The Endogenous Money Hypothesis: an Empirical Study of The Saudi Arabia

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Abstract

In this paper, the endogenous money supply hypothesis in Saudi Arabia is examined using data from January 1997 to February 2015. The study uses Johansen cointegration technique and Vector Error Correction models (VECM) for cointegrated series.The long run causality was found to run from bank loans (BL) and from demand deposit (TD) to the money supply (MS1), and not from MS1to BL, as the mainstream view. The endogenios 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. The implication of this work is that Saudi monetary agency can not control the money supply in the long run. It only has some influence on MS1 in the short run.

Key Words: Saudi arabia; money supply endogeneity; accommodationist; long-run cointegrating relationship; Post-Keynesians; inside mony;outside money

1. Introduction

Endogenous money means the money supply is mostly createdendogenously as credit. This means that private banks are the primary issuers of money and do so based on the demand from creditworthy customers. So the central bank has far less control over the money supply than one might believefrom the money multiplier theory. This is the central point in understanding endogenous money. Money is at the center of Keynesian macroeconomics, however Keynes (1936) paid little attention to the determination of the money supply and treated it as exogenous. That cure has been the source of much misperception.

The starting point is Keynes' (1936) liquidity preference theory of interest rates which represents one of the critical advances of his General Theory. Keynes' General Theory pays great attention to the importance and specification of money demand and the properties and implications of money. However, it pays almost no care to the issue of money supply which is described as being essentially exogenous, having a zero elasticity of production. According to Keynes' theory of interest rate determination of The General Theory, the nominal interest on bonds adjusts to equilibrate money supply and money demand. The interest rate has nothing to do with being a "reward for waiting". Instead, it is the reward for bearing risk plus the reward for "not hoarding" by giving up liquidity and holding bonds (Palley, 2015).

The economic thought of modern monetary economics has witnessed the appearance of two opposing views concerning the role of central bank in handling directly the supply of money and indirectly the level of economic activities in an economy. The Monetarists confirms that money supply in an economy is exogenously determined. This opinion is based on the principle that money supply equals the money multiplier times the monetary base. Since the central bank can change the monetary base, it can device the supply of money in the economy. The second group of economists categorized as Post Keynesians, postulates that money supply is endogenous rather than exogenous. Post Keynesian economics is actually macroeconomics in a world of ambiguity and endogenous money, inspired by the notions of John Maynard Keynes. While the idea of money supply endogeneity has its origin from Lord Keynes who provided some insights into this theory, the substantial contributions of four early economists must not be overlooked. Robinson (1956), Davidson (1978), Kaldor (1982) and Moore (1986, 1988, 1998) were those who actually responsible for the direct development of the present Post Keynesian school of monetary thought. According to Post-Keynesian economists money supply is determined by credit money demand. The use of credit-money originated from debt and credit decisions gives a fundamental role to the banking system (Kaldor and Trevithick 1982) and the procedure of money creation becomes independent from the Central Bank activities (Cottrell 1986; Laidler 1992). Money endogeneity infers a causality direction from loans to bank deposits. Loans demand is influenced by nominal wages: a rise in firms' labor demand causes higher wages resulting in a greater loans demand. Post-Keynesian economists argue that global demand (PY) determines the amount of money transactions (MV). In this case, the direction of causality according to the quantity theory of money is reversed. Credit-money is anticipated by the banking system to finance entrepreneurs' requests. Consequently, the quantity of money is determined endogenously by market demand. According to this theory, the monetary base is "a credit result and not the cause of it" (Arestis 1988). This inversion of relationship can be represented through the credit multiplier overthrow (Lavoie1984; Arestis 1988). Monetary base in accordance with Post-Keynesians is a banking process to obtain reserves from Central Banks. Requests to refinance deposits may exceed the capacity of individual banks, which are forced to refund by the Central Bank: through this process additional high powered money is created (Arestis 1988). This reversed causal relationship between payments and monetary base implies that Central Banks control money supply through interest rates (Shanmugan, Nair and Li 2003). This vision contrasts the exogenous multiplier approach on the monetary base. According to this theory, Central Banks control monetary base by setting money stock equal to a given target value (Moore 1989). The debate among Post-Keynesians is about the role played by banks in satisfying loans demand. Accommodationalists argue that Central Banks set the cost of short term liquidity using interest rates (overnight interest rate). In granting loans to credit-worthy borrowers, the banking system -setting a loan rate equal to a fixed markup on the overnight interest rate - acts as price setters and quantity takers (Moore 1988). Instead, Structuralists argue that Central Banks control reserves (Palley 1996), while the banking system manages liability to increase its own loans/reserves rate (Pollin 1991). In accordance with Structuralists, in fact, markup changes cyclically and in relation to risk positions (Vera 2001). Supporters of Post-Keynesian theory found the following empirical evidence to confirm this theory (Shanmugam, Nair and Li 2003):

1. Various econometric results confirm that the money supply is passive (Nell 2000; Vera 2001; Shanmugam, Nair and Li 2003);
2. Money endogeneity can be explained with other economical variables. According to this aspect Cifter and Ozun (2007) analyze the correlation between money, interest, inflation and productivity using VECM models.

