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Endogenous Determination of FDI Growth and Economic Growth: The OECD Case

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Abstract

This paper tests the endogenous relationship between FDI growth and economic growth using a panel dataset for 23 OECD countries for the period 1975-2004. In particular we estimate a two-equation simultaneous equation system with the generalized methods of moments (GMM) that treats economic growth and FDI growth as endogenous variables. We find that FDI growth and economic growth are significant determinants of each other. We also find that export growth rate and human capital are statistically significant determinants of both FDI growth and economic growth. Our findings lead us to conclude that FDI growth and economic growth have an endogenous relationship.

Keywords: FDI growth, economic growth, Panel Data, GMM
JEL Classification: C33, O5, F21.

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1. Introduction

World Bank statistics show that FDI worldwide grew 23.4 percent per annum on average between 1970-2006 and reached 1.4 trillion dollars in 2006. In the same period, the world GDP experienced a three percent growth rate per annum on average. The free movement of capital next to stable growth in recent decades suggests that there may be some positive relationship between FDI growth and economic growth. The following graph scatter plots average growth rate of GDP against average growth rate of FDI of OECD countries in the period 1975-2004 as a possible evidence of this positive relationship.

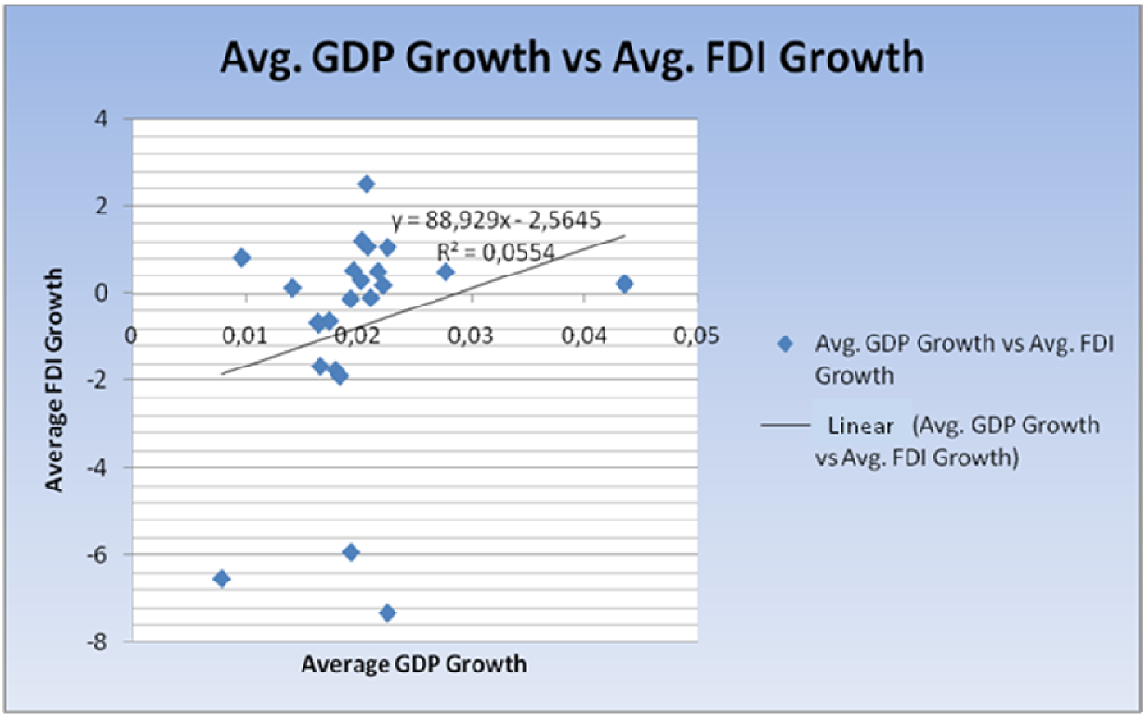

Figure 1: ***Average GDP Growth versus Average FDI Growth in OECD Countries***

Source: World Development Indicators Online

The positive relationship suggests that (i) FDI grows in those countries whose long-run growth rates are higher, (ii) those countries that attract higher and higher FDI levels in time achieves higher long-run growth rates, (iii) the two determine each other simultaneously. The answer to which explanation is more applicable is especially important for policy makers of FDI receiving economies. Take, for example, developing countries. Policy makers believe that increasing FDI inflows is the magical prescription for achieving positive long-run growth rates. However, if economic growth precedes FDI growth or if FDI growth and economic growth determine each other simultaneously, the volume of FDI that those policy makers look forward to without having high growth rates will not be realized in the level they expect. Besides policy concerns, there is a technical concern. It is important to determine whether FDI growth rate precedes economic growth or the other way around or whether the two determine each other simultaneously; without having this information, reliability of uni-directional analysis cannot be assured.

