

THE IMPACT OF REAL EXCHANGE RATE UNCERTAINTY ON PRIVATE INVESTMENT IN IRAN

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Abstract

This study sought to analyze the impacts of real exchange rate volatilities on investment in the private sector of the economy of Iran during the period 1961-2008, and also evaluate the impact of real exchange rate uncertainty on private investment behavior during the period under study. For this purpose, first, the uncertainty index of the real exchange rate is determined through auto-regressive patterns of conditional variance heterogeneity (EGARCH) and then it estimated the model. In this study, the entire economy of Iran has been studied during 1961-2008. It is a practical research, in terms of the research goal. In this study, GARCH models to obtain the uncertainty on the time series pattern have been used. Data analysis method is based on descriptive and inferential statistical research; according to inferential statistic, the research hypothesis has been tested. To verify or reject the hypothesis of this study, it was used Eviews software indicates that which variables a correlation exists between. The dependent variable in this model is ratio of the fixed investment to GDP and the independent variables include the import of capital goods, governmental investment, inflation index, GDP and real exchange rate uncertainty. The results showed that the index of real exchange rate uncertainty has a significant negative effect on private investment to GDP ratio, and imports of capital commodity and inflation have negative effects on private investment to GDP ratio.

Keywords: Capital, Investment, Private and Public investment, Exchange rate, Exchange rate uncertainty

Introduction

Investment is one of the most important factors influencing the economic growth, reduction of unemployment and economic problems in developing countries. Private sector investment is of special importance in the economy of any country, due to enhancing performance and allocating resources and production factors. On one side, the development and enhance of investing in any part depend on both the economic benefits of that part and presence and lack of the security and stability of the country's macroeconomic variables. Most economists, regardless of their own school of thought and views, have introduced investment, as the main engine of growth and development. Investment will result in increase in production capacity and productivity with increased employment per capita incomes. In this case, we have a consensus of economists with different schools of thought that the lack of investment in underdeveloped countries is due to and the factor of the backwardness. In general, they

believe that investment is the main solution of complex problems in developing economies and it can be considered as a major factor in economic development. Basically, the investment is divided into two parts, public and private investment. Economists often advise more public investment in infrastructure sectors of the economy, because, from the perspective of private sectors, it cannot be invested in the infrastructure sector and on the other side, infrastructure investment is particularly important in the economy of any country, and this existing feature make economists develop influence of the scope of this section as much as possible, compared with different economic sectors. One of the factors that affect private investment and shift investors in their investment decisions is exchange rate.

Projecting the problem

Developing countries, including Iran, have a high degree of uncertainty in the macroeconomic variables. In this group of countries, growth, inflation, exchange rate and other key macroeconomic variables are more vulnerable to volatility compared with industrial countries' economies. One of the major challenges related to the management of the foreign exchange market in Iran comes back to oil revenues over time; the largest supplier of foreign exchange in Iran is oil sales by state. Experience has shown that the decline, indeed, in oil revenues makes problem in the economy. Pourolady (2008), if considering relationship between exchange rate and DP, it must be said that increase in the exchange rate of the domestic manufacturing companies, which make import inevitably to supply their Foreign-Exchange-Intensive manufacturing inputs, faces increase in prices of inputs that this will increase the final price of goods and services resulting from exchange rate uncertainty. In circumstances in which production-related exchange rate policies inside and outside the country have been eliminated from foreign and domestic competition in the market, domestic investor will be loosed the desire and ability to continue activities, and, naturally, the foreign investor wont express the incentive to invest and produce goods and services, too. The foreign trade is the most important part of the sanctioned prosecutions' eye. Sanction's effect on private investment has occurred in several ways. One way is to limit Iranian relations, banking and currency transfer abroad and vice versa. The private sector, somewhat, limited the issue, by transferring through other countries. Another effect that sanctions could have decreases investing, due to the increased risk and concern in foreign investors, which arise from uncertainty in the foreign exchange rate. Wide volatilities in the real exchange rate are developing countries' characteristics create uncertain environment for the private investment decisions. (Eslamouiyan 2004) in fact, the stability of the exchange rate led to confidence in the domestic economy and thus facilitated investors to make investment decisions. A comprehensive study which was conducted in 2002 by Louis Seruen investigated the impact of real exchange rate uncertainty on private investment in 61 developing countries for the years 1970 to 1995. The study, published by the World Bank, is the main basis of the present study. Also, given the importance and role of investing in economic growth and development and private sector investment advantage due to higher efficiency and optimal allocation of resources and factors of production, as well as in the current situation with regard to the exchange rate and discussion of economic sanctions on Iran and the crisis in Europe Union, and also due to the monoculture of the economy of Iran and its heavy reliance on oil revenues, a recent study can examine how long private investment sector is affected by volatilities in the real exchange rate in investigating the relationship between private investors and volatility of