This paperanalyzes money endogeneity in a short term as well as in the long run of the Saudi Arabia during the period from January 1997 until February 2015 using monthly data.The causality issue is very important to assure the endogeneity of money supply in Saudi Arabia. If the causality runs from bank loans to bank deposits, then the endogeneity of money supply could be confirmed. This paper focuses the analysis on the two different measure of money supply: MS1and MS2 to see whether the endogeneity of money supply in Saudi Arabia is reenforced by using MS2.

The paper is organized as follows: Section II discusses literature review, Section III briefly deliberates the underlying theory of endogenous money supply, Section IVdescribes Data and Empirical Methodology. Section V implements Empirical Results. Section VI concludes.

II. Literature Review

Bourva, (1959 and 1962), is actually the one who puts thefoundation for the developments of a branch of Post Keynesian economics known as the theory of money supply endogeneity. This theory in its ‘organised’ form however, started in the late 1970s with the publication of the *Journal of Post Keynesian Economics* in 1979. Among the earliest papers published in this Journal are by Moore (1983; 1988). Kaldor (1982) was among the earliest economists who empirically investigated this theory. Heanalyzed the data for the UK for a sample period of 1966 through 1979 by utilizing the Ordinary LeastSquare (OLS) method. His findings suggest that money supply is determined by the demand for banklending, hence appears to be among the earliest evidence of money supply endogeneity.

Moore (1983) extended this evidence for the U.S economy, using quarterly data spanning from 1964 to1979, to analyze the demand for bank loans to commercial and industrial corporations. His finding cited that, in order to finance their working capital, firms increase their demand for loans (particularly for the purpose of paying wages). Thus, financing for working capital appears to be the most important determinant of bank lending to companies.Strictly speaking, when monetary authorities change interest rates, it because a“refinancing” rate, the rate at which liquidity is made available to the banking sector. It is only in the market for reserves that the bank is the monopoly supplier and only in that market that it can determine price directly. The deputy governor of Bank of England’s once noted “...the Bank of England supplies base money on demand at its prevailing interest rate, and broad money is created by the banking system” (King, 1994:264). What happens as broad money is created is determined by behavioral interactions among private sector agents. This includes what happens to market interest rates, the ones that genuinely impinge on real economic activity.Panagopoulos and Spiliotis (1998) conducted an empirical study of the commercial banks' lendingbehavior in Greece and revealed that credit money was primarily determined by the banking system inresponse to the demand for loans. In their conclusion, Panagopoulos & Spiliotis (1998: 670) underlined that "...evidence verifies the Post Keynesian approach that, in modern economies, the credit-money supply process is an endogenous one".

Vera (2001) provided other evidence that the supply of credit money is endogenous. Using the timeseries data from Spain (for the period 1987-1998), a Granger causality tests were run between the monetary base, bank lending, and various money multipliers. The evidence is strongly consistent with the hypothesis that the money supply is credit-driven and demand-determined. Granger causality was found to run from bank lending to the base, and to the money supply, and not from the base to the money supply and to loans, as the mainstream view maintains.Another evidence of money supply endogeneity was from Yulia (2005) using the Russian data.However, different from previous studies (monetarist view), Yulia found that inflation leads to moneysupply growth. Such findings support the endogenous money supply view.Lavoie (2005) examined the monetary based endogeneity of the Canadian economy. His findingssuggest that asset-based financial system, just like credit in financial systems, rely on a fully endogenous supply of high-powered money, with central bank engaging essentially in "defensive" operations. This is demonstrated through an analysis of the Canadian monetary process with the overnight rate closely gravitating around the target overnight rate. Central bank of Canada knows with perfect certainty both its supply of and the demand for settlement balances (Lavoie, 2005). Thus, money supply in Canada is endogenous.

