Inward FDI, Growth and Environmental Policy

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Abstract. Persistent disparities in regional economic conditions within developed countries continue to offer challenges to policymakers. Yet the process of regional growth has become even more complex, owing in part to the expending role of inward foreign direct investment. The role of FDI in stimulating regional growth is likely to be as strong as there is environmental policy context. The main objective of this study is to empirically examine FDI inflow effect on the gulf Persian region’s economic growth as environmental policies improve over the period 1980–2012. The results show that FDI inflow help increase of the region’s economic growth, as environmental policy has improved. Porter hypothesis is valid in this region.

Key words: Foreign Direct Investment, Environmental Policy, Economic Growth, Porter Hypothesis and Gulf Persian Region.

JEL Classification: O13, O44, O53.

1. INTRODUCTION

The issue of foreign direct investment interacting with economic growth in developing countries has become increasingly important because many developing countries have adopted a more liberal policy towards FDI since the mid-1980s in order to accelerate their economic growth.

According to Hermes and Lensink (1999), there are different channels through which positive externalities associated with FDI can occur: i) competition channel: increased competition leads to increased productivity; efficiency and investment in human and/or physical capital, and also increased competition may lead to changes in the industrial structure towards more competitiveness and more export-oriented activities; ii) training channel: increased training of labor and management; iii) linkages channel: foreign investment is often accompanied by technology transfer; such transfers may take place through transactions with foreign firms; iv) demonstration channel: domestic firms imitate the more advanced technologies used by foreign firms.

To sum up, economic theory identifies a number of channels through which FDI may exert an impact on economic growth. These effects may be direct as well as indirect. a. Direct impact: FDI flows can promote growth if they lead to an increase in the investment rate. b. Indirect impact: FDI flows can promote growth if they lead to investments that are associated with positive spillovers, which may enhance the productivity of labor and capital in the recipient economy.

Relevant literature on this issue might be divided into two groups. The first is based on growth theory in which FDI has been shown to boost economic growth through technology transfer and diffusion (Dimelis, 2005; Schneider, 2005), spillover effects, productivity gains, and the introduction of new processes, managerial skills and know-how in the host countries (Girma, 2005; Li and Liu, 2005). In addition, FDI can create an international network that can help domestic products move across borders. Also, a number of studies including those by Barro and Sala-i-Martin (1995), Grossman and Helpman (1991), Hermes and Lensink (2003), suggest that FDI plays an important role in modernizing the economy and promoting economic growth in host countries, especially developing countries.

Several empirical studies indicate that the growth effect of FDI is strongly dependent on the institutional circumstances of the host or receiving countries (Hermes and Lensink, 2003). While others find that FDI inflow is positively associated with economic growth only when countries have previously achieved a certain level of wealth (Blomstrom and Wolff, 1994), education (Borenstein et al., 1998), or financial development (Alfarro et al., 2004; Hermes and Lensink, 2003). On the other hand, Carkovic and Levine (2002) find that these results are not robust when controlling for simultaneity bias, while Townsend (2003) confirms this result using data for less developed countries. Overall, the diversity of these findings highlights the difficulty in making generalised comments on the FDI-growth nexus based on simple correlation based analysis.

The second group of studies focuses on the
importance of factors explaining the existence of multinational firms, which suggests that FDI is attracted to host countries because of the possibilities of higher returns. Viewed as a substitute for domestic capital, FDI inflows increase with higher domestic demand for capital generated by economic growth in host countries. Expanding domestic markets also make it possible for multinational firms to exploit economies of scale (Ignatius et al., 1995). Moreover, improvements in human capital development, labour productivity and infrastructure through economic growth would increase the marginal return to capital, thereby expanding the demand for investment including FDI (Zhang and Markusen, 1999). In short, better economic performance in host countries provides foreign investors with a better investment environment and greater opportunities for making profits, suggesting the hypothesis of growth-driven FDI.

