: VECM (2)**

| | M2 | RM | PSL | WPI |
|---|---|---|---|---|
| VECM Coefficients | -0.274590* | -0.270279* | -0.132094* | -0.050872 |
| Standard Error | (0.04678) | (0.08984) | (0.05594) | (0.04446) |

* Significant at 5% level.

In the vector error correction model, it is proved that shocks that can occur in the long-run equilibrium can be corrected. The coefficients in the error correction model were negative and statistically significant as expected. These coefficients indicate the rate at which the short-run deviations resulting from the non-stationary series are adjusted in the next period. The short-run imbalance that occurs in M2 is adjusted approximately in eleven month, the short-run imbalance that occurs in RM is adjusted in eleven months, and the short-run imbalance that occurs in PSL is adjusted in about twenty-two months to the long-run equilibrium level.

Finally the Granger-causality test was applied to investigate the short-run causality relationship. The results are given in Table 7.

**Table 9: Granger-Causality Test Results**

| **Dependent variable: D(LNM2)** | | | **Dependent variable: D(LNRM)** | | |
|---|---|---|---|---|---|
| Excluded | Chi-sq | Prob. | Excluded | Chi-sq | Prob. |
| D(LNRM) | 3.583082 | 0.1667 | D(LNM2) | 0.154375 | 0.9257 |
| D(LNPSL) | 7.860545* | 0.0196 | D(LNPSL) | 0.879232 | 0.6443 |
| D(LNWPI) | 0.830862 | 0.6601 | D(LNWPI) | 2.418571 | 0.2984 |
| ALL | 11.81036** | 0.0663 | ALL | 5.833208 | 0.4421 |
| **Dependent variable: D(LNPSL)** | | | **Dependent variable: D(LNWPI)** | | |
| Excluded | Chi-sq | Prob. | Excluded | Chi-sq | Prob. |
| D(LNM2) | 8.302649* | 0.0157 | D(LNM2) | 16.78757* | 0.0002 |
| D(LNRM) | 6.735262* | 0.0345 | D(LNRM) | 4.850561** | 0.0885 |
| D(LNWPI) | 7.585983* | 0.0225 | D(LNPSL) | 4.577005 | 0.1014 |
| ALL | 25.42203* | 0.0003 | ALL | 39.93129 | 0.0000 |

* Significant at 5% level.

The short-run causality relationship between variables is based on the Granger causality test:

LNPSL→LNM2 →LNWPI,

LNM2, LNRM, LNWPI→LNPSL.

According to test results, the first important finding is that money supply is endogenously determined in Turkish economy. There is a mutual causality among money supply, reserve money and credit demands in the long-run. Money supply is not only exogenously determined by the reserve money as monetarists advocate and it is not only determined by the credit demands endogenously as horizontalist post-Keynesians advocate. In the long-run, the money supply is determined both by the reserve money and the credit demands, as the structuralist post-Keynesians advocate. Meanwhile the money supply is only determined endogenously by the credit demands in the short run as the horizontalist post-Keynesian defend.

The second important finding is that the causality between money supply and inflation. According to findings there is one-way causality from inflation to money supply in the long-run, while there is reverse causation in the short-run. Total production is the reason of monetary aggregates in the long-run.

## 5. CONCLUSION

In this study, it was questioned whether the monetary base is an optimal instrument for monetary policy applications. The endogeneity of the money supply and the relationship between money supply and inflation in the Turkish economy for a sample period of 1990-2016 has been examined. The Johansen cointegration test and the Granger causality test were applied as an appropriate econometric approach to carry out this study. According to findings CBRT cannot control the money supply and monetary base, although it can determine the interest rate in the short-run. CBRT implements accommodative monetary policy in the short-run. In the long-run money supply doesn`t have predictable effect on inflation, thus CBRT cannot use monetary aggregates in the conduct of monetary policy. Fluctuations of money supply is not reason of inflation, but on the contrary result of inflation. According to these results, monetary base may not be the optimal policy instruments to ensure price stability. Both short-run and long-run results suggest that the CBRT has very limited control over the money supply.

## REFERENCES

Ahmad and Ahmed (2006). The Long-run and Short-run Endogeneity of Money Supply in Pakistan: An Empirical Investigation. Research Bulletin, 2(1), State Bank of Pakistan.

Alesina, A., and Summers, L. H. (1993). Central bank independence and macroeconomic performance: some comparative evidence. Journal of Money, Credit and Banking, 25(2), 151-162.

AYBAR, Sedat, HARRIS, Laurence (1988), "Credibility Models of Central Bank Independence and the Case of Turkey", METU Studies in Development, C.25, S. 4, 535-558.

Barro, R. J., and Gordon, D. B. (1983). Rules, discretion and reputation in a model of monetary policy. Journal of monetary economics, 12(1), 101-121.

Bernanke, B. S., and Gertler, M. (1995). Inside the black box: the credit channel of monetary policy transmission (No. w5146). National bureau of economic research.

ÇİFTER, Atilla, ÖZÜN, Alper (2007), "The Monetary Transmission Mechanism in the New Economy: Evidence from Turkey (1997-2006)", South East European Journal of Economics and Business, C. 2, S. 1, 15-24.

Fischer, S., and Modigliani, F. (1978). Towards an understanding of the real effects and costs of inflation. Review of World Economics, 114(4), 810-833.