real exchange rate uncertainty. Therefore, this study seeks to analyze the effects of real exchange rate volatility on private investment in the economy of Iran during the years 1961-2008.

Research Literature

In classical economists' viewpoint, interest rate is determined by supply and demand for savings. Investment demand is an indirect function of interest rate. When exchange rate goes up, in the same conditions, the demanded quantity decreases and vice versa increases by reducing interest rate, on the other side, supplying the savings is a direct function of interest rate. At a time when savings equals investment demand, interest rate will be in equilibrium. The classical economists did focus on earnings and earnings rate as a determinant of investment reflects their emphasis on savings. Therefore, the main objective in investment theory explains the classical view of interest rates. (Tafazoli, 1993:127-123). Keynes argues that if the market interest rate is less than IRR, the real capital stock is less than optimal capital investment and increase in investment makes increase in firms' earnings, in such case, there are incentives for investment and real capital stock moves to the desired capital stock, because income is more than the cost of investment. In Keynes's theory, the optimal capital stock is determined by the relationship between finally efficiency of capital and the interest rate, and then adjustment in real capital stock can be done to the desired capital stock. Changes in interest rates affect inversely on changes in the desired capital stock and as a result, investors (136-135p and 1936, and Keynes). Before the acceleration principle is a complete theory of investment, one explanation is the Business Cycle used by Harvard for analysis of business cycles and analyzed by Samuelson for interaction between the acceleration principle and the concept of proliferation coefficient. Therefore, the acceleration principle, in its basic form, is examined the Business Cycle rather than applied in investment theory, (297-269 P and 1952, Knox). Neo-classic school is superior to three famous economists, William Stanley Jones (1870), Carl Menger (1871) and Leon Walras (1874). These three scientists are a founder for a school is named as Neo-Classic School or New Classic School. They eventually reached a kind of classical liberal ideas and revived classical thoughts and indeed, their opinions are actually the classical brainchild views. A characteristic of the neoclassical school is that its founders are willing to create a complete theory of economic calculation that is true everywhere, using the principles of extremity theory in form of utility theory. Indeed, basis of neoclassical method is firm's demand for capital or desired capital stock. The volume of demand is determined in the process of maximizing the net present value or discounted value of expected revenues over time. Therefore, only if the expected sales and interest rates can change, incentives for new investment will exist. Therefore, we realize the relationship between net investment and product development was raised first by John Clark became known as the acceleration principle. Acceleration patterns assumed a limiting models that ratio of K/Y is the fixed, and assume that substitution among K and L is zero. While in the economic literature, the substitution of data is an important element in economic theory. This incompatibility was introduced in 1963 by someone named Dale Jorgenson. Jorgenson and aides to overcome disagreements carried out these studies that today are known as the neoclassical model. This method discussed investment is derived from the capital factor and price of capital is important to determine amount of investment and investment decisions. He argues his own theoretical analysis, according to the neoclassical theory, that the firm aims to maximize the present value of firm based on a series of