Mainstream economic theory has long held that environmental regulations act as a major constraint on economic growth (Jaffe et al., 2002; Magat, 1979; Milliman and Prince, 1989). Environmental regulations, according to the argument, increase a firm’s costs of production because of higher factor costs and increased environmental compliance costs. As a consequence, firms have fewer resources to invest in research and development, productive capacity, and other forms of technology. In the long run, environmental regulations place firms at a competitive disadvantage in the marketplace when compared with their unregulated rivals. Moreover, most economists argue that firms will adjust to environmental regulations by relocating to regions or countries where environmental regulations are less stringent or nonexistent, resulting in significant job loss and economic deterioration in the communities left behind. The long-run effects of environmental regulations on the economy, according to standard economic theory, are a decline in firm productivity, job loss, and a reduction in the U.S. standard of living.

Empirical research in economics has supported the theoretical claim that environmental regulations impede economic growth. In a highly cited study, Jorgenson and Wilcoxen (1990) constructed a detailed model of the economy that incorporated the determinants of long-term economic growth. They estimated the impact of environmental regulations on the U.S. economy by simulating the growth of the economy between 1973 and 1985 with and without environmental regulations. According to their findings, environmental regulations reduced annual economic growth by about 0.2% per year. Gross national product (GNP) by the early 1990s would have been about 2.5% higher in the absence of the regulations. In another study using the same methodology, Jorgenson and Wilcoxen (1992) assessed the impacts of the CAA Amendments of 1990 on the U.S. economy. They estimated that GNP would have been about 3% higher by 2005 if it had not been for the CAA regulations.

Barbera and McConnell (1986) attempted to measure the effects of the environmental regulations of the 1970s on economic productivity in several manufacturing industries, including paper, chemicals, stone, clay and glass, iron and steel and nonferrous metals. Comparing industry productivity in the 1970s with that in the 1960s, they found that environmental regulations caused an annual reduction in the rate of productivity growth of between 0.12% and 0.43% in these industries. Gollop and Roberts (1983) measured and analyzed the effect of sulfur dioxide emission restrictions on the rate of productivity growth in the electric power industry between 1973 and 1979. Their econometric model incorporated the severity of the emission standard, the extent of enforcement, and the unconstrained emission rate of each facility. They concluded that the annual productivity growth of electric utilities declined by 0.59 percentage points over the period. Gray and Shadbegian (1995) used data from the Pollution Abatement and Control Expenditures (PACE) survey to assess the effects of environmental compliance costs on the productivity of oil refineries. The PACE survey collects information on the capital and operating costs of environmental regulations for manufacturing industries in the U.S. economy. Their cross-sectional estimates indicated that $1 spent on pollution abatement by oil refineries induced a productivity loss of $1.35.

Jaffe and Palmer (1997) studied the effects of environmental regulations on technological innovation among firms and industries in the U.S. economy. The traditional economic assumption is that innovation leads to higher levels of productivity and economic growth but environmental regulations restrict this process. Specifically, Jaffe and Palmer examined pollution control expenditures, research and development (R&D) spending data, and patent data in a panel of industries between 1976 and 1989. Data on pollution control expenditures were taken from the PACE survey. They found some evidence that increases in PACE spending were associated with increases in R&D spending but no evidence that this spending produced greater innovation as measured by successful patent applications. In another study on this question, Schmalensee (1994) argued that although R&D devoted to environmental compliance may increase with stricter environmental regulation; this increase will likely come at the expense of other research efforts that could have been more profitable.

The remainder of this paper is organized as follows: Section 2 sets up an overview of the
relationships between technology transfer and FDI inflow; Section 3 examines the relationships between environmental policy and foreign direct investment; Section 4 describes the dataset, the methodology used and the main empirical results, and Section 5 summarizes the results.

2. ENVIRONMENTAL POLICY AND TECHNOLOGY

If the imposition of environmental requirements can stimulate invention and innovation that reduces the cost of complying with those requirements, this has profound implications for both the setting of environmental policy goals and the choice of policy instruments. It is useful to identify two major strands of thought regarding the determinants of innovative activity. We call these two broad categories of modeling approaches the “induced innovation” approach and the “evolutionary” approach.