Ahmad and Ahmed (2006) studied Pakistan monthly data based on a sample period of twenty-fouryears (i.e., 1980 - 2003) and came up with interesting findings that might have some implications for future research on money supply endogeneity. They found that Pakistan money supply for the period of 1980 –2003 is endogenously determined in the short run. Different from other studies of money supply endogeneity, in the long-run their findings indicate that it is the base money that determines the total bank advances, versus otherwise. Similar to Ahmad and Ahmed (2006), Cifter and Ozun (2007) also utilized Granger Causality andVector Error Correction (VECM) methodology to examine money endogeneity in a developing country. They were heading for testing monetary transmission mechanism and passive money (or money supply endogeneity) hypothesis, they used seven types of variables: money base, money supply, credit capacity, industrial production index (i.e., the proxy for the GDP), interest rates, inflation and real exchange rate. They used quarterly data for the sample periods of ten years, ranging from 1997 to 2006. One of the major outcomes of the study is that the endogeneity of money supply hypothesis of the Post Keynesian economics is supported in part by Accommodationists view but differ from those of Structuralist and Liquidity Preference theories. Lopreite (2012)examines the endogenous money supply hypothesis in the

Euro Area using data from1999 to 2010. He makes extensive use of Vector Autoregression models (VAR) withGranger causality procedure to analyze non-cointegrated series and Vector Error Correction models(VECM) for cointegrated series. The cointegration analyses reveals a bidirectional causalitybetween loans and M1 both in the short and long run whereas loans cause variations in the M2mainly in the short run. However, according to Granger causality test there is a one-way causalityfrom loans to M3 but not from loans to industrial production index. The results are confirmed byadjusting the loans series for securitization activity in the Euro Area and partially support theaccommodationist view.Nayan et.al. (2013)investigates thetheory of endogenous money supplyusing a panel dataset of 177countries from year 1970-2011 utilizing dynamic panel data analysis and has found that money supply is endogenous asproposed by Post Keynesian theorists.Palley (2015) presents the Post Keynesian theory of endogenous money supply and shows how it is fundamentally different from the conventional money supply theory. Money is at the center of macroeconomics, which makes understanding the money supply central for macroeconomic theory. The conventional approach relies on the money multiplier and bank lending is invisible. Post Keynesian theory discards the money multiplier and focuses on bank lending which drives money creation.

Almutair (2015) uses the Cointegration to analyze the relationship of money Supply and Saudi Stock Price Index (SSPI) using different measure of money supply MS1 and MS2 and different time series; annual data from 1985 until 2012 and monthly data from 2000 until 2013. The goal is to discover the relationship between SSPI and MS and to identify the long run as well as the short run causality using Vector Error Correction Model (VECM). The most important finding is the confirmation of long run relationship between MS1 and SSPI as well as MS2 and SSPI in both monthly and yearly data. The study has found that the long run causality is running from SSPI to MS1 for annual data but not the other way around. This finding supports the Post-Keynesian theoretical approach which indicates the endogeneity of MS. The implication of this result is that Saudi Arabian Monetary agency as well ascommercial banks cannot affect the Saudi Stock prices through change in MS.Almutair (2015) assures bidirectional short run causal relationship (**or** feedback effect) between SSPI and MS1 by using annual data. The paper has not found neither long run nor short run causal relationship between SSPI and MS2 with annual data. Furthermore, the study could not prove any long run or short run causality between MS1 and SSPI or between MS2 and SSPI through the use of monthly data.

III. Underlying Theory

Money is at the center of macroeconomics and understanding of the determination of the money supply is therefore critical for macroeconomic theory. That explains why Post Keynesians have devoted so much effort to the theory of endogenous money. Post Keynesian theory is very different from the conventional money multiplier story.There are several features to note compared to Keynes' *General Theory* model (Palley, 2015). First, there is now a distinction between outside money and inside money. Outside money refers to liabilities of the central bank. Inside money refers to bank deposits created by the banking system.

Second, outside money is exogenous and under the control of the central bank. Inside money is endogenous and created by the banking system through the money multiplier mechanism. The overall money supply is therefore endogenous and the element of exogeneity is pushed into the background. Third, the inside money supply depends jointly on the volume of high powered money and the magnitude of the money multiplier. The elasticity of the inside money supply depends on the sensitivity of the money multiplier to the interest rate. Fourth, the magnitude of the money multiplier also depends negatively on the size of reserve requirements. A higher reserve requirement means banks must retain as reserves more of each deposit they receive, reducing the amount they have available to lend out and create additional deposits.

Endogenous money is a major component of Post Keynesian economics. It refers to the theory that the existence of money in an economy is driven by the requirements of the real economy – that market forces combine with the central bank in establishing the money supply (Pollin, 1991). The banking system reserves then, expand and contract as needed in order to accommodate the demand for credit at prevailing interest rates.

