THRESHOLD EFFECTS OF REAL INTEREST RATE ON INVESTMENT OF THE PRIVATE SECTOR IN IRAN: TESTING STIEGLITZ'S THEORY

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Abstract

In this paper, Stieglitz's theory regarding the threshold effects of real interest rate on investment of Iran's private sector during 1973-2008 is experimentally examined. The study showed that although the real interest rate directly affects on private investment in Iran, an increase of more than 2 percent in the real interest rate will reduce the private sector's investment. In other words, Stieglitz's argument about a one-threshold level (close to zero) of the real interest rate is confirmed in Iran. Paying attention to the rate of inflation and threshold limit of influence of interest rate on monetary policies is considered the most important proposals of the present research.

JEL Classification: E22, E43, E44.
Field of Research: *Private sector's investment, Real interest rate, Threshold effects.*

1. Introduction

After World War II, a large number of economic researches have been allocated to economic growth. In one-[3], two-[4] and three-gap growth models[5], investment is always regarded as engine of economic growth. Importance of positive investment, on one hand is due to its key role in building capacity of the production and increasing supply; and on the other hand it is because of stimulation of overall demand. Referring the statistical data and information, one can observe that generally the private sector's investment is the most fluctuate component among the GDP components, especially in developing countries, for which one main reason is too many factors and variables, including economic and non-economic, affecting the private sector's investment. The real interest rate is considered as the most important factor affecting the private sector's investment. From the perspective of traditional Monetarists, expansionary monetary policies are mostly aimed to increase investment by reducing the interest rate. From 1949, followers of this school insisted on the negative effect of real interest rate on

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[3]One-gap growth models include those in which the gap between savings and investment is considered a challenge for economic growth.
[4]Two-gap growth models include those in which the gap between savings, investment and foreign exchange gap (exports and imports) are considered as restrictions on economic growth.
[5]The models, in which gaps between savings and investment, and foreign exchange gap and the gap between government expenditures and revenues are considered obstacles to development. For more information on multi-gap growth models, see also: Bacha, Edmar. L (1990).

investment for two decades. From early 1970s, structuralisms, who supported the traditional Monetarists' views, believed that the increased interest rate of the bank deposits confronts the financial and non-bank monetary markets with a record impulse. Therefore, considering the role of the above markets in financing projects, increased interest rate of the bank deposits will always reduce the investment. Following severe criticism by McKinnon (1993), negative effect of real interest rate on investment of the private sector was questioned. Citing some experimental results, he showed that any increase in interest rates, which is done due to increased supply of credit and money resources, will finance increase in the private sector's investment. Although the viewpoints of traditional monetarists and structuralisms against the McKinnon's idea provide two completely different thoughts and beliefs, Stieglitz (1998) proposed an intermediate but new opinion. He believes that the any increase, from a positive value, and close to zero, in real interest rate reduces the private sector's investment. In other words, from the perspective of Stieglitz, the effect of real interest rate on investment of the private sector is not always positive or negative, and there is a threshold level for the real interest rate, to less than which reduction of real interest rate decreases the private sector's investment. This paper examines the effect of real interest rate on investment of the private sector in Iran during the 1973-2008. The main goal of this study is to estimate the threshold (critical) rate of interest in accordance with the Stieglitz's perspective and experimental test of the above views in Iran's economy. For this purpose, first, some domestic empirical studies as well as studies abroad are reviewed. The third section of the paper is assigned to introduce methodology and econometric models. In the fourth section research findings and results of estimating econometric models are presented, and the final section will conclude.

2. Empirical Evidences

As can be seen in the introduction of this research, theoretical views on the research's subject matter do not confirm each other. That's why in some countries, the effect of interest rates on the private sector's investment has been experimentally tested. Using time series data of 1983-1996 related to 105 Nigerian companies, Falokun and Omole (1999), concluded that liberalization of interest rates had significant positive effect on investment of the companies above. Studies by Pratap and Urrutia (2004) about the financial crises in Latin America and East Asia showed that adopting expansionary monetary policies in these regions has increased the investment, considering reduction of real interest rate. Mallick and Agarwal (2005) examined the short-run effect of real interest rate on investment and economic growth in India. The results of this study showed that interest rates had negative effects on the country's investment and economic growth. Research by Dasgupta and Sengupta (2007) showed that the expected (future) interest rate has positive effect, and current interest rates have negative effect on the private sector's investment. Faia and Monaceli (2007) examined the match of Taylor rule regarding interest rates in the economy of the United States. Result obtained from this study proves that low interest rates increase property prices and investment. Giovanni (2008) examined the effect of interest rate on real output and investment in industrial countries. Based on the results which are in industrial countries, high interest rates have negative effect on the private sector's investment. Therefore, it

can be seen from the matters above that the recent empirical studies do not provide the same results concerning the effect of interest rate on the private sector's investment.