restrictions. One important aspect of the investment decision is issue about risk and its evaluation by the market. The method which is applied in Tobin's research and work by Tobin and William Branyard using maximizing the present value of net current income with limited capital stock and production function has been known as Tobin q. Soleimani and safdari conducted in year (2012) an article titled "The relationship between exchange rate uncertainty and investment in sub-Saharan Africa in year 1972-2002". This paper has examined the relationship between exchange rate uncertainty and domestic investment using the fixed-affecting techniques of pattern of panel data. The results of this section indicate that there is a nonlinear relationship between these two variables. These results are of particular significance to the uncertainty of exchange rates and investment. Fifteen countries of the sub-Saharan Africa were selected and the GARCH approach has been used to obtain the uncertainty of exchange rates for each country. The estimation results indicate that there exists a negative relationship between exchange rate uncertainty and investment and the investment share of GDP in these countries is very low. In addition, investment in these countries is too sensitive than exchange rate uncertainty not only at that time but also another time. Another result is that the share of investment in GDP growth is the same in each period. Soleimani and safdari in year (2012) provided an article titled "Exchange rate uncertainty and investment in some countries of the Middle East and North Africa in years (1974-2004)". In this paper, the relationship between exchange rate uncertainty and domestic investment are analyzed using the method of fixed-effect panel data model. The results show that there is non-linear relationship between these variables (exchange rate uncertainty and investment). Using methods of GARCH, exchange rate uncertainty has been obtained for each of the six countries. The estimation results indicate that there exists a negative relationship between exchange rate uncertainty and domestic investment and, capital in these countries has also suffered from a delay of exchange rate uncertainty. Cambes in year (2011) studied an article titled "Capital flows, exchange rate flexibility and real exchange rate for period (1980-2006)". In this paper, the impact of capital flow and exchange rate flexibility on the real exchange rate in developing countries is analyzed on the basis of panel integration methods. The results indicate that public and private flow depends on changes in the real exchange rate. Among private flows, investment has the highest impact i.e. as seven times as direct investment or bank loans, and private investment, the least impact. Magnus Frimpong in year (2010) examined an article titled "Determinants of private investment in Ghana in period (1970-2003)" is as follows. Due to successive governments, Ghana is affected fully by private policies that are conducive to growth theory. Accordingly, this study seeks to provide an empirical assessment of factors that has stimulated and adjusted private investment in Ghana for several decades and using new time-series economic methods such as (ADF) test and accumulation and modification of ARDL error, attractive results have been provided. The results indicate that short-term private investment get known by public capital, inflation, real interest rate, real exchange rate, while real output including inflation, foreign debt, real interest rate and real exchange rate may be affected response of private investment in long term. Critical-informative recommendations and findings related to policymaking encourage increase in private investment in Ghana. Busaria in year (2008) in an article titled "The behavior of private investment and trade policy measures" aimed to investigate private investment delayed of three channels: 1. restrictions on the international mobility of capital, 2. intensive impact of the sharp decline in the exchange rate variable, 3. restrictions on imports

emanating from custom tariff and the cost of import, using panel data method on company's balance data from 67 Nigerian companies during 1980-2003. These results emphasized on a strong correlation between private investment, trade policies and current uncertainty including exchange rate in the macroeconomic that these factors lead to a negative impact of exchange rate volatilities on private investment in companies that are interested to import. Atelloa, Atzeni, Blowisi assessed a subject in year (2005) titled "The effect of exchange rate uncertainty on investment associated with market power". In this study, data from 2,988 firms was used between the years 1989-94, in Italy. Being interested to study this period, there was a large volatility of exchange rates in Italy. In this model, the exchange rate volatility is measured using error correction model (ECM). All firms based on market power have been divided into four-level: dominant district, specialized district, district with high concentration and district based on knowledge. In this study, using dummy variables, it examined market power. The results showed a significant negative relationship between dominate district and specialized district and district with high concentration, but not significant in IV district, implying that the uncertainty, in this study, was divided into two parts, income and expenses. The results showed sensitivity was inversed in suppliers of district with high concentration and district of specialized. Generally, the impact of uncertainty is further highlighted in cost measurement. While being also market power, the sensitivity decreased and the firms with greater market power than uncertainty would represent less sensitive. Clasina in year (2005) conducted a research titled "Evaluating impact of exchange rate uncertainty on investment". In this study, quarterly data were used during 1979-2005 of Brazil, Chile, Colombia, Mexico, Peru, and Ecuador. Two types of models have been considered. First part, the impact of uncertainty in the exchange rate on investment was assessed and the model was estimated using GMM technique. The results showed that there is negative relationship between uncertainty and investment in Brazil, Colombia, Ecuador, Peru, and positive in Mexico and Chile. Another question was whether the impact of exchange rate uncertainty on investment depends on its level (existence of effect threshold). The results show that low-level uncertainty is positively and high-level uncertainty, negatively related to investment, in Chile, Colombia, Ecuador, and Mexico. In Brazil and Peru, high-level uncertainty is positively and low-level uncertainty, negatively related to the investment. But, in general, Soccer's talks is approved which there is an effect threshold for uncertainty.