According to Palley (1992:155) the theory of endogenous money "…maintain that money supply is endogenously determined by the joint actions of the monetary authority, the asset and liability. Management decisions of commercial banks, the portfolio decisions of the non-bank public, and the demand for bank loans". Further, Rochon (2001) underlines that the theory of endogenous money consists of five propositions:

1- The causality between money and income in the Quantity Theory of Money is reversed. The supply of money is a function of profit expectation (Wray, 1992). The causality runs from profit expectation– the expected (or desired) income of firms – to the demand for credit. It is the demand for credit that leads to the creation of money. The creation of money through loans leads to the creation of effective demand.
2- The causality between reserves, deposits and loans is reversed (Pollin, 1991: Lavoie, 1992).Being endogenous, bank reserves have no causal influence on loans. This suggests the rejection of the money multiplier model.
3- The causality between savings and investment is reversed (see also Davidson, 1993; Shapiro, 2005). In other words, savings cannot cause investment (Lavoie, 1992). Investment cannot be financed by savings because in a world of endogenous money it is the creation of income resulting from an increase in investment that creates savings.
4- The rate of interest is exogenous (see also Lavoie, 1996; Smithin, 1994; Wray,1995). Interest rate is not determined by the market mechanism – it is determined neither by the supply of and the demand for savings nor the supply of and the demand for money. The nominal interest rate is exogenous because it is set by the central bank. Interest rate is exogenously determined according to internal and external economic objectives (Lavoie, 1992; Moore, 1988).

5- The money supply is 'demand-determined and credit driven.' Money which is primarily a flow exists as a result of the demand for credit that allows firms to fulfill their expenditure plans. Being endogenous, the supply of credit is determined by decision of commercial banks.

IV. Data and Empirical Methodology

IV.1 Data

This study uses monthly data that span from January 1997 to February 2015. It was obtained from the Saudi Monetary Agency various issues of Annual Report, Quarterly and Monthly Bulletin. This paper has used different measure of money supply; MS1 and MS2 because different measures of money supply used can yield different result regarding the endogeneity issue. All the variables are taken in their natural logarithms to avoid the problems of heteroscedasticity. The estimation methodology employed in this study is the cointegration and error correction modeling technique. The entire estimation procedure consists of three steps: first, unit root test; second, cointegration test; third, the error correction model estimation.

IV.2Pearson's correlation coefficient

At the outset, the Pearson's correlation coefficient between money supply one (MS1), demand deposit (DD), bank loans (BL), total deposit (TD) and money supply two(MS2) are calculated over the sample period, and its significance is tested by the t-test. The values of Pearson's correlation coefficient (r) among these variables over the sample period is very strong. It ranges between 0.97 and 0.99. It shows that money supply in the form of M1 and M2, and demand deposit (DD), total deposit (TD) and bank loans (BL) are positively related in Saudi Arabia and that a very high degree of correlation is evident between any pair of them. To test whether this value of r shows a significant relationship between the two time series, student's t-test is used. The null hypothesis of the test is $r = 0$ against the alternative of $r \neq 0$. Since the t-statistic at 168 degrees of freedom ranges between 58.67 and 328.46, which is substantially higher than critical t-value at 1 per cent level of significance, the null hypothesis is rejected. The alternative hypothesis is accepted and the sign should give an indication of the direction of the relationship, and the magnitude indicates its strength.Therefore, it can be said that the correlations among all variables in this study are statistically significant. Correlation, however, does not say anything about long-run relationship, nor the causality issue and thus, the forthcoming of tests will try to find out the long-run relationship and the direction of the causality.

Table 1 correlation coefficients

	MS1	DD	BL	MS2	TD
MS1	1.000000	0.999938	0.970412	0.990579	0.984771
DD	0.999938	1.000000	0.970195	0.990441	0.984673

BL	0.970412	0.970195	1.000000	0.992760	0.995653
MS2	0.990579	0.990441	0.992760	1.000000	0.999096
TD	0.984771	0.984673	0.995653	0.999096	1.000000

IV.3 Augmented Dick-Fuller (ADF) Test

This paper uses Augmented Dicky-Fuller (ADF) test to examine the presence of unit roots in the variables. ADF test is an extended version of the original test of Dicky and Fuller (1979) to control for the serial correlation of the error term (Dicky and Fuller, 1981). Cointegration in empirical methodology requires variables that are non-stationary in level but stationary after first-differencing. To test whether variables are stationary or not, unit root tests are performed. The time series properties of variables are examined by Dicky and Fuller (DF) or Augmented Dick-Fuller (ADF) unit root test. It is used to determine the order of integration of time series. The test is based on estimates of the following regression equations. For level:

$$\Delta x_t = \propto_1 + \propto_2 T + \propto_3 x_{t-1} + \sum_{i=1}^{p} \propto_{4i} \Delta x_{t-i} + \varepsilon_t \qquad (1)$$

And for first difference:

$$2_\Delta \; x_t = \propto_1 + \propto_2 T + \propto_3 \Delta x_{t-1} + \sum_{i=1}^{p} \propto_{4i} 2_\Delta \mathrm{x}_{\mathrm{t-i}} + \varepsilon_t \qquad (2)$$

Where variable $x_t$the variable is tested for unit root; Δ is the first difference operator; $\propto_1$.is the constant term; T is time trend; p is the number of the lag length which was selected. The null hypothesis is H_0: $\propto_3$=0 and the alternative hypothesis H_1: $\propto_3$<0. When the absolute value of the calculated t-test is greater than the critical value from Mackinnon (1991), the null hypothesis of the unit root (non-stationary) is rejected, indicating that the variable is stationary at level and integrated of degree zero [I~ (0)]. However, when the absolute value of the calculated t-test is smaller than the critical value, the null hypothesis of the unit root (non-stationary) is accepted, indicating that the variable is not stationary at their level form and we have to check their stationary for the first difference.