Within the induced innovation approach, firms undertake an investment activity called “R&D” with the intention of producing profitable new products and processes. The recognition that R&D is a profit-motivated investment activity also leads to the hypothesis that the rate and direction of innovation are likely to respond to changes in relative prices. Since environmental policy implicitly or explicitly makes environmental inputs more expensive, the “induced innovation” hypothesis suggests an important pathway for the interaction of environmental policy and technology, and for the introduction of impacts on technological change as a criterion for evaluation of different policy instruments. This raises the possibility that environmental regulation can lead to a “win-win” outcome in which pollution is reduced and profits increased.

The traditional view among economists and managers concerning environmental protection is that it comes at an additional cost imposed on firms, which may erode their global competitiveness. Environmental regulations such as technological standards, environmental taxes, or tradable emissions permits force firms to allocate some inputs (labor, capital) to pollution reduction, which is unproductive from a business perspective. Technological standards restrict the choice of technologies or inputs in the production process. Taxes and tradable permits charge firms for their emissions pollution, a by-product of the production process that was free before. These fees necessarily divert capital away from productive investments.

The Porter hypothesis asserts that stricter environmental standards can spur innovations that enhance competitiveness, and therefore that the right kinds of environmental policies can greatly reduce the costs of environmental policies and can even make companies more profitable. This paper provides an epilogue to a 1995 debate on the Porter hypothesis that appeared in the Journal of Economic Perspectives. Porter and van der Linde go on to explain that there are at least five reasons that properly crafted regulations may lead to these outcomes:

First, regulation signals companies about likely resource inefficiencies and potential technological improvements.

Second, regulation focused on information gathering can achieve major benefits by raising corporate awareness.

Third, regulation reduces the uncertainty that investments to address the environment will be valuable.

Fourth, regulation creates pressure that motivates innovation and progress.

Fifth, regulation levels the transitional playing field.

Finally, they note, “We readily admit that innovation cannot always completely offset the cost of compliance, especially in the short term before learning can reduce the cost of innovation-based solutions” (Porter and van der Linde, 1995).

Porter and other “win-win” theorists have argued that in a non-optimizing world, regulation may lead to “innovation offsets” that “can not only lower the net cost of meeting environmental regulations, but can even lead to absolute advantages over firms in foreign countries not subject to similar regulations” (Porter and van der Linde, 1995). Of course, the fact that firms engage in non-optimizing behavior creates a possibility for profit improvements, without suggesting that such improvements would be the norm, would be systematic, or even likely.

Porter and van der Linde (1995) provided case studies of firms which adopted new technology in response to regulation, and appear to have benefited, but win-win theorists do not claim that all environmental regulations generate significant innovation offsets. Indeed, they emphasize that regulation must be properly designed in order to maximize the chances for encouraging innovation. Quantitative evidence is limited—much of it from a large related literature on the impact of environmental regulation on productivity and investment—and results seem to be industry and methodology dependent.

Economists have been skeptical of the win-win theory (Palmer et al., 1995; Oates et al., 1993). From a theoretical perspective, it is possible to model apparently inefficient firm behavior as the (second-
best) efficient outcome of imperfect information and divergent incentives among managers or between owners and managers in a principal/agent framework.

From this perspective, the apparent inefficiency does not have normative implications. Since firms are doing the best they can give their information environment, it is unlikely that the additional constraints represented by environmental policy interventions would be beneficial. On a more concrete level, Palmer et al. (1995) surveyed firms affected by regulation—including those cited by Porter and van der Linde as success stories—and found that most firms say that the net cost to them of regulation is, in fact, positive.

For regulation to have important informational effects, the government must have better information than firms have about the nature of environmental problems and their potential solutions. Furthermore, while it seems likely that environmental regulation will stimulate the innovation and diffusion of technologies that facilitate compliance, creation and adoption of new technology will typically require real resources, and have significant opportunity costs. Overall, the evidence on induced innovation and the win-win hypothesis seems to be a case of a “partially full glass” that analysts see as mostly full or mostly empty, depending on their perspective.

