The Impact of Exchange Rate Volatility on Foreign Direct Investment in Iran

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Abstract

The flows of foreign investment are the fundamental elements in the economical evolution of countries within the globalization process of economy. Previous research on exchange rate shows its significance as a key role in trades and flows of FDI. Although exchange rate and FDI are empirically investigated but the relationship between the volatility of exchange rate and flows of international investments is generally not identified. Therefore, considering the importance of the subject discussed, it is needed to consider the determinants of FDI especially the volatility of exchange rate and provide better situations for attracting FDI in Iran.

The main goal of this study is evaluating the determinants of inward FDI particularly volatility of exchange rate in Iran by using the Johansen and Juselius’s cointegration system approach model covering the period 1980Q2-2006Q3. The findings of this study reveal that gross domestic product, openness and exchange rate to have positive relationship with foreign direct investment but, world crude oil prices and volatility of exchange rate have negative relationship with foreign direct investment. The empirical results obtained in this paper recommend the economy Politicians in Iran to implement exchange rate policies that promote stability of exchange rate, which could help reduce exchange rate volatility in order to attract more FDI.

Keywords: Exchange rate volatility, FDI, Johansen and Juselius’s cointegration approach, Openness.

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1. Introduction

Continuous growth and development in the economy need to attend its determinants. Investing or forming capital is the necessary condition for economic growth and development. The place and the role of investing in the stated processes are to the extent that investing is the motive engine in economic growth. So the investment topics are one of the vital and non-separable parts of the economy. Some growth and development scientist believe that, lack of capital has been identified as one of the main reasons for poverty in many countries. Currently, the situation of Iran economy is in a way that savings and internal sources provide aren’t sufficient and needed capital and attracting foreign capital seems to be the only useful and valid way. Specially, considering the high rate of unemployment, using of these sources are confirmed, Komijani and Abasi, 2006.

The most important character of stockholding investment is that the foreign investor is able to sell stock or bond, move his capital to his own country or third country every time. But FDI is a kind of investment that happens in order to gain perpetual and continual benefit in an institution located in a country other than the investor’s country and its consequence is gaining the effective right of vote in the management of the firm. Different studies show that FDI is done in any form and for any reason, has considerable effects on macroeconomic variables including the decrease of interest rate, reduction exchange rate, the increase of economic growth, increment of state tax income, reduction of state debts, development of income distribution, transfer of technology, export development, import deduction and positive effect on balance of payment. Capital in all theories and patterns of economic growth has been as a motive engine of economic growth and development. Therefore, making plan for attracting of adequate capital in order to provide the financial sources of economic projects is one of the most important challenges of economic decision makers in every society. By the passage of time and extension of various theories and patterns about the economic growth, new variables are introduced as the growth engine which attract the economists’ opinions as well, Mahdavi, 2004.

The main goal of this study is evaluating the determinants of inward FDI especially volatility of exchange rate in Iran. In this paper after the introduction, theoretical basis, specification of the econometric model, discussion and result and finally conclusions are presented.

2. Effective Factors on Volatility of Exchange Rate and Its Relationship to FDI

Based on the New Open Macroeconomics, the effective elements on the variation of real exchange rate are divided into two categories, monetary and non-monetary elements. In theoretical view, Dornbusch, 1976 show that forecasted monetary shocks through overshooting effect of exchange rate can create extreme volatility of exchange rate. In addition, Calderon, 2004 say that the stability of monetary shocks are the only effective element on the variation of exchange rate and the non-monetary elements including efficiency shocks and state expenses can be effective on them. About the way of effecting stat expenditures on the variation of exchange rate, different opinions have been offered. Base on Frenkel and Mussa, 1985 continuous increase of state expenditures lead to the balanced increase of real exchange rate in the long run and consequently to the increase of net foreign equities. Similarly, state expenditures through influencing on the demand side of economy in short run can have a positive effect on real exchange rate. Although, maybe the most of state expenses in long run lead to the instability of local money value and consequently will have negative effect on the real exchange rate. Because increase of state expenses with excessive-burdening taxes can make the effect of state expenses on real interest rate ambiguous.