IV.4 Johansen Cointegration Test

In order to examine the cointegration relationship between the stock market index and the M1 and M2, this study employs widely used Johansen (1988, 1991) cointegration test which implement a maximum likelihood procedure. This is because our time series variables are nonstationary in level and stationary after first-differencing. If a cointegration among the LDD, LBL and MS1 or LTD, LBL and MS2 variables were found, it implies that there is a long run relationship between stock market price index and money supply. This methodology tests for the number of cointegration relationships and estimates the parameters of such cointegrating relationships. The cointegration is applied by using vector autoregressive (VAR) model. A general unrestricted VAR model can be represented as the following:

$$y_t = A_0 + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \eta_t \quad t = 1, 2, \ldots, T \qquad (3)$$

Where y_t is (n x 1) vector of variables, α is (n x 1) vector of constant terms and η_t is (nx1) vector of usual error term. Equation (3) could be rewritten in the following error correction form:

$$\Delta y_t = A_0 + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \Pi y_{t-1} + \eta_t \qquad (4)$$

Where

$$\Pi = \sum_{i=1}^{p} A_i - I \quad \text{and} \; \Gamma_i = -\sum_{j=i+1}^{p} A_j$$

If coefficient matrix Π has reduced rank r < k, then there exist k x r matrices α and β each with rank r such that $\pi = \alpha\beta'$ and βy_t is stationary. Here r is the number of cointegrating relationships, the elements of α are defined as the adjustment parameters and each column of β is a cointegrating vector. The Johansen-Juselius test uses two test statistics through VAR model to identify the number of cointegrating vectors, namely the trace test statistic and the maximum eigen-value test statistic. The test statistic for the trace test is given by:

$$Trace = -T \sum_{i=r+1}^{n} In(1 - \hat{\lambda}_i) \qquad (5)$$

The trace test's null hypothesis is r = 0, cointegrating vectors against the alternative hypothesis of n cointegrating vectors.

The maximum eigenvalue test is given by:

$$\lambda_{max} = -T\, In(1 - \hat{\lambda}_{r+1}) \qquad (6)$$

This test, on the other hand, tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of (r + 1) cointegrating vectors.

IV.5 Vector Error Correction Model (VECM)

Once a cointegration relationship is established between variables, a need arises for the construction of an error correction mechanism to model the dynamic relationship. The aim of the error correction model is to indicate the speed of adjustment from the short-run to the long-run equilibrium. A Vector Error Correction Model (VECM) is a restricted VAR model used with non-stationary series that are cointegrated. When equilibrium conditions are imposed, the VECM describes how the model is adjusting in each time period toward its long-run equilibrium. Because the variables are supposed to be cointegrated, any deviation from the long-run equilibrium will feedback in the short run on changes in the dependent variables in order to move toward the long-run equilibrium. According to Engle and Granger (1987), if two series are co-integrated of order one, that is, $I(1)$, then there must exist a VECM representation in order to govern the joint behavior of the series of the dynamic system.For this study, VECM is estimated as follows:

$$\Delta LMS1_t = \propto_1 + \sum_{i=1}^{p} \propto_{2i} \Delta LMS1_{t-i} + \sum_{i=1}^{n} \propto_{3i} \Delta \mathrm{LDD}_{t-i} + \sum_{i=1}^{n} \propto_{4i} \Delta \mathrm{LBL}_{t-i} + \sum_{i=1}^{n} \propto_{5i} \Delta \pi + \propto_{6i} e_{t-1} + \delta_{1t} \quad (7)$$

$$\Delta \mathrm{LDD}_t = \propto_1 + \sum_{i=1}^{p} \propto_{2i} \Delta LMS1_{t-i} + \sum_{i=1}^{n} \propto_{3i} \Delta \mathrm{LDD}_{t-i} + \sum_{i=1}^{n} \propto_{4i} \Delta \mathrm{LBL}_{t-i} + \sum_{i=1}^{n} \propto_{5i} \Delta \pi + \propto_{6i} e_{t-1} + \delta_{2t} \quad (8)$$

$$\Delta \mathrm{LBL}_t = \propto_1 + \sum_{i=1}^{p} \propto_{2i} \Delta LMS1_{t-i} + \sum_{i=1}^{n} \propto_{3i} \Delta \mathrm{LDD}_{t-i} + \sum_{i=1}^{n} \propto_{4i} \Delta \mathrm{LBL}_{t-i} + \sum_{i=1}^{n} \propto_{5i} \Delta \pi + \propto_{6i} e_{t-1} + \delta_{2t} \quad (9)$$