3. TECHNOLOGY TRANSFER AND FDI INFLOW

While technology is an abstract term, three main characteristics of technology can be identified (Bassant and Chandra, 1999). Technology can be characterized by the knowledge that is embodied in products, processes and practices. Products comprise the knowledge of how things work, their design, and their interface with other products. Processes comprise knowledge on how a product can be produced or changed. And practices consist of the routines necessary to manage the product-process combination and the knowledge re-generation process.

There are many ways a firm can acquire new technology besides its own investments into R&D capital. Despite trade, FDI is potentially the most important international vehicle of technology transfer for firms. This source of productivity growth has been particularly important for firms in transition economies because of the urgent need to restructure quickly. Foreign ownership often provides local firms with efficient corporate governance, as they, mainly privatized to insiders; do not have incentives to restructure (Blanchard, 1997). FDI may also be the cheapest means of technology transfer, as the recipient firm normally does not have to finance the acquisition of new technology. And it tends to transfer newer technology more quickly than licensing agreements and international trade (Mansfield and Romeo, 1980). And since it has a more direct effect on the efficiency of firms, it also has the potential to create positive spillover effects to local firms.

Multinational firms are among the most important players in the world responsible for creating and controlling technology. They facilitate putting tangible and intangible resources available in different countries to their most productive uses. As part of the global profit-making operations of multinational enterprises, FDI, by its nature, involves the transfer of capital, technology and knowledge from home to host countries. Using better technologies offers possibilities to increase productivity and hence economic growth and development. Hence it is not surprising that many countries view investments by those MNEs as one of the most important means to acquire technology and knowledge to upgrade their own production base. However, it is difficult to paint an unambiguous picture as to how FDI can transfer technology, and how this technology is going to contribute to development. It is not a priori clear that every type of technology transferred is appropriate, and not every investment made is by definition beneficial to host country development.

While FDI is only one of several means available for a firm to transfer technology outside its home country (e.g. exporting products that embody the technology or licensing its technology to an agent abroad), for developing countries it remains the most important means of acquiring new technology. Technology transfer through FDI offers benefits that other modes of transfer do not, for at least three reasons:

Unlike trade in goods, where host countries must try to imitate and learn from reverse engineering, FDI involves the explicit transfer of technology. In addition to the technology itself, FDI brings needed complementary resources such as management experience and entrepreneurial abilities, which can be transferred through training programmes and learning by doing. A World Bank study using firm-level survey data on Czech enterprises of different ownership shows that domestic firms receiving FDI or involved in joint ventures tend to provide training programs and acquire new technologies more frequently than those with no foreign partners (Djankov and Hoekman, 1999).

Technology spillovers through FDI can occur between firms that are vertically integrated with the MNC (inter-industry spillovers) or in direct
competition with it (intra-industry spillovers). Kokko (1992) identifies at least four ways that technology might be diffused from foreign investment enterprise (FIE) to other firms in the economy: (1) demonstration - imitation effect, (2) competition effect, (3) foreign linkage effect, and (4) training effect. Not all spillovers are positive as FDI can generate negative externalities when foreign firms with superior technology force domestic firms to exit. These negative externalities are often called also competition effect, crowding-out effect or business-stealing effect.

Recent analyses of importance of technology transfer and spillovers through FDI are typically carried out using firm panel data. As mentioned above, the evidence provides support for direct technology transfer from MNCs to their affiliates, while there is only a weak evidence of spillovers to indigenous firms.

However, with the very recent exceptions of Blalock (2001), Schoors and van der Tool (2001), Smarzynska (2002) and Smarzynska and Spatareanu (2002), all of the studies have focused on intra-industry spillovers. Aitken and Harrison (1999) show significant technology transfer to the affiliates and some positive spillovers to domestic firms in Venezuela located close to the affiliate, but there were also negative spillovers to the domestic economy as a whole. There were some positive spillovers in other developing countries, but these were limited to certain industries, such as those with relatively simple technology in Morocco (Haddad and Harrison, 1993), are export oriented as in Indonesia (Blomström and Sjöholm, 1999), or have sufficient human capital as in Uruguay (Blomström et al., 1994). Earlier studies that did not use panel data often found evidence of intra-industry spillovers. These include a study by Caves (1974) of Australian manufacturing in 1966, a study by Globerman (1979) of Canadian industry in 1972 and studies of Mexico in the mid-1970s by Blomström and Persson (1983) and the mid-1980s by Blomström and Wolff (1994). However, a study of US firms in Europe shown that spillovers were localized and that competition forced many local competitors out of small markets (Cantwell, 1989). Recent analyses of panel data for advanced countries provide little or no evidence of spillovers in the 1990s. Girma, Greenaway and Wakelin (2001) provide evidence for the United Kingdom, (Berry, et. al. 2001), for Ireland, and Alverez et al. (2002) for Spain. There was also some evidence of negative spillovers in Ireland.