3. Methodology

In this paper, all the data have been collected from Iran central bank data statistic center. Also, the time limitations of the research are related to the time series of 1973-2008. In order to estimation the real interest rate on the private sector investment, the following regression model is proposed:

$$IPF_t = \alpha_0 + \alpha_1 Ipf\,(t-1) + \alpha_2 \Delta GDpf_t + \alpha_3 GEX_t + \alpha_4 RR_t + U_1 t \qquad (1)$$

In the above model, IPF_t, ΔGDP, GEx_t, RR_t, and $UI2$ are the private sector's investment (based on the constant prices of 1998), changes in real GDP, government expenditures, real interest rate and error term component, respectively. Hence, interest rate of the long-run bank deposits is used as the interest rate. A variable with the private sector's investment lag (IPF_{t-1}) has been also entered into the model, considering the partial adjustment pattern. Furthermore, coefficient α_2, actually represents the simple acceleration coefficient; and based on the crowding out effect theory, variable of government expenditures was added to the model. Obviously, in case of a significant α_3, if $\alpha_3 > 0$, crowding in effect will be confirmed; and if $\alpha_3 < 0$, crowding out effect of government expenditures on the private sector's investment will be confirmed. In addition, in case the coefficient of the real interest rate (α_4) is statistically significant, If $0\ \alpha_4 >$, theory of McKinnon will be confirmed; and if $\alpha_4 < 0$, the theory of structuralisms and monetarists regarding the effect of real interest rate on investment of the private sector will be confirmed. To estimate the threshold effect of real interest rate on investment of Iran's private sector, the following regression model is proposed, considering the Sargsyan (2005) [9] method:

$$IPF_t = \beta_0 + \beta_1 .Ipf\,(t-1) + \beta_2 .\Delta GDpf_t + \beta_3 .GEX_t + \beta_4 .RR_t + \beta_5 .D_j R_t + U_2 t \qquad (2)$$

In the relation above, D_j is a dummy variable, which may accept values of 0 and 1, for j=0, 1, 2, so that for the real interest rates of RR<0; values 1 will be first considered; otherwise values 0 will be considered. Then the same way will be repeated for real interest rates of RR<1 and RR<2. In other words, there are three different scenarios being designed for critical real interest rates close to zero (0, 1, and 2 percent). Based on the findings of Nelson and Plosser[6] (1982), most time series of economic data are not reliable, while the unreliable variables increase the risk of spurious regression. Dickey and Fuller (1981 and 1979) and Said and Dikey (1984) have tested unit root and unreliability of time series using an autoregressive model[7]. In 1988, Phillips and Perron introduced another method for testing the unreliability of variables, in which the possibility of structural failure in the time series is considered. In the present study, Phillips-Perron unit root test is used to test the reliability of the model variables above and ensure the absence of spurious regressions. Furthermore in all tests, estimation of econometric models will be done by E-Views software.

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[6]To read more about spurious regression, see also: Verbeek, M (2004).
[7]For more information, see: Phillips, P.C.B. and P. Perron (1988).

4. Results

Results of Phillips-Perron unit root test of variables have been given in Table 1. As it can be seen from the information in this table, variables of the private sector's investment (IPF_t) and the real interest rate (RR_t) are stationary at the significance level of 5 percent, while variables of change in real GDP (D (GDP_t)) and government expenditures (GEX_t) are stationary at the significance level of 1 percent.