Cociu, 2007 defines interest rate as one of the effective variables on the exchange rate volatility. Based on the macroeconomic subjects, the variation of interest rate lead to the variation of inflation and exchange rate. So, it is expected that by the increase of interest rate, the inward foreign investments increase and
consequently local money value increase. The other non-monetary effective variables on the variation of real exchange rate are the efficiency growth. According to Balassa-Samuelson’ model, the consumer price index in rich countries is greater than the poor ones and the efficiency growth rate in the tradable sections is also different than to other sections. So the increase of efficiency growth in the tradable sections leads to reduction of cost in non-tradable sections and as a result the real exchange rate will increase.

Aliber, 1970 was the first one who investigated the effect of exchange rate variation on FDI flows. His logic was that the countries which have weak money rate, with the goal of increasing purchasing power, may apply for attracting FDI. In spite of Aliber primary logics, this explanation was not popular until the end of 1980s and the beginning 1990s and in fact it was the time that the exchange rate topic was seriously introduced as the one of the determinants of FDI. For example Froot and Stein, 1991 in their studies found out that depreciation of dollar cause the preferment of relative place of foreign investment and so decrease of investment costs. In their opinion, in spite of the fact that the total foreign investment flow versus the real value of U.S. dollar is in a decreasing form, FDI is the only way of investment that statistically have had a negative correlation with the dollar value. In addition, Cushman, 1985 studied the effort of corporations for increasing certain future profits versus the current currency of the investor’s country. He analyses the effects of exchange rate risk and FDI expectations in four different cases and believe that the relation between the variation of exchange rate and FDI flow is in dependent to the place where the data have been purchased, products are manufactured, fiscal capital is emanated from and products are sold.

Limited foreign investment has been done for the relation between exchange rate volatility and FDI. In one of them Jeanneret, 2007 in his paper with title of "Foreign direct investment and exchange rate volatility: a non-linear Story", has investigated the impact of exchange rate volatility on FDI using the panel data of 27 countries during 1982 - 2002. In this paper he shows that there is a U shape and non-uniform relation between FDI and exchange rate. In addition, Xiong, 2005 in his research with the topic of "Impact of exchange rate uncertainty on foreign direct investment", has studied the stated subject for multi-national firms in Australia, Canada, UK, Japan and U.S. since 1973 till 2002 using ARDL technique and of course contemplating the impact of other determinants of FDI. About inward FDI to U.S. he found out that exchange rate volatility and bilateral exchange rate have a negative effect on outward FDI of Australia but for Canada, Japan and UK, only the bilateral exchange rate has significant effect and the exchange volatility plays no significant role. Masten, 2007 in his thesis about the Impact of exchange rate volatility on U.S. foreign direct investment on Latin America starts to say that previous studies have shown that exchange rates play a vital role in the analysis and are a major determinant in the flow of FDI. Empirical results show that exchange rate volatility significantly deters the flow of U.S. FDI into Latin America. Conflict and corruption are the political risk factors that have significant impacts on FDI flows.

3. Econometric Model Specification

In this paper in order to investigate the determinants of inward FDI, especially volatility of exchange rate in Iran using the Johansen and Juselius’s cointegration system approach, 1990 in the form of vector autoregressive pattern (VAR). For the first time Johansen, 1988 used the co-integrated test for studying the long run relationship between volatility of exchange rate and export. The main idea of the co-integrated analysis is that lots of economic time series are not static and have a stochastic ascending or descending trend, but it may be possible that a linear combination of these variables are always static and have no stochastic trend. The co-integrated analysis helps to find out this a balance long run relation.

Considering the most theory and tentative studies for identifying the determinants of inward FDI emphasize the economic factors of the country or destination countries and also specific concerns of Iran’s
economy, variables such as exchange rate, GDP, openness, world oil price, volatility of exchange rate can be introduced as the determinants of inward FDI in the econometric pattern below:

\[ LFDI_t = \alpha_0 + \alpha_1 LYD_t + \alpha_2 OS_t + \alpha_3 OP_t + \alpha_4 SE_t + \alpha_5 E_t + U_t \]  

(1)

In this model, LFDI is the logarithm of inward foreign direct investments in Iran in terms of million dollars. LYD is the logarithm of gross domestic product of Iran in time t and in terms of million dollars. This index is to be used as the best one for representing the size and scale of the economy and is expected that the economy with greater size, can provide better situation for foreign investing. E is the informal exchange rate and is one of the indicators that show money parity of countries, it is expected the increase of this variable has positive effect on the inward FDI for the country. SE is volatility of exchange rate or variability of exchange rate that is quantified by moving average standard deviation index. OP is the openness of trading and indicates the national economy partnership in the universal economy. This index determines the total volume of trading into the GDP and show the extent to which the host economy is open toward the entry and exit of goods and services. It is obvious that the more the economy is open toward the entry and exit of goods and services, the incentives of foreign direct investment will increase. OS is the world oil price. Considering Iran as one of the oil exporter countries which has a state economy, it is expected that the more the world oil price increases, investing attraction will decrease. Ut is the error term in model.