As stated above, one possible direction of causality is from FDI to economic growth. On theoretical grounds, it is argued that FDI may affect growth positively because it lowers rental rate of capital, increases production via enhancing labor productivity, and introduces new technologies embedded in the capital by moving capital from capital-rich countries to capital-scarce economies. Some studies underlining these features of FDI are Hyun (2006), Hsiao and Hsiao (2004), Zhang (2001) and Duttaray (2001). Some other studies, however, argue that FDI may affect growth negatively, as it may deteriorate competition and may corrupt the development path of the country in its own interests. Most empirical works have found that FDI has a positive impact on economic growth. For example, Papanek (1973), Balasubramanyam *et al*. (1996), Borensztein *et al*. (1998), Balasubramanyam *et al*. (1999), Berthelemy and Demurger (2000), Obwona (2001), Reisen and Soto(2001), Zhang and Ram(2002), Massoud (2003), Bengoa and Sanchez–Robles (2003), Basu *et al*. (2003), Saha (2005), Li and Liu (2005), Johnson (2006), Basu and Guariglia (2007) found that FDI enhances economic growth. Some other (and fewer) studies, on the contrary, such as Fry (1993) and Bornschier *et al*. (1978), found that FDI may deteriorate economic growth as it may distort the development path of FDI-receiving economy.[1] In Annex A, we provide a more detailed list of the literature and their main findings.

The alternative direction of causality that economic growth may be a determinant of FDI is also a plausible conjecture. Indeed, figure 1 may be interpreted as economic growth has some positive impact on FDI as well as the other way around. On theoretical grounds, advocates of the idea that economic growth has positive impact on FDI argue that higher growth rates of an economy stimulate the growth in demand, which implies greater profitability opportunities for inflowing capital. Hence, capital movement must prefer higher growing countries. On the other hand, opponents of the idea argue that lower growing economies may imply higher profitability opportunities for capital, given that these economies are capital-scarce and labor abundant. Empirical research on the issue has mixed results. On the one hand, works such as Chowdhury and Mavrotas (2006), Saha (2005) and Choe (2003) found that higher growth rates attract more FDI. On the other hand, studies like Hansen and Rand (2006), Hsiao and Hsiao (2004) and Mencinger (2003) argue that high-growing countries do not attract much FDI.

This study works out the two possible directions of causality together in a simultaneous equation system for the case of OECD. We undertake a simultaneous equation system because it would be technically wrong and therefore results would be unreliable were we assume one-way causality. The simultaneous equation setup allows us to treat FDI growth and economic growth variables endogenously. This is also supported by the causality studies such as Chowdhury and Mavrotas (2006) and Choe (2003), which have shown evidence that there is bi-directional causality between FDI and economic growth. Heuristically speaking, our approach is rare in the literature; most empirical studies test direction of determination in one-way. In our simultaneous equation model, we estimate the determinants of FDI and economic growth for OECD countries through a panel data analysis. In particular, following Saha (2005) and Li and Liu (2005), we use Generalized Methods of Moments (GMM) estimation technique in a panel dataset for OECD countries. Another novelty in our paper is that we run FDI growth rather than FDI inflow or FDI stock (sum of FDI inflows) against economic growth. We believe that using FDI growth is more proper than FDI inflow or FDI stock. Firstly, running a level value (FDI inflow or FDI stock) against percentage (economic growth rate) is not proper in a simultaneous equation system. Secondly, as long as FDI inflow or FDI stock are growing, which must be actually, percentage change of the level value would

[1] Interestingly, some other studies like Alfaro et al. (2002), Carkovic and Levine (2002), Durham (2004), and Herzer et al. (2008) found that there is no direct relationship between FDI and economic growth.

capture the same regularity.[2] We consider OECD countries in this research because (i) its FDI data are wider and reliable, (ii) covers mainly developed countries, a better representative of long-run FDI growth and economic growth rates.

The organization of paper is as follows. Section 2 portrays an illustrative theoretical framework. We show that FDI determines economic growth and that economic growth is a determinant of FDI. Section 3 first describes the data and its limitations and next discusses the simultaneous equation system. Section 4 presents the findings of the model and its implications. The last section provides some concluding remarks.

2. An Illustrative Framework[3]

Let us assume a single-good open economy populated by identical households. Suppose that utility function of the representative consumer is defined as

$$U(c) = \int_0^\infty e^{-\rho t} u(c) L dt \tag{1}$$

where $U(c)$ is the overall utility, ρ is the subjective rate of discount, $u(c)$ is the momentary felicity function, c is consumption per capita and L is the labor which grows at rate n. We assume that momentary utility is defined as $u(\mathrm{c}) = \frac{\mathrm{c}^{1-\theta} - 1}{1-\theta}$, where θ is the elasticity of marginal utility. The representative household's optimization problem requires construction of an optimal control problem, which yields:

$$\frac{\dot{\mathrm{c}}}{\mathrm{c}} = \frac{1}{\theta}(r - \rho) \tag{2}$$

In (2), r is the real rate of interest and a dot on top of a variable indicates a time derivative of the variable. Equation (2) is nothing but an arbitrage condition between "to consume today" versus "to consume tomorrow". According to (2), if the real rate of interest is greater than the subjective rate of discount, then consumers prefer not to consume today to enjoy higher consumption tomorrow.

We assume in this open economy that capital may freely move between borders. We further assume that domestic and foreign capital are perfect substitutes as factor of production; hence each pay the same rate of return, r, the world interest rate. Suppose that capital K^* that exists in a domestic country at a particular time has two possible ownerships: domestic residents and foreigners. Suppose also that K is capital that belongs to domestic residents. Hence, $K^* - K$ represents the sum of foreign investments in the domestic country. In another interpretation, $K^* - K$ represents net claims by foreigners on the domestic economy. For matter of illustration, we assume that $K^* - K > 0$, without loss of generality. The only function of openness in this model is the free movement of capital; that is, labor is immobile. Suppose that the production technology is represented by

[2] Were the variable run against economic growth was a constant FDI inflow, then a constantly falling FDI/GDP yielding constant positive economic growth must have been possible. Visibly, this is implausible.