Fischer, S. (1995). Central-bank independence revisited. The American Economic Review, 85(2), 201-206.

Friedman, B. M. (1990). Targets and instruments of monetary policy. Handbook of monetary economics, 2, 1185-1230.

Friedman, M. (1959). A program for monetary stability (Vol. 3). Fordham University Press.

Friedman, M., and Schwartz, A. (1963). A monetary history of the United States.

Friedman, M. (1968). The role of monetary policy.

Friedman, M., and Schwartz, A. J. (1975). Money and business cycles. In The state of monetary economics (pp. 32-78). NBER.

Friedman, Milton. "Nobel lecture: inflation and unemployment." Journal of political economy 85.3 (1977): 451-472.

Geraats, P. M. (2002). Central bank transparency. The economic journal, 112(483).

Giuseppe Fontana (2003), "Rethinking Endogenous Money: A Constructive Interpretation Of The Debate Between Horizontalist And Structuralists," Metroeconomica, 55:4, S.367-385.

HOWELLS, Phillip, HUSSEIN, Khalid (1998), "The Endogeneity of Money: Evidence from G7", Scottish Journal of Political Economy, C. 45, S. 3, 329-40.

IŞIK, Sayım (2000), Para Arzının Endojenliği Tartışması: Türkiye Örneği, Doktora Tezi, Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.

Johansen, S. (1988). Statistical analysis of cointegration vectors. Journal of economic dynamics and control, 12(2-3), 231-254.

Johansen, S. (1995). Identifying restrictions of linear equations with applications to simultaneous equations and cointegration. Journal of econometrics, 69(1), 111-132.

Kaldor, N. (1985). The scourge of monetarism. Oxford; New York: Oxford University Press.

KARABULUT, Gökhan (2005), “Paranın Endojenliği ve Türkiye Örneği”, Yönetim/İstanbul Üniversitesi İşletme Fakültesi İşletme İktisadı Enstitüsü Dergisi, C. 16, S. 51, 25-31.

Keynes, J. (1964). M. 1936. The general theory of employment, interest and money, 154-6.

Kydland, F. E., and Prescott, E. C. (1977). Rules rather than discretion: The inconsistency of optimal plans. Journal of political economy, 85(3), 473-491.

Lavoie, M. (1984). The endogenous flow of credit and the post Keynesian theory of money. Journal of Economic Issues, 18(3), 771-797.

Lavoie, M. (1985). Credit and money: the dynamic circuit, overdraft economics, and post-Keynesian economics. In Money and Macro Policy (pp. 63-84). Springer Netherlands.

Lavoie, M. (2005). Monetary base endogeneity and the new procedures of the asset-based Canadian and American monetary systems. Journal of Post Keynesian Economics, 27(4), 689-708.

Mankiw, N. G. (2001). The inexorable and mysterious tradeoff between inflation and unemployment. The Economic Journal, 111(471), 45-61.

McCallum, B. T. (1988, December). Robustness properties of a rule for monetary policy. In Carnegie-Rochester conference series on public policy (Vol. 29, pp. 173-203). North-Holland.

Moore, B. J. (1979). The endogenous money stock. Journal of Post Keynesian Economics, 2(1), 49-70.

Moore, B. J. (1983). Unpacking the post Keynesian black box: bank lending and the money supply. Journal of Post Keynesian Economics, 5(4), 537-556.

MOORE, Basil J. (1989), “The Endogeneity of Credit Money”, Review of Political Economy, C. 1, S. 1, 65-93.

Nayan, S., Kadir, N., Abdullah, M. S., and Ahmad, M. (2013). Post Keynesian endogeneity of money supply: Panel evidence. Procedia Economics and Finance, 7, 48-54.

Niggle, C. J. (1991). The endogenous money supply theory: an institutionalists appraisal. Journal of Economic Issues, 25(1), 137-151.

Özgür, G. (2011). Türkiye Ekonomisinde Para Arzının İçsel Süreci. Ekonomik Yaklasim, 22(78), 67-90.

Panagopoulos, Y., and Spiliotis, A. (1998). The determinants of commercial banks' lending behavior: some evidence for Greece. Journal of Post Keynesian Economics, 20(4), 649-672.

Pantula, S. G. (1989). Testing for unit roots in time series data. Econometric Theory, 5(02), 256-271.

Phillips, A. W. (1958). The relation between unemployment and the rate of change of money wage rates in the United Kingdom, 1861–19571. Economica, 25(100), 283-299.

Pollin, R. (1991). Two theories of money supply endogeneity: some empirical evidence. Journal of Post Keynesian Economics, 13(3), 366-396.

Poole, William. "Optimal choice of monetary policy instruments in a simple stochastic macro model." The Quarterly Journal of Economics 84.2 (1970): 197-216.

Sheshinski, E., and Weiss, Y. (1977). Inflation and costs of price adjustment. The Review of Economic Studies, 44(2), 287-303.

Taylor, J. B. (2001). The role of the exchange rate in monetary-policy rules. The American Economic Review, 91(2), 263-267.

Tobin, J. (1970). Money and income: post hoc ergo propter hoc?. The Quarterly Journal of Economics, 301-317.

Vera, A. P. (2001). The endogenous money hypothesis: some evidence from Spain (1987-1998). Journal of Post Keynesian Economics, 23(3), 509-526.

Woodford, M. (2001). Monetary policy in the information economy (No. w8674). National Bureau of Economic Research.