On the other hand, empirical evidence (Kokko, 1994; Borensztein et al., 1998 and Kinoshita, 2000) demonstrate that FDI can contribute to over-all domestic productivity growth only when technology gap between domestic and foreign firms is not too large and when a sufficient absorptive capacity is available in domestic firms. In other words, technology spillovers from MNCs tend to occur more frequently when the social capabilities of the host country and the absorptive capacity of the firms in the economy are high. While relatively backward countries have a certain advantage in catching-up, it becomes increasingly more difficult for the country to build the necessary social capabilities and absorptive capacities that allow firms to take advantage of the technology spillovers that are available in the economy. For this reason, R&D can be thought of as having two complementary effects on firm’s productivity growth (Cohen and Levinthal, 1989). First, R&D directly expands firm’s technology level by new innovations, which is called innovation effect. On the other hand, it increases firm’s absorptive capacity ability to identify, assimilate and exploit outside knowledge, which is usually called learning or absorption effect. These two important effects have to be included into a serious investigation of spillovers through FDI.

4. ANALYTICAL FRAMEWORK AND DATA

4.1. Aggregate production function

The nature of relationship between FDI and economic growth is not clearly understood. The theoretical and empirical literature has identified some of the ‘pre-conditions’ necessary for FDI to stimulate national growth, yet their importance may vary dramatically by region. Although the mechanisms through which it stimulates regional economies have largely been ignored, “new” growth theories imply a pivotal role for FDI.

The endogenous growth literature has emphasized the importance of both human and knowledge capital in forestalling decreasing returns to capital accumulation. As such, growth is not limited to exogenous forces that drive the rate of technical change; environmental policy or conditions that foster human capital development, R&D, or an influx of FDI may actually spur growth. Fundamental, environmental policy is a composite bundle of “know-how” and pollution reduction by FDI that enhances technology transfer, skill diffusion and pollutant industry replacement within the regions. As such, besides directly affecting growth via environmental policy is also expected to generate indirect impacts via FDI. The role of environmental policy in stimulating regional growth is likely to be as strong as it is in a national context.

Observing from theory the possible growth promoting role of FDI, our data analysis is modelled
in an aggregate production function (APF) framework. The standard APF model has been extensively used in econometric studies to estimate the impacts of FDI inflows on growth in many developing countries. The APF assumes that, along with “conventional inputs” of labour and capital used in the neoclassical production function, “unconventional inputs” like FDI may be included in the model to capture their contribution to economic growth. The APF model has been used by Kohpaiboon, 2004; Mansouri, 2005; Feder, 1983; Fosu, 1990 and Ukpolo, 1994.

Following Herzer et al. (2006), the general APF model to be estimated is derived as:

\[ Y_{it} = A_{it} K_{it}^{\alpha} L_{it}^{\beta} \]  

(1)

where \( Y_{it} \) denotes the aggregate production of the economy (real GDP per capita) at time \( t \), \( i \) is country and \( A_{it} \), \( K_{it} \), \( L_{it} \) are the total factor productivity (TFP), the capital stock and the stock of labour, respectively.