[3] This section is inspired from chapter 3 of Barro and Sala-i-Martin (2005).

$$\mathrm{Y} = F\left(K^{*}, N\right) \tag{3}$$

where Y is output, K^{*} is total physical stock available in the domestic economy, and N is labor stock. The optimization conditions for the representative firm entail equality between the marginal products and the factor prices:

$$f'(k^{*}) = r \tag{4a}$$
$$f(k^{*}) - k^{*} f'(k^{*}) = w \tag{4b}$$

In (4), k^{*} is capital per person that exists in a domestic country at a particular time, w is the real wage rate, and r is the world's real rate of interest. Capital accumulation function for the domestic resident is

$$\dot{k} = w + (r - n)\cdot k - c \tag{5}$$

where k is capital per person owned by domestic residents, n is the population growth rate, c is the consumption. If we substitute for w from equation (4b) and for r from equation (4a) into equation (1), the change in assets per capita can be determined as

$$\dot{\mathrm{k}} = f\left(k^{*}\right) - r(k^{*} - k) - nk - c \tag{6}$$

$k^{*} - k$ represents the sum of foreign investments per capita in the domestic country and without loss of generality, we assume that $k^{*} - k > 0$. Note from equation (6) that it would become the standard equation of motion of Ramsey if the economy were closed, $k^{*} - k = 0$. The difference between equation (6) and the macroeconomic budget constraint of Ramsey model is that the domestic economy is incurring rental cost for the total foreign capital that came in until time t. By definition, it must be true that $k^{*} - k = \int_{0}^{t} FDI dt$, where FDI is the physical capital inflow from abroad at time t. If we take time derivative of this identity, we obtain that $\dot{k}^{*} - \dot{k} = FDI$. Hence, we may alternatively express equation (6) as follows:

$$\dot{k}^{*} = f\left(k^{*}\right) - r(k^{*} - k) - nk - c + FDI \tag{7}$$

Given that $y = f(k^{*})$, the growth rate of output is $g_{y} = \frac{\dot{y}}{y} = \frac{f'(k^{*})k^{*}}{f(k^{*})}\frac{\dot{k}^{*}}{k^{*}}$. Substituting respective value of $\frac{\dot{k}^{*}}{k^{*}}$ from (7), we may express growth rate of output as

$$g_{y} = \frac{f'(k^{*})k^{*}}{f(k^{*})}\left[\frac{f\left(k^{*}\right)}{k^{*}} - r\frac{(k^{*} - k)}{k^{*}} - n\frac{k}{k^{*}} - \frac{c}{k^{*}} + \frac{FDI}{k^{*}}\right] \tag{8}$$

where $\frac{f'(k^*)k^*}{f(k^*)}$ is the share of capital income in total income in the domestic country. Equation (8) indicates that the growth rate of domestic economy is supported positively by FDI and negatively by returns out of sum of claims of foreigners, that is, $\frac{\partial g_y}{\partial FDI} > 0$ and $\frac{\partial g_y}{\partial (k^* - k)} < 0$.[4]

We need to define an FDI behavior next to modeling the foreign economy in order to search theoretically the relationship between FDI growth and economic growth. We believe that this is below the purposes of this work. For that reason, we would rather prefer to directly exploit the literature on the determinants of FDI. The literature suggests that *ex ante* differences between domestic and world interest rates, the size of the economy, the growth rate of economy, export growth rate of economy are some major determinants of FDI. Therefore, without any theoretical exposure, we will directly argue that the following function represents the FDI behavior:

$$FDI = f(g_y, M) \tag{9}$$

where M represents vector of variables next to the growth rate of domestic economy that contributes to the determination of FDI.

3. Data, Method and Limitations

3.1. Data

FDI inflows data have been retrieved from World Development Indicators Online Database. Raw FDI data were in current US$. Real FDI per capita data were formed by using population statistics, which were collected from Penn World Table Database, and CPI, which were collected from World Development Indicators Online Database. FDI per capita growth rates were calculated simply from per capita real FDI. A similar procedure was applied for determining export growth rates. Firstly, exports of goods and services data were collected from WDI Online Database. Next, per capita exports values calculated by using population data from Penn World Table and finally growth rates of export per capita were found. Growth rates of per capita GDP values were directly retrieved from WDI Online Database. Finally, human capital data are collected from Barro-Lee Dataset, which consists of post-secondary education levels of adult population.

Our data set consists of 23 OECD countries and covers time period of 1975–2004. We included Australia, Austria, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, and USA in our data set. We dropped Belgium and

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[4] As Annex B indicates, the corresponding equation for the foreign country is $\tilde{g}_{\tilde{y}} = \frac{\tilde{f}'(\tilde{k}^*)\tilde{k}^*}{\tilde{f}(\tilde{k}^*)}\left[\frac{\tilde{f}\left(\tilde{k}^*\right)}{\tilde{k}^*} + \tilde{r}\,\frac{(\tilde{k} - \tilde{k}^*)}{k^*} - \tilde{n}\,\frac{\tilde{k}}{\tilde{k}^*} - \frac{\tilde{c}}{\tilde{k}^*} - \frac{FDI}{\tilde{k}^*}\right]$, where a tilde on top of a variable indicates that the variable corresponds to the foreign country.