In recent searches, instability based on time series models express that the conditional variance of exchange rate change in each period. In this respect, in the recent studies various models are used for calculating the volatility of exchange rate, here the moving average standard deviation is used.

\[ SE_t = \sqrt{\frac{1}{m-1} \sum_{i=1}^{m} (E_t - E_{t-i})^2} \]  

(2)

4. Discussion and Result

Investigating the stationary of variables through Dicky Fuller unit root test as one of the most practical tests of measuring stationary, we found out that all the variables have unit-root and are non-static. But all of them are static in the first order difference and confidence of 95%. Therefore all of the variables are converge of degree one, I(1). The result of Dicky Fuller stationary test is reported in the table (1).

| Variables | DF Statistics | Variables | DF Statistics |
|-----------|--------------|-----------|--------------|
| LFDI      | -2.28        | ΔLFDI     | -3.65        |
| LYD       | -1.97        | ΔLYD      | -4.30        |
| E         | -2.09        | ΔE        | -8.50        |
| SE        | -2.99        | ΔSE       | -5.66        |
| OS        | 1.80         | ΔOS       | -5.29        |
| OP        | -2.20        | ΔOP       | -3.93        |

Critical value with an intercept but not a trend: -2.89

Critical value with an intercept and a linear trend: -3.45

Source: The research results
Akaike Information Criterion (AIC), Schwarz Criterion (SC) indicators can be used to determine the optimum lags (Selecting the Order of the VAR Model). The result in table (2) suggests orders of 1 and 7 for the VAR model that according to adjusted LR test the order of 7 bases on (AIC) index is accepted.

Table 2. Selecting the Order of the VAR Model

| Order of the VAR Model | AIC | SBC | Adjusted LR test |
|------------------------|-----|-----|------------------|
| 8                      | -1143 | -1543 | 0.00             |
| 7                      | -1134 | -1485 | 0.82             |
| 6                      | -1145 | -1450 | 0.27             |
| 5                      | -1153 | -1409 | 0.13             |
| 4                      | -1169 | -1376 | 0.02             |
| 3                      | -1202 | -1361 | 0.00             |
| 2                      | -1200 | -1312 | 0.00             |
| 1                      | -1244 | -1308 | 0.00             |
| 0                      | -1939 | -1956 | 0.00             |

Source: The research results

Usually for estimating the coefficients of the model and specifying the long run relationships with Johansen and Juselius’s cointegration system approach we need the 2 statistic\( \lambda_{trace} \) and \( \lambda_{max} \). Monte Carlo’s studies reveal that when the residuals of equations have inordinate skewness or kurtosis, the \( \lambda_{trace} \) test is more suitable than \( \lambda_{max} \). The reason is that \( \lambda_{trace} \) and \( \lambda_{max} \) is not necessary equal. Because the results show that the residuals of the equation have no normal distribution, that is they have skewness or kurtosis more than normal, \( \lambda_{trace} \) statistic is used for estimation of the model and if the residuals have normal distribution the \( \lambda_{max} \) suggests better estimations. Noferesti, 1999.

Table 3. \( \lambda_{trace} \) statistic test in order to specify the appropriate pattern and Number of Cointegrating Relations