Since we want to investigate the impacts of interaction between environmental policy (\( EP \)) and FDI inflows (\( FDI\)) to capture Porter hypothesis and trade openness (\( OP \)) on economic growth through changes in TFP, we assume therefore that TFP is in a function of \( EP\times FDI\) and \( OP \). Thus

\[ A_{it} = f(EP_{it} \times FDI\text{IN}_{it}, OP_{it}) = (EP_{it} \times FDI\text{IN}_{it})^{\gamma} OP_{it}^{\delta} \]  

(2)

Combining equations (2) with (1), we get:

\[ Y_{it} = K_{it}^{\alpha} L_{it}^{\beta} (EP_{it} \times FDI\text{IN}_{it})^{\gamma} OP_{it}^{\delta} \]  

(3)

Where \( \alpha, \beta, \gamma \) and \( \theta \) are constant elasticity coefficients of output with respect to the \( K_{it}, L_{it}, EP_{it}, FDI\text{IN}_{it} \) and \( OP_{it} \). From equation (3), an explicit estimable function is specified, after taking the natural logs of both sides, as follows:

\[ \ln Y_{it} = c_{i} + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma \ln (EP_{it} \times FDI\text{IN}_{it}) + \theta \ln OP_{it} + \mu_{i} + \phi_{i} + \epsilon_{it} \]  

(4)

where all coefficients and variables are as defined, \( \mu_{i} \) are the time specific intercepts, \( \phi_{i} \) represents country-specific effects that summarize the influence of unobserved variables such as infrastructure, period average climate, history and culture, and which are assumed to be distributed independently across countries, with variance \( \sigma_{\phi}^{2} \). \( \epsilon_{it} \) is a constant parameter and \( \epsilon_{it} \) is the white noise error term.

4.2. Data descriptions

From equation (4) \( Y \) is defined as real GDP per capita; \( FDI\text{IN} \) is the value of real gross foreign direct investment inflows; \( EP \) is country’s change in energy production intensity (energy production/GDP) over the period 1980 – 2012, together with the level of energy production intensity in 1980. \( OP \) is the sum of export and import values to GDP ratio; \( L \) is measured as the volume of the total labour force, \( K \) is proxied by the real value of gross fixed capital formation. The annual time series data used is sourced from the World Development Indicators 2013 edition published by the World Bank and covers the period from 1980 to 2012.

4.3. The Results

We test the stationarity of variables in the model. Therefore, we make the unit root test of Levin, Lin & Chu and Im, Pesaran & Shin W-stat to test for it. The results show that all variables are stationarity at level (Table 1).

Given that OLS will yield biased results in the presence of unobserved heterogeneity, either random effects or fixed effects could be employed to obtain consistent results. While the fixed effects model treats the \( \mu_{i} \) and \( \phi_{i} \) as regression parameters, the random effects model treats them as components of the random disturbance. We employ a Hausman test to test for the inconsistency of the random effects estimate. Furthermore, since heteroscedasticity may be present in the sample because of large variations in the variables, it needs to be tested for in the estimations. A likelihood-ratio test is used that compares a feasible general least squares regression (FGLS henceforth) that is corrected for heteroscedasticity with one that is not. Where the null hypothesis of homoscedasticity could be rejected, robust standard errors are used. A final methodological issue concerns serial correlation in the error term. A Wooldridge test for autocorrelation in panel data is used to test for autocorrelation.
Ignoring first order serial correlation still results in consistent, but inefficient estimates of the coefficients and biased standard errors (Baltagi, 2006). Therefore, where necessary, additional FE models with (FGLS) correcting for AR(1) and FE regressions with Driscoll and Kraay (1998) standard errors are estimated and compared with the results of the other specifications.

We estimate the equation (4) using fixed and random effects using 1980–2012 panel data for the 4 Gulf Persian countries (Bahrain, Iran, Kuwait, Oman and Saudi Arabic). All results are discussed in Table 2.