Research methodology

This research is a practical and causality & library research, in terms of goal and methodology, respectively. In recent studies, uncertainty based on time series model in which the conditional variance of the exchange rate varies from period to period, is measured. Types of GARCH models to obtain uncertainty have been used in many recent studies. In this pattern, conditional variance has been changed in terms of information from previous data and past predication error and it showed exchange rate uncertainty

Conditional variance model to follow Boulraslou (1998) can be written as follows:

$$h_t = \alpha_0 + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^p \beta_i h_{t-i}$$

where h_t is the conditional variance $\{\varepsilon_t\}$.

The most general form of conditional volatility is as follows:

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \beta_2 h_{t-2} + \dots$$

For example GARCH (p, q) with higher-order, conditional variance can be obtained if the following condition is satisfied:

$$1 - \sum_{i=1}^q \alpha_i - \sum_{i=1}^p \beta_i > 0$$

This result indicates that the conditional variance of the error process is not constant. GARCH and ARCH processes, due to calculation of conditional variance of error terms, are more suitable to show instability. Also, to get the most appropriate model ARCH or GARCH, Akaike and Schwarz-Box-jenkins criteria are used.

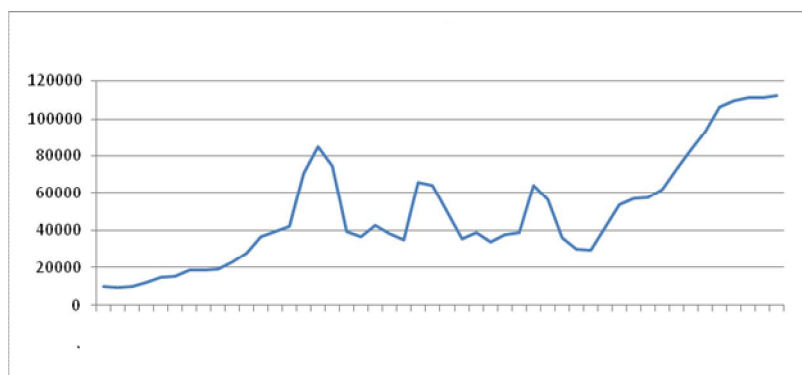
To estimate the model of exchange rate uncertainty, generalized autoregressive conditional heterogeneity variance model called the GARCH models are used. Before estimating the model of uncertainty in the exchange rate, it should provide the primary model for the real exchange rate. According to Box - Jenkins the best model to describe the behavior of the real exchange rate is obtained, is as follows:

$$\log(rer) = c + \alpha ar(1) + \beta dum(2)$$

Where dum2 is a dummy variable related to the years 1994 and 1995. In fact, C is the effect of other variables such as liquidity, inflation rate on the exchange rate over time. Moreover, β can also be caused by a structural failure of the exchange rate, which is achieved due to the policy change. Therefore, the proposed model is considered the effects of other variables on the real exchange rate in Iran. In this line, uncertainty of exchange rates from real exchange rate volatility has been calculated through generalized autoregressive conditional heterogeneity model (EGARCH). Also data sources in the site of the Central Bank of the Islamic Republic of Iran, Iran Statistical Center Research and Center Commercial Research. Finally, particular tools are not used to gather information and research data and required information to the research is intended as an annual basis, the library and the Statistical Yearbook of the Central Bank. J. A. A. Centre for Business Research, Statistical Center of Iran and the computer sites of these companies. Also the population and the terms under investigation is entire economy of Iran and period 1961-2008, respectively. Method of data analysis is descriptive and inferential, for this purpose, based on descriptive statistical, data and macroeconomic variables would be examined and at last, the interpretation is tested accordance with inferential statistical analysis.