Luxembourg from the data set as their FDI data are not trustable. As a result, we obtained our balanced panel data set sample with 690 observations.

3.2. Simultaneous Equation System

A simultaneous equation system consists of a number of *structural equations* involving several *endogenous variables* whose values are determined by *exogenous variables* and lagged values of variables, known as *predetermined variables.* After each of the endogenous variables is solved in terms of the exogenous and predetermined variables, we obtain a system of *reduced form equations*.

Although the implications of simultaneity for econometric estimation were recognized long time ago, e.g., Working (1926), the first major contribution to the area of estimating simultaneous equation system has been made by Trygve Haavelmo (1943). According to Haavelmo (1943), if one assumes that the economic variables considered satisfy, simultaneously, several stochastic relations, it is usually not a satisfactory method to try to determine each of the equations separately from the data, without considering the restrictions which the other equations might impose upon the same variables. That this is so is almost self-evident, for in order to prescribe a meaningful method of fitting an equation to the data, it is necessary to define the stochastic properties of all the variables involved. Otherwise, we shall not know the meaning of the statistical results obtained. Furthermore, the stochastic properties ascribed to the variables in one of the equations should, naturally, not contradict those that are implied by other equations.

If the simultaneity is ignored and ordinary least squares applied, the estimates will be biased and inconsistent. Consequently, forecasts will be biased and inconsistent. In addition, tests of hypotheses will no longer be valid (Ramanathan, 1998).

Our illustrative framework suggests that FDI contributes positively to the growth rate of FDI receiving economy, and that positive growth rate stimulates FDI inflows positively. That means, on theoretical ground, there is a bi-directional relationship between variables. Hence, we need to consider the determination of FDI growth and growth rate together as it would not be correct to use unidirectional relationship between these variables.

4. Econometric Analysis

In this part of the paper, we present our results out of simultaneous equation system analysis. Our simultaneous equation system is composed of two equations:

$$g_{FDI,it} = \beta_0 + \beta_1 g_{Y,it} + \beta_2 g_{X,it} + \beta_3 hc_{it}(-5) + \beta_4 g_{FDI,it}(-1) + u_{it} \qquad (10a)$$

$$g_{Y,it} = \alpha_0 + \alpha_1 g_{FDI,it} + \alpha_2 g_{X,it} + \alpha_3 hc_{it}(-5) + \alpha_4 g_{Y,it}(-1) + v_{it} \qquad (10b)$$

In (10a), $g_{FDI,it}$ is the growth rate of foreign direct investment of the i^{th} country at time t, $g_{Y,it}$ is the growth rate of GDP, $g_{X,it}$ is the growth rate of exports, hc(-5) is five year lagged value of human capital and $g_{FDI,it}(-1)$ is one year lagged value of FDI growth rate. In (10b), $g_{Y,it}(-1)$ is one year lagged value of GDP growth rate. Growth rate of exports is the annual percentage change of goods and services exports. GDP growth rate is defined as annual percentage change in GDP. Lastly, FDI growth rate is the growth rate of foreign direct investment inflows to countries. Finally, human capital variable is the five-year lagged values of post-secondary education rate of adult population. We consider lagged education levels do affect FDI inflow and economic growth rate, that is, it takes time for human capital to affect FDI and economic growth. As Barro–Lee Dataset education statistics are for five-year periods, we did take five-year lagged values of this variable.

Before starting to our analysis, we undertake alternative unit root tests of series in order to avoid "artificial regression" problem. There are different approaches to unit root tests. Our results with these alternative approaches are shown in Annex C. Unit root test results prove that our series are stationary series, i.e., they do not involve unit root problem. The following table shows the estimation results of our simultaneous equation system which was estimated by diverse econometric models.

