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# DETERMINANTS OF FOREIGN DIRECT INVESTMENT IN IRAN: AN EMPIRICAL STUDY USING STRUCTURAL EQUATION MODELLING

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**Abstract**. This paper examines the determinants of foreign direct investment (FDI) in Iran by applying the structural equation modelling (SEM). Using the annual time series data for the 1991-2006 period, two models were developed. In the first model the correlation between 12 determining factors and FDI in Iran were analyzed and in the second model the 12 factors were fit into five categories of determinants namely: Business, Economic, Infrastructural, Oil and Science and Technology and the impact of each of the mentioned groups of factors was investigated.

The results derived through the first model indicated that openness of trade and Gross Domestic Product (GDP) per capita have a significant positive impact on FDI in Iran, while along with inflation, oil extraction and production had a surprisingly negative correlation with FDI. The results also suggested that infrastructural factors pertaining to telecommunications in addition to market size, research and development (R&D), education and the scientific output encourage FDI inflows in Iran.

The second model output estimates revealed that the business factors promote FDI most and interestingly once more the oil factor proved to have a negative impact on the FDI inflows to Iran.

**Key words:** Foreign Investment, Structural Equation Modelling, Iran

# 1. INTRODUCTION

Trans-national corporations (TNCs) have become central organizers of economic activities and major actors in shaping the international division of labour. They perform this role through foreign direct investment in the host country enterprises.

By most measures TNCs play a larger role in the world economy today than they did in the past in terms and in relation to key economic indicators such as gross domestic product (GDP), exports and domestic capital formation in the world economy as a whole and in the host countries both developed and developing (UNCTAD 1992).

FDI inflows can lead to a range of economic benefits for transitional and developing countries, including restructuring their economic activities in line with dynamic comparative advantage; reducing their costs of structural adjustment; raising the productivity of national resources and capabilities; improving quality standards and finally stimulating economic growth (Dunning 1994), (Jones, Fallon et al. 2000).

Various international organizations and foreign advisors recommend developing countries to rely primarily on foreign direct investment (FDI) as a source of external finance. They argue that, for several reasons, FDI stimulates economic growth more than other types of capital inflows. In particular, FDI is supposed to be less volatile, and to offer not just capital but also access to modern technology and know-how. However, it is surprisingly hard to support by empirical evidence this policy advice. Some studies find a positive relationship between FDI inflows and economic growth in host economies. (Caves 1996)

It is also widely accepted that FDI can have direct positive potential impact on host economies including the creation of well paid employment for scientists and engineers; better use of locally available materials; technology transfer (new equipment, laboratories, etc.); and the design of consumer products better suited to domestic needs, the development of new disciplines and specializations at local universities; the development of R&D clusters; and spin-offs of by-products that TNCs do not want to develop themselves.(UNCTAD 2005)

With around 1% of the population of the world, Iran currently possesses 7% of the world's natural reserves including 10% of the global proven oil reserves, 16% of the world's natural gas resources and has the largest natural gas resources worldwide after Russia.(BMI 2008)

The availability of these energy reserves and an abundance of natural resources provide an obvious locational advantage with respect to attracting FDI given the increasing importance of energy and other materials in the expanding global market. It offers prospects for lower costs for production facilities in Iran but also suggests a future concentration of R&D capability associated with these industries.

From the perspectives of the economies of scale involved in the activities of TNCs, many studies conclude that the size of the host country market measured by GDP or real GDP can put significantly positive influence on the flows of FDI into a region, in other words the bigger the market of an economy, the more FDI the region can attract.(Dunning 1993; Holland and Sass 2000; Durán and Ubeda 2001; Globerman and Shapiro 2002; Sun, Tong et al. 2002; Zhou and Lall 2005; Ang 2008)

Unlike most middle eastern countries such as UAE, Kuwait, Bahrain, Saudi Arabia and Turkey that will have negative or slight GDP per capita growth, Iran will have over 150% growth in the GDP per capita by 2012 (BMI 2008) considering the population growth of 1.5% (WB).

Keeping the above mentioned factors in mind, an expectation of growth in FDI inflows to Iran is realistic, however with the 901 M$ of inward FDI flow in 2006, the Islamic Republic of Iran stands at the 133rd position out of 141 economies (UNCTAD 2007). The relatively small scale of FDI inflows into Iran is also reflected in the two following diagrams.

