LUND UNIVERSITY

School of Economics and Management

Department of Economics

The Impacts of FDI on Productivity and Economic Growth: A Comparative Perspective

Master Thesis, Spring 2010

Author: Cem Tintin Supervisor: Klas Fregert

TABLE OF CONTENTS

ABSTRACT

This study investigates the impacts of FDI on productivity and economic growth in comparative perspective by using two samples, namely “developing” and “developed” countries. The study employs panel cointegration and panel estimation methods. The panel cointegration test results indicate that there are long-run relations between “FDI and productivity”, and “FDI and economic growth” variables. The study’s main findings show that FDI triggers (labor) productivity and economic growth in a positive way but at different degrees. Nonetheless, the magnitudes of these effects differ across developing and developed countries. Moreover, the findings testify that the impacts of FDI on productivity and economic growth can be improved with high labor quality. Finally, it is analyzed that higher openness and macroeconomic stability might be other important factors in assessing the positive impacts of FDI concerning economic growth.

Key Words: Foreign Direct Investment, Productivity, Economic Growth, Panel Cointegration, Panel Estimation.

To My Family

ACKNOWLEDGEMENTS

I would like to thank my supervisor Associate Professor Klas Fregert for his invaluable comments and guidance throughout the writing of this thesis. Also, I would like to thank the Swedish Institute for financial support during my studies in Sweden. A special word of thanks goes to the members of my family who have encouraged and unconditionally supported me throughout all my studies.

LIST OF TABLES AND FIGURES

TABLES

FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lag
DOLS	Dynamic Ordinary Least Squares
Eq.	Equation
FDI	Foreign Direct Investment
FMOLS	Fully modified Ordinary Least Squares
G1	Developing Countries Sample
G2	Developed Countries Sample
GDP	Gross Domestic Product
GSP	Gross State Product
IFS	International Financial Statistics
IMF	International Monetary Fund
INF	Inflation Rate
IPS	Im-Peseran-Shin
LP	Labor Productivity
LQ	Labor Quality
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
OPEN	Openness Index
PGDP	Per capita Gross Domestic Product
TFP	Total Factor Productivity
TNE	Transnational Enterprises
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development.
UNDP	United Nations Development Programme
USA	United States of America
VAR	Vector Autoregression

1. INTRODUCTION

The globalization process, which aims to reduce all kind of barriers across countries, has fostered the physical and financial capital flows tremendously in the last thirty years. Although physical capital is a less mobile factor relative to financial capital, the amounts of FDI inflows and stocks in both developing and developed counties have been rocketed up since 1980s due to reduced barriers for foreign direct investors. In particular, the collapse of Soviet Union and the open market oriented policies followed by developing countries such as China and India have been accelerated the pace of direct investments which led to increase in the share of FDI stock as percentage of GDP in all countries.[1]

FDI has been increasingly seen as an important stimulus for productivity and economic growth both for developing and developed countries. According to OECD; "FDI triggers technology spillovers, assists human capital formation, contributes to international trade integration, helps create a more competitive business environment, and enhances enterprise development." (OECD, 2002, p.5). According to the Solow economic growth model; the capital stock of a country enlarges due to FDI inflows henceforth this country would experience economic growth in the short run which is known as capital widening. On the other hand, endogenous growth models adds a further dimension that the latest technology and managerial skills in developed countries can be transferred to all countries via FDI which would also trigger productivity and economic growth in host countries which is defined as capital deepening. In a nutshell, economic theory predicts that FDI triggers productivity and economic growth by different channels.

In this regard, this study aims to investigate the prediction of economic theory by analyzing the impacts of FDI on productivity and economic growth in comparative perspective by using two samples namely "developing" and "developed" countries. Because empirical findings of previous studies are somewhat mixed about the impacts of FDI on productivity and economic growth in different countries (Johnson, 2006, p.3). In particular, the results differ according to the method of analysis that researchers employ and selected sample countries for the analysis. Moreover, the findings point out that the impacts of FDI might differ remarkably between

[1] For example, in 1990 "inward FDI stock of all countries as a percentage total world GDP" was 8.77, as of 2008 this figure reached to 24.38, which is a historical record (World Investment Report, 2009).

developed and developing countries which have different economic and institutional structures. Therefore, this subject needs to be analyzed with different models and samples to gain further insights about the impacts of FDI on productivity and economic growth.