| H0 | H1 | Pattern I | Pattern II | Pattern III | Pattern IV | Pattern V |
|----|----|-----------|------------|-------------|------------|-----------|
| Hypothesis | statistic | 95% | 90% | statistic | 95% | 90% | statistic | 95% | 90% | statistic | 95% | 90% | statistic | 95% | 90% | statistic | 95% | 90% | statistic | 95% | 90% |
| r=0 | r=1 | 130.64 | 83.18 | 78.47 | 164.67 | 102.56 | 75.67 | 152.14 | 95.87 | 91.40 | 202.58 | 115.85 | 110.60 | 177.22 | 109.18 | 104.27 |
| r=1 | r=2 | 81.06 | 59.33 | 55.42 | 106.84 | 75.98 | 71.81 | 96.62 | 70.49 | 66.23 | 129.86 | 87.17 | 82.88 | 104.57 | 82.23 | 77.55 |
| r=2 | r=3 | 43.91 | 39.18 | 36.69 | 66.78 | 53.48 | 49.95 | 58.73 | 48.88 | 45.70 | 81.73 | 63.00 | 59.16 | 59.04 | 58.93 | 55.01 |
| r=3 | r=4 | 22.50 | 24.05 | 21.64 | 33.64 | 34.87 | 31.93 | 25.58 | 21.94 | 28.78 | 48.42 | 42.34 | 39.34 | 28.29 | 39.33 | 36.28 |
| r=4 | r=5 | 8.25 | 12.36 | 10.25 | 18.37 | 20.18 | 17.88 | 13.09 | 17.86 | 15.75 | 20.39 | 25.77 | 23.08 | 8.52 | 23.83 | 21.23 |
| r=5 | r=6 | 0.12 | 4.16 | 3.04 | 7.51 | 7.16 | 7.53 | 2.29 | 8.07 | 6.50 | 7.92 | 12.39 | 10.55 | 9.60 | 11.54 | 9.75 |

Source: The research results

Now according to the quantity of trace test in table (3) and the method explained, we estimate the regulated standard from conditional form (Pattern 1) to the unconditional one (pattern5), so we can determine the proper pattern and the rank of II matrix simultaneously. Based on results obtained, the pattern 3 is the proper one for co-integration analysis. And based on this pattern the existence of 3 cointegrated vectors is confirmed.

Table (4) shows the coefficients of the cointegrated vectors that are explanatory of long run equilibrium relations between the model variables. Among these vectors, the coefficients of vector 1 and 2 are not compatible with the economic theories and do not have the expected signs and just the quantity and coefficient of the third cointegrated vector are matched with the economic theories and have the expected signs.
Table 4. Estimated Cointegrated Vectors in Johansen Estimation (in Brackets)

| Variables | Vector 1 | Vector 2 | Vector 3 | Normalized vector 1 | Normalized vector 2 | Normalized vector 3 |
|-----------|----------|----------|----------|---------------------|---------------------|---------------------|
| LFDI      | 0.95     | 0.11     | 0.63     | -1.00               | -1.00               | -1.00               |
| LYD       | -0.40    | 0.45     | -0.13    | 0.42                | 4.21                | 0.21                |
| Os        | 0.021    | -0.025   | 0.001    | -0.02               | -0.24               | -0.002              |
| Op        | 0.46     | 0.26     | 0.09     | -0.49               | -2.45               | 0.15                |
| Se        | 0.00006  | 0.00006  | 0.0008   | 0.0006              | -0.005              | -0.001              |
| E         | 0.0001   | 0.0001   | 0.00006  | 0.0001              | 0.001               | 0.0001              |

Source: The research results

Therefore based on vector 3 we can express the long run relationship between the variables as below.

\[ LFDI = 0.21 \text{LYD} - 0.002 \text{OS} + 0.15 \text{OP} - 0.001 \text{SE} + 0.0001 \text{E} \]  

(3)

The estimated result of the FDI function shows that based on the theoretical basis, the GDP, openness and exchange rate variables have positive effect but the volatility of exchange rate and world oil price have negative effect on FDI. These results express the fact that FDI in Iran has a direct relation with GDP, openness and exchange rate variables and has an opposite relation with volatility of exchange rate and world oil price.

The consequence of impulse-response function (IRF) and forecast error variance decomposition (FEVD) are shown in the graph (1) and table (5). The impulse-response of one shock for each variable not only has a direct influence on itself but also influences the other endogenous variables in a dynamic structure. In fact, we show that how the FDI change when one shock occurs in each variable. It needs to remind that the occurred shock is the scale of one standard deviation that is accounted based on the variance of the error term in the structural model. FEVD is used as a tool for short run investigation of dynamics turnover. With this tool we can determine that what is the contribution of each explanatory variable in the variance of forecasting error.