Table 1: ***Estimation Results of the Simultaneous Equation System***

Dependent Variables		***Independent Variables***										
		Constant	**g_Y**	**g_{FDI}**	**g_X**	**hc(-5)**	**g_{FDI}(-1)**	**g_{FDI}(-2)**	**g_{FDI}(-3)**	**g_Y(-1)**	**g_Y(-2)**	**g_Y(-3)**
1 (OLS)	g_{FDI}	-133.01 (-0.54)	76.62 (1.50)	-	9.10 (0.99)	-14.39 (-0.57)	-	-	-	-	-	-
2 (TSLS)		-364.94 (-1.10)	164.76 (1.45)	-	-15.22 (-0.99)	-3.69 (-0.13)	-	-	-	-	-	-
3 (3SLS)		-801.05*** (-2.57)	378.74*** (3.85)	-	26.50* (1.82)	1.14 (0.04)	-	-	-	-	-	-
4 (GMM)		-226.68*** (-4.84)	108.74*** (6.87)	-	8.61*** (3.73)	-0.27 (-0.08)	-	-	-	-	-	-
5 (GMM)		-190.03*** (-4.50)	88.96*** (6.20)	-	7.82*** (3.59)	6.78** (2.26)	0.10* (1.75)	-	-	-	-	-
6 (GMM)		-184.46*** (-4.33)	87.73*** (6.05)	-	7.37*** (3.29)	0.35 (0.11)	0.11* (1.83)	0.004*** (2.83)	-	-	-	-
7 (GMM)		-176.60*** (-4.00)	82.23*** (5.26)	-	6.85*** (2.91)	1.13 (0.37)	0.14** (2.15)	0.005*** (3.10)	0.001 (1.18)	-	-	-
1 (OLS)	g_Y	2.04*** (11.13)	-	5.17 (1.50)	0.05*** (7.64)	-0.02 (-1.02)	-	-	-	-	-	-
2 (TSLS)		3.79*** (3.90)	-	0.001*** (2.84)	0.07** (2.38)	0.21* (1.80)	-	-	-	-	-	-
3 (3SLS)		3.43*** (4.06)	-	0.001*** (4.12)	0.07** (2.55)	-0.16 (-1.60)	-	-	-	-	-	-
4 (GMM)		3.74*** (10.44)	-	0.001*** (4.82)	0.06*** (9.47)	0.20*** (4.83)	-	-	-	-	-	-
5 (GMM)		3.01*** (8.01)	-	0.001*** (4.75)	0.05*** (8.22)	0.17*** (4.22)	-	-	-	0.24 (5.87)	-	-
6 (GMM)		2.88*** (7.38)	-	0.001*** (4.50)	0.05*** (5.78)	0.16*** (3.67)	-	-	-	0.22*** (5.68)	0.02 (1.02)	-
7 (GMM)		2.97*** (7.81)	-	0.001*** (4.23)	0.04*** (5.43)	0.16*** (3.71)	-	-	-	0.23*** (5.84)	0.04 (1.48)	-0.05* (-1.70)

t values in parenthesis: *** 1% level, ** 5% level, * 10% level of significance

For matter of clarity, let us call the equation that tries to identify the determinants of FDI as "the first equation" and that the equation that tries to identify the determinants of GDP growth as "the second equation". An ad hoc estimation technique was used in order to describe the best model and consequently different models with different lags of dependent variables and different estimation methods were applied.

The first model uses Ordinary Least Squares (OLS) estimation method, to identify the first and second equations. t-statistics of all the independent variables in the first equation are insignificant for 1%, 5%, and 10% levels of significance. In the second equation, t-statistic of $g_{FDI,it}$ and hc(-5) is insignificant at all levels, while $g_{X,it}$ is significant at 1% level. Our test results indicate us that OLS regressions do not produce statistically reliable/significant results.

In the second model, Two Stage Least Squares Method (TSLS) was used to estimate the system. The results indicate that t-statistics of $g_{Y,it}$, hc(-5) and $g_{X,it}$ in the first equation are insignificant. Moreover in the second equation hc(-5) is significant at the 10% level; $g_{X,it}$ is significant at the 5% level, and $g_{FDI,it}$ is significant at the level of 1%.

In the third model, Three Stage Least Squares (3SLS) estimation technique was used in order to estimate the system. hc(-5) is insignificant both in the first equation and the second equation. On the other hand, in the first equation, $g_{X,it}$ is significant at the 10% level and $g_{Y,it}$ is significant at the 1% level. Moreover in the second equation of the system, while $g_{X,it}$ is significant at the 5% level, $g_{FDI,it}$ shows significance for the level of 1%.

The fourth model, which was estimated by GMM technique, yield that $g_{Y,it}$ and $g_{X,it}$ are statistically significant at the 1% level and signs are positive, as expected, in the first equation. However, hc(-5) is statistically insignificant in the same equation. All the coefficients are statistically significant at 1% in the second equation and signs of variables are as expected. However these results are not sufficient to make any interpretation about the fitness of the model. As it was mentioned before we are applying an ad hoc estimation approach. Consequently, we must continue to estimate other models with lagged values of dependent variables of the system.

Fifth model consists of one year lags of $g_{FDI,it}$ and $g_{Y,it}$ and is estimated by GMM method, as inclusion of one year lagged values of dependent variables implies that the model behaves as an autoregressive model. As it can be seen from the table, all independent variables are significant in the first equation, though at varying significance levels. However, in the second equation, one year lagged value of GDP growth rate is statistically insignificant.

Sixth model consists both one-year and two-year lagged values of $g_{FDI,it}$ and $g_{Y,it}$, respectively. Our estimation results show that hc(-5) is insignificant in the first equation and two-year lagged value of $g_{Y,it}$ is statistically insignificant in the second equation. All other variables in both equations are significant at different levels of significance and also their signs are as expected.

Finally, seventh run consists of three-year lags of dependent variables. In the first equation, coefficients of hc(-5) and $g_{FDI}(-3)$ are statistically insignificant. Moreover, in the second equation $g_Y(-2)$ is insignificant.

Our analyses suggest that the best model for our system is model 5. In model 5, coefficients of the variables show that FDI and economic growth are important determinants of each other. Also, it is obvious from the results that export growth rate and human capital are statistically significant determinants of FDI and economic growth. On the other hand, although both FDI and economic growth affect each other in a positive way, the effect of economic growth on FDI is larger than the effect of FDI on economic growth in OECD countries.

Our findings are mostly consistent with the literature, though there are some counter findings. Our finding that FDI inflows affect economic growth positively is supported by a bulky number of studies such as Hyun (2006), Li and Liu (2005) and Saha (2005), among others.[5] Contradicting evidence is found by Bornschier, Chase-Dunn and Rubinson (1978) and Durham (2004). The former study argues that FDI has especially negative impact on the growth rate of developing countries. The latter study asserts that current value of FDI does not have any positive impact on the growth rate. Johnson (2006) on the other hand argues that FDI has positive impact on developing countries but not on developed countries. As our study focuses on OECD countries, which are developed by and large, our results contradicts with this result.