$$\Delta LMS2_t = \propto_1 + \sum_{i=1}^{p} \propto_{2i} \Delta LMS2_{t-i} + \sum_{i=1}^{n} \propto_{3i} \Delta \mathrm{LTD}_{t-i} + \sum_{i=1}^{n} \propto_{4i} \Delta \mathrm{LBL}_{t-i} + \sum_{i=1}^{n} \propto_{5i} \Delta \pi + \propto_{6i} e_{t-1} + \delta_{1t} \quad (10)$$

$$\Delta \mathrm{LTD}_t = \propto_1 + \sum_{i=1}^{p} \propto_{2i} \Delta LMS2_{t-i} + \sum_{i=1}^{n} \propto_{3i} \Delta \mathrm{LTD}_{t-i} + \sum_{i=1}^{n} \propto_{4i} \Delta \mathrm{LBL}_{t-i} + \sum_{i=1}^{n} \propto_{5i} \Delta \pi + \propto_{6i} e_{t-1} + \delta_{2t} \quad (11)$$

$$\Delta \mathrm{LBL}_t = \propto_1 + \sum_{i=1}^{p} \propto_{2i} \Delta LMS2_{t-i} + \sum_{i=1}^{n} \propto_{3i} \Delta \mathrm{LTD}_{t-i} + \sum_{i=1}^{n} \propto_{4i} \Delta \mathrm{LBL}_{t-i} + \sum_{i=1}^{n} \propto_{5i} \Delta \pi + \propto_{6i} e_{t-1} + \delta_{2t} \quad (12)$$

where e_{t-1} is the error correction term lagged one period with coefficient$\propto_{6i}$ measuring the adjustment of model from the short run to the long run and δ is the white noise. The estimation of the first two equations determines the nature of the relationship between SSPI and M1.

Whether a VAR model in levels or a VECM is a better approach for modeling cointegrated series remains debatable. While the VECM conveniently combines the long-run behavior and short-run interactions of the variables and thus can better reflect the relationship between the variables, the popularity of the VAR model in levels lies in its low computational burden. Moreover, it is still unclear whether the VECM outperforms the VAR model in levels at all forecasting horizons (Naka and Tufte, 1997). In the literature dealing with short-run dynamic interactions, it seems to be normal to estimate the VAR model in levels for cointegrated variables.

Granger (1986) states that if two variables are stationary of order (1) and cointegrated, then either the first variable leads to the second variable or vice versa. In this study, the Granger causality test based on VECM is used. This provides an additional channel for long-run causality, which is ignored by the Sims and Granger causality tests. Long-run causality is confirmed using the joint significance of the coefficients of lagged variables. A Chi-squared test is employed to check the joint significance of the coefficients of lagged variables and t-tests are used to check for significance of the error term.

V. Empirical Results

V.1 Unit Root Test

Table 2 Unit Root Test

	Augmented Dickey-Fuller test statistic				Phillips-Perron test statistic			
Variables	(t-Statistic) Level with Constant	Prob.	(t-Statistic) First difference with Constant	Prob.	t-Statistic Level with Constant	Prob.	(t-Statistic) First difference with Constant	Prob.
LMS1	2.671709	1.00	-13.57415*	0.00	2.671709	1.0000	-13.62966*	0.00
LMS2	1.906415	0.99	-15.02610*	0.00	1.964946	0.9999	-15.02750*	0.00
LTD	1.356481	0.99	-16.51947*	0.00	1.489762	0.9993	-16.42247*	0.00
LBL	-0.173715	0.93	-6.320085*	0.00	-0.077092	0.9492	-16.39399*	0.00
LDD	2.089317	0.99	-14.37508*	0.00	2.049188	0.9999	-14.42305*	0.00

Note: * Statistically significant at the 1% significant level

All variables are not stable in their levels but they are stable at their first difference. Therefore, the null hypothesis is accepted in the levels of the variables but rejected at their first differences.These variables are in fact integrated of order one, I~ (1) The conclusion is the same with Augmented Dickey-Fuller test statistic and with Phillips-Perron test statistic.

V.2 Johansen Cointegration Test

From Table 3 panel A the study confirms the fact that long run relationship among LMS1, LDD and LBL exists. Trace test as well as Max-eigenvalue test indicate one cointegration equation at 5% level of significant.