The IRF and FEVD tests confirm the estimated results of the long run relationship quite well. So that the occurrence of one shock in GDP, openness and exchange rate have a significant and positive effect on FDI. GDP is one of the indexes for measuring economic size and to the extent the economy is extensive it causes a positive perspective of trade in country and make it easy to enter the world markets. By entering the international trade, the country can attract more foreign investments especially FDI. Gradual reduction of tariff and non-tariff barriers for creating competitive situations in domestic markets is very important. Also trade volume which has a direct relation with openness shows the contribution of the economy in the world markets. The more the economy is open and consequently the more the trade volume leads to the attraction more FDI. For the effects due to the exchange rate volatility, the significant and negative effects of this variable on FDI in the long run and short run can be clearly observed. The world oil price also has significant and negative effect on FDI in both long run and short run.

Generally, exchange rate volatility makes risk, uncertainty and reduces foreign investment incentives and particularly reduces inward FDI. One of the major reasons for exchange rate volatility can be the lack or deficiency of exchange rate forward markets to cover the risk of exchange rate that with creation or attendance in these markets, we can reduce this variation to the extent possible and prepare the situation for entering more FDI to the country.
In case of Iran which has a considerable income due to its world oil export, the world oil price may be the main cause of variability in real exchange rate. On the other hand, by the increase of world oil price, the government income is increased and because a considerable part of the Iran economy is state, then the government investments in the infra-structures will be increased and eventually leads to lower propensity of foreign investors in the country and lower inward FDI.

Table 5: forecast error variance decomposition

| Horizon | LFDI | LYD | E | OP | OS | SE |
|---------|------|-----|---|----|----|----|
| 1       | 1.00 | 0.00| 0.00| 0.00| 0.00| 0.00|
| 4       | 0.89 | 0.00| 0.00| 0.00| 0.07| 0.03|
| 8       | 0.71 | 0.00| 0.01| 0.00| 0.22| 0.06|
| 12      | 0.55 | 0.00| 0.01| 0.01| 0.38| 0.06|
| 24      | 0.42 | 0.00| 0.01| 0.00| 0.52| 0.05|
| 40      | 0.37 | 0.00| 0.01| 0.00| 0.57| 0.04|

Source: The research results

Diagnosis statistics for the classical hypothesis test are reported in table (6). According to the given statistics, the entire hypothesis is not rejected at level of 95%. In other words there is no serial correlation, the functional form is well specified, the error terms of estimated model is normal and no heteroscedasticity exit.

The coefficient of error correction term is 0.068 that firstly confirms the co-integration between the variables and secondly shows that in each season about 7% of created imbalance in the model is balanced in
the next season. In other words, it takes 3.5 years to offset each created imbalance in the model and to get to the original long run model. Therefore adjustment is lag and is done with a very low speed.

Table 6: Diagnosis tests

| test              | Serial Correlation | Functional Form | Normality | Heteroscedasticity | *ECM coefficient |
|-------------------|--------------------|-----------------|-----------|--------------------|------------------|
| statistic         | 9.01               | 2.05            | 540       | 11.25              | 0.068            |
| p-value           | 0.06               | 0.15            | 0.07      | 0.08               | 0.02             |

Source: The research results

The graph below shows the cumulative sum of recursive residuals (CUSUM) test for the estimated model. The straight lines are the meaningful level of 5%. As it can be seen in the graph, the movement path of the test statistic is always between the straight lines, so that the model has the necessary stability.

Fig 2. Stability Test, CUSUM

5. Conclusion

The main goal of this research is the evaluation of determinants of inward FDI particularly volatility of exchange rate in Iran by using the Johansen and Juselius’s cointegration system approach covering the period 1980Q2-2006Q3. Moving average standard deviation is used for calculating volatility of exchange rate. Conclusion on empirical results show that openness, GDP and exchange rate do have a significant and positive impact but volatility of exchange rate and World crude oil prices do have a significant and negative impact on the flow of inward FDI in Iran. So economical macro-economic politicians should minimize the barriers of import through joining the world trade organization that is with de-regulation and reduce tariffs and at the same time, emphasize on the production and non-oil exports especially industrial commodity and promote the foreign trade. For the world oil price, it is recommended that the goals of macro-economic policies support the base and power of country production to increase the non-oil export and reduce the country dependence to the world crude oil price that eventually can minimize the negative effect of world crude oil price on inward FDI. For the GDP, increasing the efficiency of internal resources and activating the non-used capacity to enable the production basis, attention to the legal infra-structures, skills and efficiency of labor and doing actions to encourage and support the private internal investment, may be lead to absorb more FDI.

* Error Correction Model
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