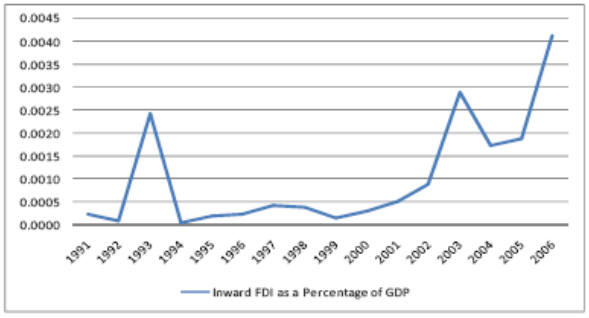


Figure 1- FDI inflows to Iran 1991-2006 (as a percentage of GDP)

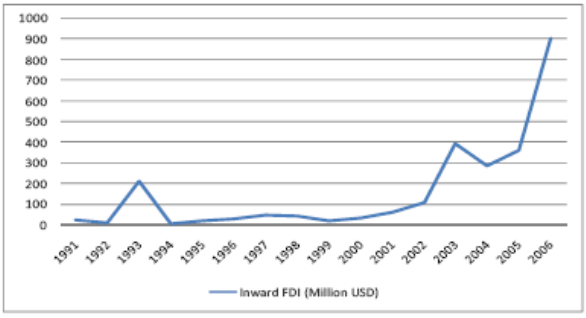


Figure 2- FDI inflows to Iran 1991-2006 (Million USD)

## 2. RESEARCH METHODOLOGY

Most of the previous studies of the determinants of FDI inflows have been based on a regression in the form of the following equation;

**Equation 1**

$$\mathrm{FDI}_i = \alpha_0 + \sum_{j=1}^{n} \alpha_j x_{ji} + \varepsilon_i$$

where $\mathrm{FDI}_i$ is inward foreign direct investment flows into country $i$ and $xji$ the $j$th explanatory variable of country $i$. These studies report a sample of regressions, including a certain set of explanatory variables. The problem is that theory (particularly the theory of FDI) is not adequately explicit about the variables that should appear in the "true" model. The following problem is often encountered: $x1$ may be significant when the regression includes $x2$ and $x3$, but not when $x4$ is included. So, which combination of all available $xj$'s do we choose? Most, if not all, of the existing studies report the most "appealing" or convenient regression or regressions after extensive search and data mining, typically to confirm a preconceived idea (Moosa and Cardak 2006).

In order to build up the model and test the impact of the determining variables on FDI the structural equations modeling (SEM) as developed by Jöreskog (Jöreskog 1970), and extended by Goldberger & Duncan (Goldberger and Duncan 1973) was applied. SEM is a powerful technique that can combine complex path or simultaneous equation model and it includes confirmatory factor analysis and regression models.

The particular advantage of SEM is involving latent variables and as a result investigating causal theories as they pertain directly to the underlying constructs of interest, rather than to the measured variables whose observed relations are often attenuated by error of measurement.

Many researchers consider SEM to be a second generation statistical tool following multiple regression, factor analysis, and path analysis. Goldberger (Goldberger 1973) outlined three situations in which multiple regression falls short of structural equations: when the observed variables contain measurement errors and the interesting relationship is among the true variables; when there is interdependence or simultaneous causation among the observed response variables, and when important explanatory variables have not been included in the analysis.

As another advantage SEM enables researchers to answer a set of interrelated research questions by modeling the relationships among multiple independent and dependent constructs simultaneously. This capability for simultaneous analysis differs greatly from most first generation regression models which can analyze only one layer of linkages between independent and dependent variables at a time. Hence instead of testing the hypothesized relationships one by one, by applying SEM all the relationships among the model are tested simultaneously (Bollen 1989).

In addition, by applying SEM measurement error in the process of model building can be identified, estimated and then removed and by estimating and removing measurement error, the reliability of multiple indicators can be explicitly calculated within the analysis and more importantly the intricate causal networks enabled by SEM characterize real-world processes better than simple correlation-based models. Therefore, SEM is more suited for the mathematical modeling of complex processes to serve both theory and practice (Dubin 1976), (Gefen, Straub et al. 2000).