Data description

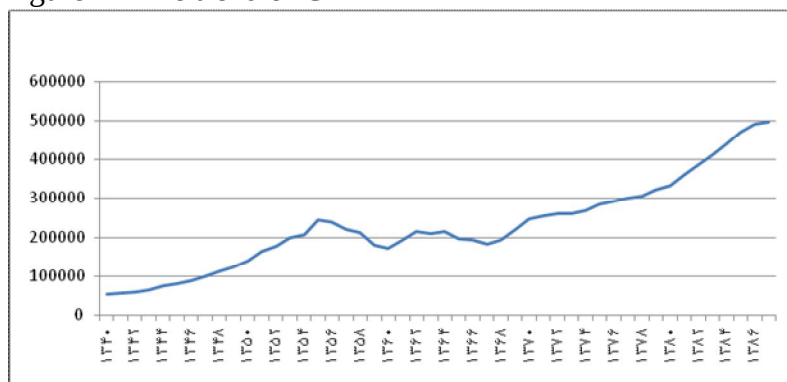
Figure 1 - The trend of private investment in Iran in 1997 constant prices



Source: Central Bank

As you can see there are relatively increasing trends in changes for private investment.

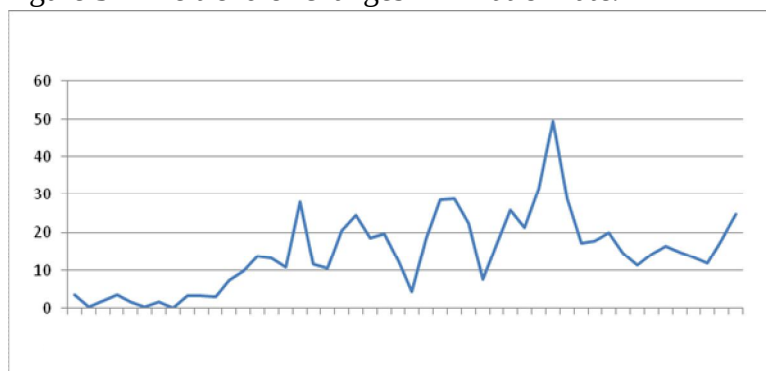
Figure 2 - The trend of GDP



Source: Central Bank

In some charts, such as GDP, it is clear that has an increasing trend over time, and hence the mean is not constant and is non-stationary.

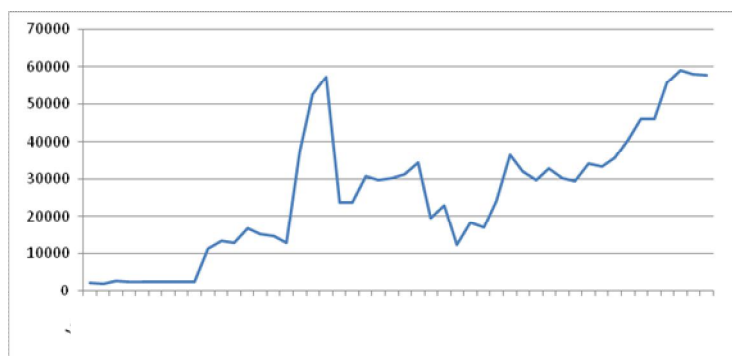
Figure 3 - The trend of changes in inflation rate.



Source: Central Bank

In some charts like above chart suggesting the changes trend for inflation rate, as can be seen, the increase in the inflation rate in some years, decreases private investment rate.

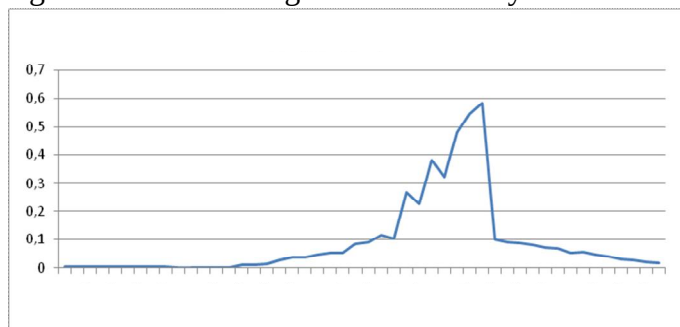
Figure 4 - The trend of public investment



Source: Central Bank

In the above chart, as can be seen, the public investment fell off the end of the war and after that, it has been growing.

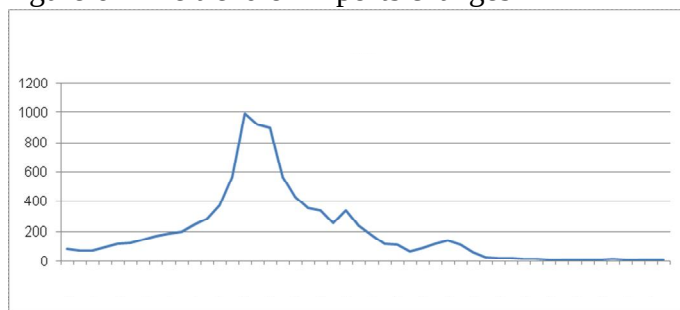
Figure 5 - The exchange rate uncertainty



Source: Central Bank

As you can see in the chart above, since 1961 to 1975 it is a uniform trend of exchange rate uncertainty and then increasing trend that among 1961 to 2008, it is the highest in 1994.