Table 3 Cointegrration

Panel A: Cointegration Test - LMS1, LDD and LBL				
R	Trace Statistic	Prob.**	Max-Eigen Statistic	Prob.**
None*	48.82883	0.0010	34.67474	0.0006
At most 1	14.15409	0.2789	8.564263	0.2789
At most 2	5.589828	0.2249	5.589828	0.2249
Panel B: Cointegration Test - LMS1 and LDD				
R	Trace Statistic	Prob.**	Max-Eigen Statistic	Prob.**

None*	39.54720	0.0000	34.88062	0.0000
At most 1	4.666581	0.3220	4.666581	0.3220
Panel C: Cointegration Test - LMS1 and LBL				
R	Trace Statistic	Prob.**	Max-Eigen Statistic	Prob.**
None*	32.94660	0.0005	28.72217	0.0003
At most 1	4.224421	0.3797	4.224421	0.3797
Panel D: Cointegration Test - LDD and LBL				
R	Trace Statistic	Prob.**	Max-Eigen Statistic	Prob.**
None*	27.75198	0.0038	23.84921	0.0023
At most 1	3.902765	0.4268	3.902765	0.4268
Panel E: Cointegration Test - LMS2, LBL and LTD				
R	Trace Statistic	Prob.**	Max-Eigen Statistic	Prob.**
None*	38.79686	0.0196	24.94704	0.0208
At most 1	13.84982	0.2999	8.906879	0.4439
At most 2	4.942939	0.2897	4.942939	0.2897
Panel F: Cointegration Test - LMS2 and LDD				
R	Trace Statistic	Prob.**	Max-Eigen Statistic	Prob.**
None*	37.64749	0.0001	35.00425	0.0000
At most 1	2.643237	0.6492	2.643237	0.6492
Panel G: Cointegration Test - LMS2 and LTD				
R	Trace Statistic	Prob.**	Max-Eigen Statistic	Prob.**
None*	36.49091	0.0001	32.36688	0.0001
At most 1	4.124031	0.3940	4.124031	0.3940
Panel H: Cointegration Test - LMS2 and LBL				
R	Trace Statistic	Prob.**	Max-Eigen Statistic	Prob.**
None*	29.98620	0.0017	24.37406	0.0018
At most 1	5.612138	0.2229	5.612138	0.2229

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

This is true also for LMS1 and LDDas shown in panel B which indicates long run relationship between LMS1 and LDD.Panel C confirms long run relationship between LMS1 and LBL. From cointegration table 3 panel D, the long run relationship between LDD and LBL is confirmed.Table 3 panelE, G and H, verifies a rejection of the null hypothesis of no cointegration (r=0) between LMS2, LTD and LBL against the alternative of presence of cointegration at 5% level of significance. A trace test as well as Max-eigenvalue test indicates one cointegration equation for all cases. The study concludes a long run relationship between all variable. Since the cointegration among all variables are satisfied, the vector error correction model (VECM) is used to discover the direction of long run as well as short run causality and to measure the speed of adjustment toward long run equilibrium.

V.3 Vector Error Correction Model (VECM)

Long run causality in model (1) Table 4 is confirmed for a long run relationship among DLMS1, DLDD and DLBL which mean that the long run change in MS1 is explained by the dependent variables: DLDD and DLBL. The Error Correction Coefficient is negative and significant which means that 31 percent of the deviation of MS1 from its long run equilibrium is corrected monthly by the dependent variables. The second equation in the same model for DLDD confirms a long run relationship among DLMS1, DLDD and DLBL which means that the long run change in DLDD is explained by the dependent variables: DLMS1 and DLBL. The Error Correction Coefficient is negative and significant which means that 21 percent of the deviation of DD from its long run equilibrium is corrected monthly by the dependent variables. In the second model which looks to the relation between the DLMS1 and DLDD confirms a long run relationship and a long run bidirectional causality between DLMS1 and DLDD. The Error Correction Coefficient for the equation of DLMS1 is negative and significant which indicates that 18 percent of the deviation of MS1 from its long run equilibrium is corrected monthly by the dependent variable DLDD. In the same model the Error Correction Coefficient for the equation of DLDD is negative and significant which means that 12 percent of the deviation of LDD from its long run equilibrium is corrected monthly by the dependent variable.

Table 4 VECM Results

Mod	Dependent Variables	Exogenous Variables	Error Correction Coefficients	t-stat estem	LR causa	Lag selec	Criteria	SR causality "Wald Test"	SR causality "Granger"
1	DLMS1	DLDD, DLBL	-0.311005	-5.14	Yes	7	FPE & AIC	No	NO
	DLDD	DLMS1, DLBL	-0.211452	-3.10	Yes	7	FPE & AIC	LMS1 Causes LDD	LMS1 Causes LDD
	DLBL	DLMS1, DLDD	-0.059025	-0.92	NO	7	FPE & AIC	NO	NO
2	DLMS1	DLDD	-0.179275	-4.59	Yes	8	LR, FPE, & AIC	NO	NO
	DLDD	DLMS1	-0.122687	-2.79	Yes	8	LR, FPE, & AIC	LMS1 Causes LDD	LMS1 Causes LDD
3	DLMS1	DLBL	-0.007884	-3.98	Yes	8	LR, FPE, & AIC	NO	NO
	DLBL	DLMS1	0.003390	1.63	NO	8	LR, FPE, & AIC	NO	NO
4	DLDD	DLBL	-0.007788	-6.13	Yes	8	LR, FPE, & AIC	NO	NO
	DLBL	DLBL	0.001573	1.36	NO	8	LR, FPE, & AIC	NO	NO