## 3. RESEARCH VARIABLES

Different sets of variables have been defined in the various studies conducted on determinants of FDI such as (Ang 2008), (Asiedu 2002), (Bevan and Estrin 2004),

(UNCTAD 1998), (Altomonte 2000), (Driffield and Noor 1999), (Ford and Strange 1999), (Holland and Sass 2000),(Nunnenkamp and Spatz 2002), (Zhou and Lall 2005), (Moosa and Cardak 2006), (Mina 2007), (Na and Lightfoot 2006), (Sun, Tong et al. 2002).

After an in-depth and a state of the art review of the existing literature while considering the availability of data and practicality of data collection in mind, the following variables were defined and calculated for Iran in the period between1991-2006. Table 1 and Table 2 summarize the variables, their indicators and the source of data.

| Determining Factors | Latent Independent Variables | Observed (exogenous) Indicators | Data Source |
|---|---|---|---|
| | Market Size | GDP (Million USD) | (WB) |
| **Economic** | Purchasing Power | GDP Per Capita | (WB) |
| | Economic Risk | Inflation Rate | (IMF) |
| **Infrastructure** | Telecommunications | Fixed Line and Mobile Phone Subscribers per 1000 People | (WB) |
| **Business** | Trade Openness | (Import + Export)/GDP | (WB) |
| | Oil Exploitation | Crude Oil Production (1000 barrels per day) | (OPEC) |
| **Oil** | Oil Potential | Proven Crude Oil Reserves (Million Barrels) | (OPEC) |
| | Relative Oil Exploitation | Crude Oil Production/Reserves | (OPEC) |
| **Science and** | Innovation | Total Patent Applications Filed | (UNESCO) |
| **Technology** | R&D | Expenditure on R&D as a Percentage of GDP | (UNESCO) |
| | Education | Total Enrollments in All Tertiary Programs/ Population | (UNESCO) |
| | Scientific Out put | Journal Paper Publications | (NRISP) |

**Table 1-The Latent independent variables and their observed indicators**

| Latent Dependant Variable | Observed (endogenous) Indicator | Data Source |
|---|---|---|
| Inward FDI In Iran | Inward FDI (Million USD) | (UNCTAD 2007) |

**Table 2- The latent dependant variable and its observed indicator**

# 4. MODEL DEVELOPMENT

On the basis of the data gathered two models were developed and tested, in Model 1 the impact of each individual factor on the FDI inflows to Iran was analyzed in order to get a micro view about the individual factors determining the FDI inflows and their level of significance. In model 2, all the independent variables were classified into five different categories as shown in Table 1and the impact of each category on the dependent variable (i.e. inward FDI) was investigated.

Both models were developed on the basis of General Model of Structural Equation Modelling. Figure 3 shows a general model of SEM, where, η (eta) represents the latent dependent, or endogenous, variables; ξ (ksi) represents latent independent, or exogenous, variables; Y represents the observed (endogenous) indicators of the dependent latent variables η; x represents the observed (exogenous) indicators of the independent latent variables; ε (epsilon) is a *p* x 1 measurement errors in an observed endogenous variable y; (delta) is a *q* x 1 vector of measurement errors in an observed exogenous variable x; **λ(y)** (lamda y) represents coefficients of the regression of y on η; **λ(X)** (lamda x) represent the coefficients of the regression of x on ξ.

**a. Model 1**

Figure 4 illustrates model 1 w here X1-X1 2 are the observed indicators for the latent independent variables of ξ−ξ 2 as explained in Table 1. For instance $\xi_3$ represents economic risk which as a latent independent variable for which inflation ($X_3$) is the obseved indicato r. η represents the latent dependent variable of inward F DI to Iran which has been indicated by the observed variable of Y that represent Inward FDI (Million USD).

**b. Model 2**

As shown in Figure 5, in Model 2, the determining factors of Inward FDI as listed in Table 1; namely economic, infrastructure, business, oil and science and technology have been considered as the latent independent variables and respectively represented by ξ− $\xi_5$, while their observed indicators $X_1$-$X_{12}$ and the latent dependent variable and its indicator are similar to Model 1.