Moreover, our finding about the positive impact of economic growth rates on FDI inflow, consistent with the findings of Chowdhury and Mavrotas (2006), Saha (2005) and Choe (2003). Also, our finding that human capital has a positive impact on FDI and economic growth is consistent with the foundations of Li and Liu (2005) and Balasubramanyam, Salisu and Sapsford (1999). Lastly, positive impacts of exports on both economic growth rates and FDI inflows are also found in the article of Saha (2005).

5. Concluding Remarks

The bi-directional relationship between FDI and economic growth has not been sufficiently studied in the literature. In this study, we run several models to test whether there exists bi-directional relationship between FDI and economic growth or not. This is an important research question because if bi-directional relationship exists between these variables, one-direction (one-equation) studies investigating the impact of FDI on economic growth or vice versa statistically yield misleading results. In other words, if there is an endogeneity between FDI and growth, then all econometric estimations ignoring this endogeneity will produce wrong and misleading results.

In this paper, the endogenous relationship between foreign direct investment and economic growth was examined for 23 OECD countries for the 1975 – 2004 period. A simultaneous equation system was established and an econometric estimation procedure was applied. Our empirical results suggest that FDI growth positively affects economic growth rate and also that economic growth rate positively affects the growth rate of FDI inflows. Our results also indicate that economic growth stimulates growth rate of FDI inflows more strongly than that the growth rate of FDI stimulates economic growth.

[5] See Annex A for the list of all studies, with supportive or contradictory results.

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Annex A

Table A.1: Literature Review

Author	Sample Size and Time Period	Econometric Method and Tests	Empirical Evidences
Basu & Guariglia (2007)	119 developing countries 1970 – 1999	Generalized Methods of Moments (GMM)	FDI enhances both educational inequalities and economic growth in developing countries. However, it reduces the share of agriculture sector in GDP.
Johnson (2006)	90 developed and developing countries 1980 – 2002	OLS	FDI inflows accelerate economic growth in developing countries. But it is not valid for developed countries.
Hyun (2006)	59 developing countries 1984 – 1995	OLS	FDI has positive effect on economic growth but lagged FDI values have no positive effects on current economic growth.
Li & Liu (2005)	21 developed countries and 63 developing countries 1970 – 1999	Unit Root Tests, Durbin – Wu – Hausman Test, OLS	Endogenous relationship between FDI and economic growth has accelerated since the middle of 1980s. Also, relationships between FDI, human capital and technological differences effect economic growth in developing countries indirectly.
Saha (2005)	20 Latin America countries and Caribbean countries 1990 – 2001	3 Stage of Least Squares	FDI and economic growth are important determinants of each other in Latin America and Caribbean. There is an endogenous relationship between FDI and economic growth.
Durham (2004)	80 countries 1979 – 1998	Extreme Bound Analysis (Sensitivity Analysis)	There is no direct positive effect of current and lagged values of FDI and portfolio investment on economic growth.
Hermes & Lensink (2003)	67 less developed countries 1970 – 1995	OLS	Financial development level of a FDI attracting country is an important pre-condition in order to provide positive affect of FDI on economic growth.
Bengoa & Sanchez – Robles (2003)	18 Latin America countries 1970 – 1999	Hausman Test OLS	Economic freedom is an important determinant of FDI inflows. Also FDI affects economic growth positively.
Massoud	51 developing countries	OLS	FDI accelerates economic growth in both time periods (1989 – 1996 and 1989 – 2000)

(2003)	1989 – 1996 1989 – 2000		
Zhang & Ram *(2002)*	85 countries 1990 – 1997	OLS	There is a positive relationship between FDI and economic growth in 1990s.
Carkovic & Levine *(2002)*	72 developed and developing countries 1960 – 1995	OLS and GMM	FDI alone has no statistically significant affect on economic growth.
Alfaro, Chanda, Kalemli-Ozcan & Sayek *(2002)*	*1. sample*: 20 OECD countries and 51 non-OECD countries 1975 – 1995 *2. sample*: 20 OECD countries and 29 non-OECD countries 1980 – 1995	OLS	FDI alone has an ambiguous affect on economic growth. However, the countries which have developed financial markets can benefit from FDI.
Reisen & Soto *(2001)*	44 countries 1986 – 1997	GMM	FDI and portfolio investments affect economic growth positively.
Obwona *(2001)*	Uganda 1975 – 1991	2 Stage Least Squares	FDI has a positive effect on economic growth in Uganda.
Berthelemy & Demurger *(2000)*	24 Chinese provinces 1985 – 1996	GMM	FDI plays an important role in the economic growth of Chinese provinces.
De Mello *(1999)*	32 OECD and non-OECD countries 1970 – 1990	Augmented Dickey-Fuller, Panel Cointegration,OLS	There is an inverse relationship between the difference of technologically leader countries and their followers, and effect of FDI on economic growth.
Nair – Reichert & Weinhold *(1999)*	24 developing countries 1971 – 1995	MFR model (mixed fixed and random model) Causality Test	Although there is heterogeneity between countries, the affect of FDI on future economic growth rates is more in more open countries.
Balasubramanyam, Salisu & Sapsford	46 countries	OLS	FDI – labor force relations play an important role in the growth process.