Figure 6 - The trend of imports changes



Source: Central Bank

The above chart shows the trend of changes in import up to 1975 is increasing and then decreasing. This chart shows that it is the highest import in 1975, during 1961-2008.

The process of private investment and GDP are relatively rising during 1961-2008. It is noteworthy that in the years that private investment is reduced, inflation rate has increased and the import process is an increasing one up to 1975 and then a decreasing since 1975 to 2008 and in assessing exchange rate uncertainty it was observed that there has been the greatest exchange rate uncertainty, in 1993.

Model specification and estimation

In this research model, the conditional variance is varied based on prediction error and previous term data and shows uncertainty in the exchange rate. The simplest model for the conditional variance was model ARCH (q) proposed by Angal in which the conditional variance is weighted mean of squared past-prediction errors.

$$\varepsilon_t = V_t \sqrt{a_o + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2}$$

Where V is a white noise process. The main task of technical Bouhraslou has developed Angal's primary work and uses technique which allows the conditional variance to have an ARMA process:

$$\varepsilon_t = V_t \sqrt{h_t}$$

Where $\sigma_y^2 = 1$

$$h_t = a_o + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^p \beta_i h_{t-i}$$

Where V_t and ε_{t-1} are independent of each other conditional and unconditional means ε_t are zero.

$$E_{t-1} \varepsilon_t^2 = h_t$$

$$E \varepsilon_t = E V_t \sqrt{h_t} = 0$$

The important point of this model is that the conditional variance ε_t is equal to h_t :

$$h_t = a_o + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^p \beta_i h_{t-i}$$

This result indicates that the conditional variance of error process is not fixed and to obtain the most appropriate model, ARCH, GARCH or EGARCH were used from Akaike and Schwarz Bayesian criteria. Based on the Box - Jenkins the best model is obtained to describe the behavior of the real exchange rate is as follows.

$$\log(rer) = c + \alpha ar(1) + \beta dum(2)$$

Where Dum2 is a dummy variable related to the year 1994 and 1995. Indeed, C is the effect of other variables such as liquidity, inflation rate etc. on the exchange rate over time. Moreover, β can also be caused by a structural failure of the exchange rate, which is achieved due to the policy change. Continue to, the presence or absence of the regression variance heterogeneity will be discussed. ARCH LM test results indicated that in 95% level there is the variance heterogeneity of residuals at the real exchange rate model. Therefore, the proposed model regarded the effects of other variables on the real exchange rate in Iran. It should be noted that performing static test on real exchange rate variable is essential; here that results indicate the absence of a unit root for variable of real exchange rate.

To detailed study of the behavior of real exchange rate, different models with different levels are tested and results are described in the following table:

Table 1 - Results of the estimation of different models

Criterion	GARCH (1,1)	EGARCH (1,1)	EGARCH (0,1)
Akaike	-0.343	-0.279	-0.393
Schwarz	-0.112	-0.008	-0.162
Significant coefficient	GARCH coefficient, insignificant	All coefficients Significant	All coefficients Significant

Based on the Box - Jenkins and Schwartz Bayesian determinant criterion, results of above table on EGARCH (1,1) Model for exchange rate is the best.

After considering the uncertainty of exchange rate, the model will be discussed. Among variables given in terms of theoretical basis and economic structure being existed in this context, it has estimated the demand function for private investment.

