Does Interest Rate Form Business Cycle

Bijan Bidabad[1] Abul Hassan[2]

Abstract

This paper studies the dynamic structure effect of depositors, bank and investors behaviors on business cycle. Empirical results show that the source of fluctuations in real economy comes from short term interest rates, however, medium and long terms interest rates dampen real economy fluctuations.

Keywords: Business cycle, Interest rate, Banking Sector.

JEL: E32, E43, G01

1.Introduction

There are several studies on business cycles from different points of view. Essence of these studies were to find out solution how to reform monetary and banking structure and overcome economic crisis. The purpose of this paper is to examine the relation between interest rates and business cycle formation. In the area of business cycle, Fisher's (1933) "Theory of Credit Cycles" is one of the interesting theories discusses elaborately about the causes of business cycles. He argues that credit cycles are the main reasons for economic cycles. Minsky (1992) puts forward the financial instability hypothesis and in the line of Fisher's theory, he further argues on credit bubbles and their burst effects on economic cycles. While discussing the "Austrian Business Cycle Theory", Block and Barnett (2007) state that banking structure is one of the factors to create crisis. Some other researches have also touched different aspects of the relation between interest rate and business cycle (Beaudry and Guay, 1996; Blankenau et al,2001; Ivanova et al,(2000); but none of these studies look at the fluctuation of bank interest rates which is one of the causes of business cycle in the economy. Therefore, this study made an attempt to show the co-movements between interest rates and output.

2. Dichotomization of Money Market

This study highlights on money market by bifurcating bank's behavior into two markets namely saving-deposit and investment-credit markets in line of the studies of Bidabad (2004, 2010). In one hand, the demand of bank for deposits is kept at one side which intersects with supply of deposits (saving) and fixes deposit interest rate. On the other hand, bank creates another market by supplying credit funds that

[1] - Bijan Bidabad, Professor of Economics and Chief Islamic Banking Advisor to Bank Melli Iran, Tehran, Iran. No. 2, 12th Street, Mahestan Avenue, Shahrak Gharb, Tehran, 14658 Iran. Tel.: +98-21-88360810. Fax : +98-21-88360811. Mobile: +98-912-1090164. Site: http://www.bidabad.com. E-mail: bijan@bidabad.com

[2] Abul Hassan, Lecturer and Senior Research Fellow, Markfield Institute of Higher Education (University of Gloucestershire), Ratby Lane, Markfield, Leicestershire LE67 SY, UK. Tel: +44 1530 244922. Fax: +44 1530 243102. E-mail: abul.hassan@mihe.org.uk

intersects demand for credit and creates loan interest rate. In view of this, bank stands between two markets of supply and demand of funds in money market.

In case the consumption increases, the supply of bank deposits will fall. As a result, there will be an increase in the deposit interest rate. The increase in deposit interest rate cannot instantly increase credit lending interest rate because credit contracts have been fixed for a period of time and bank has to wait for contract maturity to increase the rate. Therefore, bank will face loss during this period and thereafter it will be compensated by increasing loan interest rate by a time lag. This lag, from economic point of view creates a special dynamic relationship between supply and demand for money. In the following lines, mathematically shown that because of this lag, the relationship between these two variables (supply and demand for money) is a second order difference equation. Second order difference equations have ability to create the cycles. In other words, fluctuation of real economy is induced by fluctuations in money market. The most important effect of elimination of interest rate (Islamic banking) is to bridge between investment and saving. This analysis is shown in the following graph:

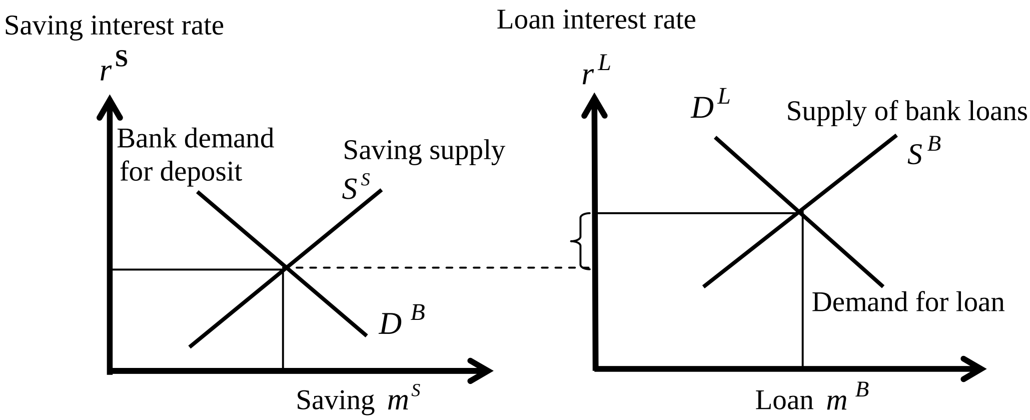

Figure 1

Where:

S^B	Loan supply by banks
S^S	Fund supply by depositors
D^L	Loan fund demand
D^B	Bank demand for funds
r^S	Saving interest rate
r^L	Loan interest rate
m^S	Amount of saving
m^B	Amount of loans
R	Bank's revenue

Bank's revenue at the time t is equal to:

$$R_t = m_t^B r_t^L - m_t^S r_t^S \tag{1}$$

At equilibrium we have:

$$m_t^B = D_t^L = S_t^B \quad (2)$$

$$m_t^S = D_t^B = S_t^S \quad (3)$$

In case the demand for loans decreases, D_t^L moves from left side to D_{t+1}^L. In the new equilibrium, if bank's revenue turns negative, we will get following equations:

$$r_{t+1}^L < r_t^L \quad (4)$$

Or:

$$R_{t+1} = m_{t+1}^B r_{t+1}^L - m_t^S r_t^S < \circ \quad (5)$$

Therefore, in respect of time-based loan contract, bank has to compensate losses during the period t+1from other sources until the next period when D^B curve moves to the left hand side. It is shown below:

$$r_{t+2}^S > r_{t+1}^L \quad (6)$$

$$R_{t+2} = m_{t+1}^B \ r_{t+1}^L - m_{t+2}^S \ r_{t+2}^S > \circ \quad (7)$$

By generalizing this hypothesis, we clearly see that whenever shocks occur in deposit supply or demand for banks' loans, because of time-based contracts, these shocks will be transferred to other market in the next period. This fluctuations will effect from one market to another market and finally extend to other markets in real economy as well.

By considering the sign of three equations of (1), (5) and (7), we can clearly see that the behavior of variable R is alternative in different time periods. The behavior of the above mentioned two markets may be similar with the Cob-Web model which creates different fluctuation according to the gradient of different parts of supply and demand schedules. The interest rates in the two markets are:

$$r_t^S = r^S(m_t^S) \quad (8)$$

$$r_t^L = r^L(m_t^B) \quad (9)$$

According to the above assumptions, if we adjust the relationship of the two markets with one time-lag, we will have:

$$m_{t+1}^S = f(m_t^B) \quad (10)$$

By replacing (8) and (9) in (10), we have:

$$r_t^S = r^S(f(m_{t-1}^B)) = r^S(f(r^{L^{-1}}(r_{t-1}^L))) \quad (11)$$

In other words, the interest rate in the deposit market is a function of interest rate in loan market in the previous period. The adjustment takes place when the return movement occurs in the next period which means that the interest rate of loan market is itself a function of interest rate of deposit market in the previous period, or:

$$m_{t+1}^B = g(m_t^S) \quad (12)$$

By replacing (10) in (12), we will have:

$$m_{t+1}^B = g(f(m_{t-1}^B)) \quad (13)$$

This is a second order difference equation which is characterized to fluctuate easily in time, (Baumol,1958; Baumol and Turvey,1951). This is also true in the case of the interest rates. By replacing (12) in (10), we have:

$$m_{t+1}^{S} = f(g(m_{t-1}^{S})) \tag{14}$$

This equation similar to (13) may be considered completely oscillatory. By replacing (12) in (9), we will have:

$$r_t^L = r^L(g(m_{t-1}^S)) = r^L(g(r^{S^{-1}}(r_{t-1}^L))) \tag{15}$$

Since equations (15) and (11) are function of m_{t-1}^S and m_{t-1}^B these two variables may be considered completely oscillatory according to (14) and (13). Hence, both loans and deposits markets may fluctuate due to interest rates and amount of deposits and loans fluctuations. Considering the equilibrium at macro level and its relationship with interest rate fluctuations induced by the banking behavior, we can go through the following national accounting relationship equations:

$$\begin{aligned} gdp &= con + inv + gov + ex - im \\ gde &= con + sav + tax + tr \\ gdp &= gde \end{aligned} \tag{16}$$

In which:

gdp = gde	Gross domestic product = Gross domestic expenditure
con	Consumption
inv	Investment
gov	Government expenditures
ex	Exports
im	Imports
sav	Savings
tax	Tax
tr	Transfer payments to outside

By solving equation (16), macroeconomic equilibrium condition will be as follow:

$$(inv\text{-}sav) + (gov\text{-}tax) + (ex\text{-}im\text{-}tr) = 0 \tag{17}$$

In order to make simplification, we will only consider the two variables of investment and saving as functions of interest rates of saving deposits and loans (r^S and r^L). The equilibrium condition in the economy at time t will be following:

$$(inv_t(r_t^L) - sav_t(r_t^S)) + (gov_t - tax_t) + (ex_t - im_t - tr_t) = 0 \tag{18}$$

By replacing r_t^S and r_t^L from equations (15) and (11) in equilibrium condition, we will have:

$$\left(inv_t\left(r^L(g(r^{S^{-1}}(r_{t-1}^L)))\right) - sav_t\left(r^S(f(r^{L^{-1}}(r_{t-1}^L)))\right)\right) + (gov_t - tax_t) + (ex_t - im_t - tr_t) = 0 \tag{19}$$

In case the government has balanced fiscal policy $(gov_t - tax_t)=0$ and trade $(ex_t - im_t - tr_t)=0$, then the equilibrium (19) is again a second order difference equation which can lead the economy into oscillation.