(1999)	1970 – 1985		
Borensztein, Gregorio & Lee (1998)	69 developing countries 1979 – 1989	SUR Method	FDI is an important tool for technology transfer. Also, it makes more contributions to economic growth than domestic investment.
Balasubramanyam, Salisu & Sapsfort (1996)	46 developing countries 1970 – 1985	OLS	In export promoting countries affect of FDI on economic growth is more than import – substituting countries.
Fry (1993)	16 developing countries 1975 – 1991 (different time periods according to different countries)	OLS	In 11 developing countries, FDI affects economic growth negatively. But in Pacific Basin countries FDI affects economic growth positively. The reason of these different evidences is that, in Pacific Basin countries economic distortions are less.
Bornschier, Chase-Dunn & Rubinson (1978)	76 less developed countries 1960 – 1975	OLS	FDI has negative impact on economic growth in developing countries. Also, this impact increases as income level increases.
Papanek (1973)	*1. Sample:* 34 countries 1950s *2. Sample:* 51 countries 1960s	OLS	Savings and FDI flows affect one third of economic growth; foreign aids have more impact than other determinants on economic growth. There is no obvious relationship between FDI and foreign aids. Also, economic growth is not correlated with export, education, per capita income and country size.
Causality Analysis			
Hansen & Rand (2006)	31 developing countries 1970 – 2000	Unit Root Tests, Panel Cointegration Test and VAR Analysis	There is a strong causality from FDI through GDP growth.
Chowdhury &Mavrotas (2006)	3 countries 1969 – 2000	Toda – Yamamoto Causality Test	In Chile, GDP growth is the Granger Cause of FDI but reverse is not true. In Malaysia and Thailand FDI and economic growth are Granger causes of each other.
Hsiao & Hsiao	8 countries	Granger Causality Test and VAR	There is one – way causality from FDI through GDP growth and exports. FDI and exports make positive

(2004)	1986 – 2004	Analysis, Unit Root Tests GMM method	contribution to economic growth.
Mencinger (2003)	8 EU countries 1994 – 2001	Granger Causality Test	FDI affects economic growth but economic growth doesn't affect FDI.
Choe (2003)	80 countries 1971 – 1995	Granger Causality Test	FDI is Granger cause of economic growth and economic growth is Granger cause of FDI. However economic growth affects FDI growth more.
Basu, Chakraborty & Reagle (2003)	23 developing countries 1978 – 1996	Unit Root Tests and Panel Cointegration Test	There is a steady state relationship between FDI and GDP growth in the long – run.
Zhang (2001)	11 East Asia and Latin America countries 1957 – 1997 (different time periods among these years)	Granger Causality Test	It's more possible FDI to affect economic growth in export promoting countries than import substituting countries.
Duttaray (2001)	66 developing countries 1970 – 1996	Granger Causality Test, Non-Stationarity Test	In less than %50 of selected countries, FDI affects economic growth.

Source: Constructed by authors.

Annex B

Derivation of FDI Growth Relationship for Foreign Country

Recall we assumed that capital may freely move between borders and that domestic and foreign capital are perfect substitutes as factor of production and therefore each pay the same rate of return, r, the world interest rate. Suppose that capital $\tilde{K}^*$ represents physical capital that literally exists in the foreign country at a particular time. Suppose also that $\tilde{K}$ is physical capital that belongs to residents of foreign country. Hence, $\tilde{K}-\tilde{K}^*$ represents the sum of outflow of foreign investments from the foreign country to the rest of the world (=domestic country in our model). $\tilde{K}-\tilde{K}^*$ is also called net claims by citizens of foreign country from rest of the world. For matter of illustration, we assume that $\tilde{K}-\tilde{K}^*>0$, without loss of generality. The production technology in the foreign country is represented by

$$\tilde{Y}=\tilde{F}\left(\tilde{K}^*,\tilde{N}\right) \qquad \text{(B.1)}$$

where $\tilde{Y}$ is output, $\tilde{K}^*$ is total physical stock available in the foreign economy, and $\tilde{N}$ is labor stock. The optimization conditions for the representative firm entail equality between the marginal products and the factor prices:

$$\tilde{f}'(\tilde{k}^*)=\tilde{r} \qquad \text{(B.2a)}$$
$$\tilde{f}(\tilde{k}^*)-\tilde{k}^*\tilde{f}'(\tilde{k}^*)=\tilde{w} \qquad \text{(B.2b)}$$

In (B.2), $\tilde{k}^*$ is capital per person that exists in the foreign country at a particular time, $\tilde{w}$ is the real wage rate, $\tilde{r}$ is the world's real rate of interest (hence, $\tilde{r}=r$; we use tilde to keep consistency in notation). Capital accumulation function for the resident of the foreign country is

$$\dot{\tilde{k}}=\tilde{w}+(\tilde{r}-\tilde{n})\cdot\tilde{k}-\tilde{c} \qquad \text{(B.3)}$$

where $\tilde{k}$ is capital per person owned by domestic residents, $\tilde{n}$ is the population growth rate, $\tilde{c}$ is the consumption per capita. If we substitute for $\tilde{w}$ from equation (B.2b) into equation (1), the change in assets per capita can be determined as

$$\dot{\tilde{k}}=\tilde{f}\left(\tilde{k}^*\right)-\tilde{r}(\tilde{k}-\tilde{k}^*)-\tilde{n}\tilde{k}-\tilde{c} \qquad \text{(B.4)}$$