## 5. RESULTS

The models were developed by means path diagram of LISREL 8.53 software[1], and afterwards the covariance matrices of the gathered data were calculated and the model was r un. Table 3 and Table 4 report t he path coefficients high lighting the

correlation between the latent variables and the pertinent T Values in Model 1 a nd Model 2 respectively.

| Latent Independent Variable | Path Coefficient | T Values* |
|---|---|---|
| Trade Openness | 0.72 | 11.28 |
| Telecommunications | 0.70 | 12.88 |
| Purchasing Power | 0.68 | 19.55 |
| Market Size | 0.61 | 18.44 |
| Scientific Out put | 0.59 | 19.42 |
| R&D | 0.52 | 10.92 |
| Innovation | 0.42 | 18.31 |
| Oil Exploitation | -0.42 | 14.22 |
| Education | 0.41 | 10.11 |
| Economic Risk | -0.39 | 14.38 |
| Relative Oil Exploitation | 0.32 | 11.21 |
| Oil Potential | -0.30 | 11.30 |
| * Significant at level 0.01 | | |

Table 3- Model 1 Results

| Latent Independent Variable | Path Coefficient | T Values* |
|---|---|---|
| Business Factor | 0.79 | 19.29 |
| Economic Factor | 0.75 | 17.79 |
| Infrastructural Factor | 0.59 | 12.77 |
| Oil Factor | - 0.49 | 24.77 |
| Science and Technology | 0.47 | 8.21 |
| * Significant at level 0.01 | | |

Table 4- Model 2 Results

| | Model 1 | Model 2 |
|---|---|---|
| $X^2$ | 102.22 | 154.78 |
| RMSEA[1] | 0.013 | 0.015 |
| CFI[2] | 0.95 | 0.96 |
| NFI[3] | 0.92 | 0.94 |
| GFI[4] | 0.94 | 0.95 |
| AGFI[5] | 0.92 | 0.94 |

Table 5- Models Fit Indices

LISREL provides several indications of the extent to which the sampled data fits the researcher-specified model. In the case of model 1 and 2 the fit indices, as summarized in Table 5, indicate that the models are reasonably good-fitting models based on the acceptable range of fit indices in LISREL as discussed extensively by Bentler (Bentler 1990) and Hoetler (Hoetler 1983) .

1 - Root Mean Square Error for Approximation
2 - Comparative Fit Index
3 - Normed Fit Index
4 - Goodness of Fit Index
5 - Adjusted Goodness of Fit Index

# 6. CONCLUSION AND POLICY IMPLICATIONS

Trade openness contributes significantly positively to FDI inflows in Iran; hence policy improvements with respect to business ease and trade liberalization will undoubtedly result in higher FDI inflows. Therefore it can be implied that more FDI-friendly regulatory improvements shall be implemented with the purpose of trade facilitation and business ease if Iran is to adopt a welcoming stance to FDI inflows.

Based on the empirical results, market factors promote FDI inflows to Iran significantly. It was also observed that economic risk indicated by inflation serves as an obstacle to FDI inflows with a substantially negative correlation coefficient. In other words investors are attracted to growth in Iran's GDP and GDP per capita and react negatively towards any increase in Iran's inflation.

The empirical evidence also points to the importance of infrastructure base in particular telecommunications infrastructure. Therefore the availability of fixed and mobile phone lines besides broad band internet connection promote Iran as a prospective investment location.

As might have been expected, research and development along with other S&T indicators promote FDI to a relatively high degree although their impact is not as high as business and economic factors. This can serve to highlight the fact that FDI in Iran has been more of a resource and market seeking types than an efficiency seeking which can be interpreted as a threat by the emergence of knowledge and innovation as the key competitive advantages in global business environment.

Hence developing a national culture supportive of invention, risk-taking, entrepreneurship and research in addition to orienting the support budget to R&D in an enterprise scale can definitely serve to enhance the overall S&T perspective of Iran. It is also recommended that a new and less bureaucratic approach to R&D support is established so that a systematic and continuous approach to R&D within enterprises is encouraged.

Surprisingly oil exploitation and oil potential were proven to impact FDI in flows negatively while the analysis suggest that increase in relative oil production leads to more FDI inflows. The findings of this research pertaining to the impact of oil factors on FDI inflows can be subject to a new research in order to track the dynamic impact of oil on Iran's economy and Iran's perceived attractiveness as a location for foreign investment.

It should also be noted that due to unavailability of empirical data, political factors such as Iran's political stability and the influence of the sanctions were not incorporated within the research framework. Since the impact of such political issues is considerably significant in the macroeconomic perspective of a country and the perceived investment risk, further research needs to be carried to clarify the extend to which political factors can influence FDI inflows in Iran.

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