Table1: Results of Philips-Perron test of variables at the level

Variable	specifying the model	optimal lag*	Status of reliability	Philips-Perron statistic
IPF_t	with intercept and without trend	3	reliable at level of 5 percent	-3.1
$D(GDP_t)$	without intercept and without trend	3	reliable at level of 1 percent	-2.7
GEX_t	without intercept and without trend	3	reliable at level of 1 percent	-23.9
RR_t	with intercept and without trend	3	reliable at level of 5 percent	-3.3

* Number of optimal lags has been selected in accordance with Akaike statistic.
Source: The Authors' Calculations.

Regression model No. 1 has been estimated in accordance with the stationary variables at the level, whose results are given in Table 2.

Table2: Results of regression estimation No. 1

Independent variables	Ipf_{t-1}	$D(GDPf_t)$	GEx_t	RR	R^2	D.W
Coefficient of independent variables	0.55	0.7	-0.03	757.3	56%	1.9
t Statistic	3.2	3.9	-1.4	1.8		

Source: The Authors' Calculations.

In the table above, R^2 and D.W are determination coefficient and Durbin-Watson statistic, respectively. As can be seen from the information in Table 2, coefficients of all variables, excluding government expenditures, are significant statistically. Positive significant coefficient of the real interest rate (573.7) shows that for every increase of 1 percent in real interest rate, 573.7 billion *Rials* will be averagely added to the private sector investment. So, theory of traditional monetarists and structure lists concerning the negative effect of real interest rate on the private sector's investment in Iran is rejected. The findings of the three proposed scenarios have been given in Table (3).

Table3: The results of estimating the proposed scenarios

Independent variables	IPF(-1)	D(GDPf)	GEX	RR	D.R	D_1R	D_2R	R_2 (percent)	D.W	Scenarios
Coefficient of independent variables	0.55	0.7	-0.03	678.33	2413.86	____	____	56	1.88	First scenario
t Statistic	3.2	3.8	-1.4	1.4	-0.3					
Coefficient of independent variables	0.55	0.7	-0.04	793.24	____	5295.23	____	57	1.84	Second scenario
t Statistic	3.1	3.7	-1.4	1.7		-0.7				
Coefficient of independent variables	0.49	0.7	-0.05	850.39			-16425.29	63	1.85	Third scenario
t Statistic	2.73	3.94	-2.06	2.49	____	____	-2.09			

Source: The Authors' Calculations

Since coefficient of dummy variable DR and D1R is not statistically significant in the first and second scenario, at the error level of 10 percent and even more, so real interest rates lower/higher than 0, as well as real interest rates lower and higher than 1 have significance difference on the private sector's investment. Therefore, theory of Stieglitz is rejected for real interest rates lower than 0 and 1. In the third scenario (R<2), coefficient of the real interest rate is positive and significant; but considering that negative D2R coefficient at the level of 5 percent is statistically significant, it can be found, from the above relationship, that for the real interest rates less than 2 percent, effects of real interest rates on investment of the private sector are positive, while it is negative for the real interest rates higher than 2 percent. Furthermore, it can be seen from the information in Table 2 that in the third scenario, government expenditures set the crowding out effect on the private sector's investment in Iran. In addition, investment with a one-period time lag and changes of GDP will increase the private sector's investment.

5. Summery and Conclusions

Referring to the literature, one can find that there is no consensus between the economists regarding in effect of real interest rate on investment of the private sector.
In addition to the differences in theoretical perspectives, empirical evidence in different countries does not confirm each other. Traditional monetarists and structuralisms theoretically believe that the real interest rate has continuous negative effect on investment of the private sector, and investment can be destroyed by reducing the interest rate. In contrast, McKinnon showed that reduction of the interest rate will reduce the supply of resources for investment, and that interest rate has always positive effect on the private sector's investment. Stieglitz also believed that there is a threshold level

of the real interest rate, more than of which any increase in real interest rate will decrease the private sector's investment. This research showed that although real interest rate has positive effect on investment of Iran's private sector, increase of more than 2 percent in real interest rate will reduce the private sector's investment. In other words, Stieglitz's argument about a one-threshold level (close to zero) of the real interest rate is confirmed in Iran. One important proposal based on findings of this study is to pay attention to the inflation rate in calculations of the nominal interest rate. Obviously, it is of special importance in the current situation where reduction of nominal interest rate has been considered by Iran central banker. In other words, implementing programs to control inflation and price level plays a key role in the success of the policy of reducing official interest rate.

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