According to estimating various models, the model intended for private investment demand during the years 1961 - 2008 is as follows.

$$\log KI = -6/77 + 1/51 \log GDP - 0/47 EGARCH(1,1) - 0/15 \log KG - 0/006 INF * DUM \\ (-6/3) \quad (11/5) \quad (-2/06) \quad (-1/91) \quad (-2/04) \\ + 10 \log IM + 0/44 AR(1) \\ (3/2) \quad (3/07)$$

The numbers in parentheses are t-statistics for each variable, all variables are statistically significant. Based on the above equation over 95% changes of private sector investment are explained by the variables GDP, exchange rate uncertainty, public sector investment, inflation and imports. Also Durbin-Watson statistic is close to 2 indicates no autocorrelation disturbing terms and correct specified pattern. This means that if GDP ratio increases as much as 1%, (assuming stability of other factors) private investment in this sector will increase as much as 1.5%. Index of real exchange rate uncertainty has a negative sign. This coefficient indicates that for every one-unit change in the index of exchange rate uncertainty, the private sector investment decreases as much as 0.47%, thus, the results indicate that the increased volatility of the real exchange rate decreases private investment. And a one percent increase in public investment, private investment rate decreases as much as 0.15 which there is an inverse relationship between the public and private sector investment. Inflation has a negative and significant effect on investment in the private sector that with a 1% increase in inflation rate, private investment decreases as much as 0.006 percent. Since investment and domestic productions is dependent on imports of capital goods, results also show that by 1% increase in imports of capital goods, private sector investment will increase as much as 0.10%.

The research results

In this paper we present the effect of real exchange rate uncertainty on private investment which is significant and the results showed that the numbers were all significant, inserted on estimates of t-statistics. According to this relationship, more than 95% changes in private sector investment are explained by variables of GDP, exchange rate uncertainty, public investment, inflation and imports. Also, the Durbin-Watson statistics is close to 2 indicates lack of Autocorrelation of a disturbing terms and correct specified pattern. Based on these results, hypothesis H_0 is confirmed which indicates the significance of the effect of real exchange rate uncertainty on private investment. The results showed that the GDP increases as a percentage (assuming stability of other factors) private investment in this sector increases

as much as 1.5%. Akbari in 2006, and Abrahami and Pourolady in 2008, Shoreh Kennedy in 2009, also achieved the same result with different coefficients, according to the information and factors in different years to be varied. Index coefficient of real exchange rate uncertainty has a negative sign. This indicates that for every one-unit change in the index of exchange rate uncertainty, the private investment is decreased as much as 0.47%, so the results show that increasing the volatility of the real exchange rate, it decreases private sector investment. Soleimani and Safdari in 2012, Doulati in 2007, and Abrahami and Pourolady in 2008, Bousaria in 2008, Seuron in 2002, Karen in 1995 and Goldberg in 1993 examined the effect of this factor and achieved the same conclusion with different coefficients. By 1% increase in public investment, private investment decreases as much as 0.15 that there is an inverse relationship between the public and private sector investment. Doulati in 2007, Bahmani in 1992 and Hajimeachel and Daneshvar 1995 achieved this conclusion. Inflation has a negative and significant effect on investment in the private sector, by an increase of one percent inflation rate, for private investment decrease 0.006 percent. Bahmani in 1992, Abrahami and Pourolady in 2008 and Seuron in 2002 achieved the same conclusion with different coefficients. Because investment and domestic productions is dependent on imports of capital goods, the results also show that 1% increase in imports of capital goods; private investment increases as much as 0.10%.

Suggestions

Based on the results of this study and the model, it suggests that government have created conditions for stability in inflation, and also shall endeavor to create a platform and infrastructure and investment in key sectors of the economy, due to the lack of appropriate benefits not be willing to invest in. About uncertainty in the real exchange rate, it should also be trying to stabilize the real exchange rate and if the price index is instable, it will cause the instability of the real exchange rate, then the government should implement appropriate policies to try to reduce volatility in commodity indices and indicators are to be followed by certain procedures in order to enhance incentives to the private sector. On the other hand, the nominal exchange rate volatility in the market causes the real exchange rate to be uncertain. Oil price makes change in exchange rate in the market. When increasing oil price, the greatest policies of reduction of the uncertainty in the real exchange rate is as follows:

- A) Select the appropriate exchange rate system to reduce instability in the real exchange rate.
- B) Governmental expenditures do cost to increase private sector investment in infrastructure sector.
- C) Efforts by the government to reduce inflation volatility
- D) Create a reserve fund.

Also, according to our country's current situation and the sanctions taken, it suggests that due to the availability of sufficient information about data and validity of sources and detailed analysis of factors affecting the sanction, this case should be considered as a variable in assessing the effect of exchange rate uncertainty on investment of the private sector.

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