Note that $\tilde{k}-\tilde{k}^*$ represents the sum of investments per capita made by foreign country in the domestic country and that we assume $\tilde{k}-\tilde{k}^*>0$, without loss of generality. Note again that equation in (C.4) would become the standard equation of motion of Ramsey if the economy were closed, $\tilde{k}-\tilde{k}^*=0$. By definition, it must be true that $\tilde{k}-\tilde{k}^*=\int_0^t FDIdt$, where FDI is the physical capital outflow to domestic country from the foreign country at time t. If we take time derivative of this identity, we obtain that $\dot{\tilde{k}}-\dot{\tilde{k}}^*=FDI$. Hence, we may alternatively express equation (B.4) as follows:

$$\dot{\tilde{k}}^* = \tilde{f}\left(\tilde{k}^*\right) + \tilde{r}(\tilde{k} - \tilde{k}^*) - \tilde{n}\tilde{k} - \tilde{c} - FDI \qquad \text{(B.5)}$$

Given that $\tilde{y} = \tilde{f}(\tilde{k}^*)$, the growth rate of output is $\tilde{g}_{\tilde{y}} = \frac{\dot{\tilde{y}}}{\tilde{y}} = \frac{\tilde{f}'(\tilde{k}^*)\tilde{k}^*}{\tilde{f}(\tilde{k}^*)}\frac{\dot{\tilde{k}}^*}{\tilde{k}^*}$. Again, $\frac{\tilde{f}'(\tilde{k}^*)\tilde{k}^*}{\tilde{f}(\tilde{k}^*)}$ is share of capital income in total income in the foreign country. Substituting respective value of $\frac{\dot{\tilde{k}}^*}{\tilde{k}^*}$ from (C.5), we may express growth rate of output as

$$\tilde{g}_{\tilde{y}} = \frac{\tilde{f}'(\tilde{k}^*)\tilde{k}^*}{\tilde{f}(\tilde{k}^*)}\left[\frac{\tilde{f}\left(\tilde{k}^*\right)}{\tilde{k}^*} + \tilde{r}\,\frac{(\tilde{k} - \tilde{k}^*)}{k^*} - \tilde{n}\,\frac{\tilde{k}}{\tilde{k}^*} - \frac{\tilde{c}}{\tilde{k}^*} - \frac{FDI}{\tilde{k}^*}\right] \qquad \text{(B.6)}$$

Hence, the growth rate of foreign economy is positively supported by returns out of sum of claims and negatively by FDI, that is, $\frac{\partial \tilde{g}_{\tilde{y}}}{\partial(\tilde{k} - \tilde{k}^*)} > 0$ and $\frac{\partial \tilde{g}_{\tilde{y}}}{\partial FDI} < 0$.

Annex C

Table C.1: Unit Root Test Results for gFDI

Method	Statistics	Probability
Levin, Lin&Chu (Null Hypothesis: Unit Root)	-5.64182	0.0000
Im, Pesaran and Shin W-stat (Null Hypothesis: Unit Root)	-9.05500	0.0000
ADF - Fisher Chi-square (Null Hypothesis: Unit Root)	179.043	0.0000
PP - Fisher Chi-square (Null Hypothesis: Unit Root)	366.293	0.0000
Hadri Z-stat (Null Hypothesis: No Unit Root)	-0.18945	0.5751

Table C.2: Unit Root Test Results for gY

Method	Statistics	Probability
Levin, Lin&Chu (Null Hypothesis: Unit Root)	-4.83151	0.0000
Im, Pesaran and Shin W-stat (Null Hypothesis: Unit Root)	-9.57166	0.0000
ADF - Fisher Chi-square (Null Hypothesis: Unit Root)	179.632	0.0000
PP - Fisher Chi-square (Null Hypothesis: Unit Root)	262.024	0.0000
Hadri Z-stat (Null Hypothesis: No Unit Root)	0.43079	0.3333

Table C.3: Unit Root Test Results for gX

Method	Statistics	Probability
Levin, Lin&Chu (Null Hypothesis: Unit Root)	-7.34907	0.0000
Im, Pesaran and Shin W-stat (Null Hypothesis: Unit Root)	-11.8374	0.0000
ADF - Fisher Chi-square (Null Hypothesis: Unit Root)	226.190	0.0000
PP - Fisher Chi-square (Null Hypothesis: Unit Root)	349.215	0.0000
Hadri Z-stat (Null Hypothesis: No Unit Root)	-0.18645	0.5740

Table C.4: Unit Root Test Results for hc(-5)

Method	Statistics	Probability
Levin, Lin&Chu (Null Hypothesis: Unit Root)	-6.15607	0.0000
Im, Pesaran and Shin W-stat (Null Hypothesis: Unit Root)	-9.6375	0.0000
ADF - Fisher Chi-square (Null Hypothesis: Unit Root)	202.110	0.0000
PP - Fisher Chi-square (Null Hypothesis: Unit Root)	256.218	0.0000
Hadri Z-stat (Null Hypothesis: No Unit Root)	-0.11635	0.6710