Table 1: Variables Stationarity Tests in the Region

<table>
<thead>
<tr>
<th>Variables</th>
<th>Levin, Lin &amp; Chu Test</th>
<th>Im, Pesaran and Shin W-stat Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistic</td>
<td>Prob</td>
</tr>
<tr>
<td>Ln $Y_{it}$</td>
<td>-4.76166</td>
<td>0.0000</td>
</tr>
<tr>
<td>Ln $K_{it}$</td>
<td>-1.70375</td>
<td>0.0442</td>
</tr>
<tr>
<td>Ln $L_{it}$</td>
<td>-3.76847</td>
<td>0.0001</td>
</tr>
<tr>
<td>Ln $E_{it}$</td>
<td>2.66335</td>
<td>0.0000</td>
</tr>
<tr>
<td>Ln FDIIN$_{it}$</td>
<td>-5.33756</td>
<td>0.0000</td>
</tr>
<tr>
<td>Ln $O_{it}$</td>
<td>5.20648</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

The all coefficients of the variables are significantly, except OP coefficient. The results show that the coefficients of physical capital, human capital, and interaction between environmental policy and FDI inflows are positive and significant.

A restrictive environmental policy lowers aggregate output because it imposes an additional constraint on the production possibilities set. But, more stringent environmental policy stimulates innovation and FDI inflow increases, so economic growth increase. This result indicates that Porter hypothesis is valid in this region.

Table 2: The Determinants of Economics Growth in the Region

<table>
<thead>
<tr>
<th>Variables</th>
<th>Random Effect</th>
<th>Fixed Effect$^{(1)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>7483.709$^2$</td>
<td>(16.34)</td>
</tr>
<tr>
<td>Ln $K_{it}$</td>
<td>-5.46e-08$^*$</td>
<td>(-3.02)</td>
</tr>
<tr>
<td>Ln $L_{it}$</td>
<td>2.79e-07$^*$</td>
<td>(11.37)</td>
</tr>
<tr>
<td>Ln $E_{it}$*FDIIN$_{it}$</td>
<td>.000021$^*$</td>
<td>(6.55)</td>
</tr>
<tr>
<td>Ln $O_{it}$</td>
<td>.0751517$^*$</td>
<td>(0.25)</td>
</tr>
<tr>
<td>R$^2$</td>
<td>0.6313</td>
<td></td>
</tr>
<tr>
<td>Groups</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Number of observation</td>
<td>151</td>
<td></td>
</tr>
<tr>
<td>Time periods</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Breusch and Pagan LM test</td>
<td>279.08</td>
<td>0.0000</td>
</tr>
<tr>
<td>Prob &gt; chi2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified Wald Test for group-wise heteroskedasticity$^{(3)}$</td>
<td>52.481</td>
<td>0.0000</td>
</tr>
<tr>
<td>Prob &gt; chi2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hausman Test$^{(2)}$</td>
<td>$X^2$(2)=0.02</td>
<td>0.8759</td>
</tr>
<tr>
<td>Prob &gt; chi2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wooldridge test for autocorrelation in panel data</td>
<td>47.809</td>
<td></td>
</tr>
<tr>
<td>Prob &gt; F</td>
<td>0.0023</td>
<td></td>
</tr>
</tbody>
</table>

Note: T-statistics are shown in parentheses. Significance at the 99%, 95% and 90% confidence levels are indicated by *, ** and ***, respectively.

The robust standard errors are White’s heteroskedasticity-corrected standard errors

$^{(1)}$ The acceptance of model by the Hausman test.

$^{(2)}$ The hausman test tests the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. If they are (insignificant P-value, Prob>chi2 larger than .05) then it is safe to use random effects. If you get a significant P-value, however, you should use fixed effects.

$^{(3)}$ For FE regression model, the modified Wald test for groupwise heteroskedasticity is used while the Wooldridge test for autocorrelation in panel data (Ho: no autocorrelation) is applied.

5. CONCLUSIONS

Does FDI contribute relatively more to growth as environmental policy has improved? Inward FDI (foreign capital inflow) is an important vehicle for augmenting the supply of funds for domestic investment thus promoting capital formation in the host country. The stringent environmental policy may bring adoption of superior production technology and innovation by FDI inflow to developing countries.
Firms learn or adopt better and highly developed production technology and innovation, either through intensive international markets competition or act as sub-contractors to foreign business concerns.

In this paper, we examine the role of stringent environmental policy in the relation between FDI inflow and Gulf Persian region’s economics growth over 1980-2012. The results show more stringent environmental policy stimulates innovation and FDI inflow increases, and so economic growth increase in the region.

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