5	DLMS2	DLTD, DLBL	-0.120157	-3.52	Yes	8	LR, FPE, AIC	NO	LTD and LBL Cause LMS2
	DLTD	DLMS2, DLBL	-0.054951	-1.68	NO	8	LR, FPE, AIC	NO	LBL Causes LTD
	DLBL	DLMS2, DLTD	0.005267	0.13	NO	8	LR, FPE, AIC	NO	NO
6	DLMS2	DLTD	-0.141004	-3.66	Yes	2	FPE, AIC, HQ	NO	LTD Causes LMS2
	DLTD	DLMS2	-0.112650	3.14-	Yes	2	FPE, AIC, HQ	NO	NO
7	DLMS2	DLBL	-0.026578	-3.37	Yes	8	LR, FPE, AIC	NO	LBL Causes LMS2
	DLBL	DLMS2	0.018322	1.87	NO	8	NO	NO	NO

LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

In model (3), the equation of DLMS1 confirms a long run relationship between DLMS1 and DLBL and one way long run causality running from DLBL to DLMS1. The Error Correction Coefficient for the equation of DLMS1 is negative and significant which means that 0.8 percent of the deviation of DLMS1 from its long run equilibrium is corrected monthly by the dependent variable DLBL, howeverthe speed of adjustment in this model is very small. Model (4)indicates that DLDD is influenced by DLBL. The Error Correction Coefficient for the equation of DLDD is negative and significant which means that 0.8 percent of the deviation of DLDD from its long run equilibrium is corrected monthly by the dependent variable DLBL, however the speed of adjustment in this model is very small. If the LMS1 is replaced by LMS2, model (5) reports the result. Long run causality in model (5) is confirmed for a long run relationship among DLMS2, DLTD and DLBL which mean that the long run change in DLMS2 is explained by the dependent variables: DLTD and DLBL. The Error Correction Coefficient is negative and significant which means that 12 percent of the deviation of DLMS2 from its long run equilibrium is corrected annually by the dependent variables DLTD and DLBL. There are a long run causality running from DLTD and DLBL to DLMS2. The model (6) assures a long run relationship and a long run bidirectional causality between DLMS2 and DLTD. The Error Correction Coefficient for the equation of DLMS2 is negative and significant which means that 14 percent of the deviation of DLMS2 from its long run equilibrium is corrected annually by the dependent variable DLTD. The Error Correction Coefficient for the equation of DLTD is negative and significant which means that 11 percent of the deviation of DLTD from its long run equilibrium is corrected annually by the dependent variable. Finally, the last model verifies a long run relationship and one way long run causality running from DLBL to DLMS2. The speed of adjustment as represented by the Error Correction Coefficient for the equation of DLMS2 is negative and significant which means that 2.6 percent of the deviation of DLMS2 from its long run equilibrium is corrected annually by the dependent variable.

The short run causality according to Wald Test is only validated the one way causality running from DLMS1 to DLDD. However, the short run causality according to Granger is running from LMS1 to LDD and from LTD and LBL to MS2. The Granger short run causality could be extended to include the causality running from LBL to LTD and from LTD to LMS2 and from LBL to LMS2.

VI. Conclusion

The study concludes a long run relationship between all variable. Since the cointegration among all variables are satisfied, the vector error correction model (VECM) is used to discover the direction of long run as well as short run causality and to measure the speed of adjustment toward long run equilibrium.The evidence related to Saudi Arabia is strongly consistent with the hypothesis that the money supply is credit-driven and demand-determined,as the vector error correction model indicates. The long run causality was found to run from bank loans (BL) and from demand deposit (DD) to the money supply (MS1), and not from MS1to BL, as the mainstream view.The endogenios money supply hypothesis is reinforced by the long run causality running from BL to DD. This result is similar to the finding of Lopreite (2012) with regard to the Euro Area using data from 1999 to 2010. For MS2, the study verifies a long run causality running from BL and DD 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 using Wald Test does not confirm money supply endogeneity in the short run. In fact the causality is running from MS1 to DD which supports conventional money supply theory.Short run causality using Granger with regard to MS2 assures short run causality running from TD and BL to MS2. The implication of this work is that Saudi monetary agency can not control the money supply in the long run. It only has some influence on MS1 in the short run. Indeed, the influences of commercial banks in Saudi Arabia cannot be ignored.

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