3. Empirical Investigations

As we shown mathematically, the behavioral difference of the equation in interest rates of the deposit and loan sources, create fluctuations in money and capital markets. This phenomena can easily fluctuates the supply and demand in real sector through investment demand and saving supply functions as shown emphatically. Bidabad (1990) argues that if the time behavior of y_t obeys a second order difference equation, type of roots (being real or complex or double), their absolute values (being larger or smaller than one), are critical for shape of fluctuations.

In order to show the oscillatory natures of the interest rates, we need to conduct empirical test to see whether the equations (11) and (15) are true in nature or not. Using the sample of USA data[3] for the period of 1948-2009, we test weather equations (11) and (15) are oscillatory or not. If it is true, then the oscillation will be transferred to equations (18) and (19) which are the macroeconomic equilibrium condition. Our empirical results show that the source of oscillation is emanated from interest rates to real sector. Ten types of short, medium and long terms interest rates have been selected. We fit a second order linear non-homogenous difference equation to all 10 selected interest rates.

Table 1. Estimation results and characteristic roots of ten estimated equations

Dependent Variable	$Y_t = ß_0 + ß_1.Yt_{-1} + ß_2.Y_{t-2}$							
Y_t	**Sample**	**obs.**	$ß_0$	$ß_1$	$ß_2$	R^2	**roots**	**Characteristic roots**
Certificates of Deposit Rate (secondary market-3 month)	1967-2009	43	1.412 (2.124)	1.173 (7.828)	-0.405 (-2.675)	0.714	complex	0.586±0.865i
Commercial Paper Rate	1974-2009	36	1.092 (1.609)	1.208 (7.807)	-0.406 (-2.564)	0.761	complex	0.603±0.877i
Discount Rate (End of Period)	1950-2009	60	0.877 (2.387)	1.168 (9.376)	-0.349 (-2.786)	0.774	complex	0.584±0.830i
Federal Funds Rate	1957-2009	53	1.159 (2.241)	1.121 (8.255)	-0.332 (-2.445)	0.721	complex	0.560±0.803i
Lending Rate (Prime Rate)	1950-2009	60	1.193 (2.553)	1.195 (9.559)	-0.364 (-2.962)	0.799	complex	0.597±0.849i
Treasury Bill Rate(Bond Equivalent-3 month)	1977-2009	33	0.920 (1.412)	1.212 (7.048)	-0.384 (-2.153)	0.768	complex	0.606±0.866i
Mortgage Rate	1974-2009	36	0.713 (1.140)	1.301 (7.983)	-0.386 (-2.339)	0.874	real	0.843, 0.458
Treasury Bill Rate	1950-2009	60	0.738 (2.126)	1.173 (9.257)	-0.330 (-2.614)	0.792	real	0.705, 0.469
Govt. Bond Yield: Long Term (10 year)	1956-2009	54	0.511 (1.491)	1.103 (7.973)	-0.180 (-1.319)	0.880	real	0.903, 0.200
Govt. Bond Yield: Medium Term (3 year)	1950-2009	60	0.539 (1.656)	1.127 (8.668)	-0.222 (-1.718)	0.856	real	0.872, 0.255

T-statistics are in parentheses.

Table 1 shows all estimated parameters are statistically significant and proves that a second order linear difference equation exist for all 10 interest rates. All short term interest rates' difference equations have complex characteristic roots; but the characteristic roots of difference equations of medium and long terms interest rates are all real. These results prove that the source of fluctuations in real economy comes from short term interest rates. On the other side, the medium and long term interest rates have real characteristic roots which one of the pair is close to one or less than one. As a result, we can come in the

[3] - International Monetary Fund, 2010. International Financial Statistics, 2010. Country Note, USA, http://www.imfstatistics.org

conclusion that the medium and long term interest rates dampen oscillation.

4. Conclusion

This study shows that the business cycles occur because of the dynamic structure of different interest rates. The results demonstrate that there is an inherent lag structure between deposit's and loan's interest rates. The observed lag structure actually forms a second order difference equation behavior in banking sector as source of oscillations which start from money market and expands to real economy. Using the sample of the United States interest rates data for the period of 1948-2009, the results show that short-term interest rates is one of the main causes of fluctuations. The estimated dynamic equations for short-term interest rates had complex characteristic roots that let the equations be oscillatory. The long-term and medium-term interest rates equations had real characteristic roots and were not oscillatory.

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