The study mainly uses panel data approach in analyzing the impacts of FDI on productivity and economic growth and differs from other studies in four respects. First of all, the study has two sample country groups namely “developing” and “developed” countries. Therefore, in the analysis it would be clarified whether the impacts of FDI differ remarkably between developing and developed country groups. Secondly, the study uses three additional explanatory variables (labor quality index, openness, inflation) in addition to main “FDI” explanatory variable. It is the first time that the study employs the “labor quality index” as an absorption capacity variable, which is constructed by Bonthuis (2010). Thirdly, the study uses two productivity measures “labor productivity and total factor productivity” in the analysis which increases the robustness of the analysis and adds additional insights into the discussion. Finally, the study employs recent panel unit root, panel cointegration and panel estimation methods in the analysis such as the IPS, Breitung panel unit root and Johansen-Fisher panel cointegration tests.

The main findings of the study show that there are cointegration relations between “FDI and productivity” and “FDI and economic growth” variables. Moreover, the findings suggest that FDI enhances (labor) productivity and economic growth in a positive way but at different degrees. Besides, the magnitudes of these impacts differ across developing and developed countries. Notably, the findings testify the importance of absorption capacity that the impacts of FDI on productivity and economic growth can be improved with high labor quality. Finally, it is argued that openness and macroeconomic stability might be other important factors in assessing the positive impacts of FDI concerning economic growth.

The organization of the study is as follows. After this short introduction, section 2 provides a brief literature review and discusses other researchers’ main findings. Section 3 revisits the economic growth models with attaining special importance to FDI and discusses how FDI can be integrated into the growth models. It also derives and presents the formal models that are used in the analysis. Section 4 explains sources and transformation of data. And it presents the sample groups. Section 5 documents the results of the unit root tests, cointegration tests and model estimations. In addition, it discusses the findings of the analysis in the light of economic theory and previous studies. Section 6 summarizes the findings of the study and concludes by adding policy implications for policy makers.

2. LITERATURE REVIEW

In this section, we present and discuss some selected empirical studies regarding the impacts of FDI on productivity and economic growth in which authors used similar methods and variables to our study. Then, Table 1 documents the summary of some selected studies.

In a benchmark article for our study, Johnson (2006) examines whether FDI has a positive effect on economic growth by triggering technology spillovers and physical capital accumulation. He uses a panel dataset compromising 90 developed and developing countries between 1980 and 2002 period. In his regression model, he uses the "annual growth rate of real per capita GDP" as the dependent variable and "average inward FDI stock as a share in GDP" as the main independent variable. In addition, he uses some control variables which are domestic investments, average years of schooling and interaction term of schooling & FDI, and economic freedom index. He performs the empirical analysis by using OLS method both for cross-section and panel data and finds out that "FDI enhances economic growth in developing economies but not in developed economies" (Johnson, 2006, p.43). He also estimates positive coefficients for the schooling variable and its interaction term which imply the importance of absorption capacity in assessing the positive impacts of FDI.

Neuhaus (2006) makes an important contribution to the literature of FDI-led growth. In his book, he formally introduces the FDI discussion into the endogenous growth models. In addition, he makes an empirical investigation by using the data of 13 Central and Eastern Europe Countries over the period from 1991 to 2002. While constructing his empirical model, he substitutes the "human capital variable" of Mankiw, Romer and Weil (1992) growth model with "FDI variable". Furthermore, he includes some additional explanatory variables such as the lag of per capita income, trade openness, inflation volatility, government consumption, government balance, and domestic investment to improve the explanatory power of his model. And he uses the growth rate of per capita income as the dependent variable. He runs his ARDL (autoregressive distributed lag) type regression model by using pooled mean group estimation method. As a result of estimations, he concludes that "FDI had a significant positive impact on the rate of economic growth in Central and Eastern Europe Countries" (Neuhaus, 2006, p.81). Moreover, he claims that FDI is an important determinant of growth especially for transition economies. Therefore, he supports pro-FDI policies of governments to attract more FDI inflows for growth and development.

Olofsdotter (1998) finds evidence that FDI has positive impacts on growth by using the data of 50 countries over the period 1980-1990. Remarkably, she has considered the absorption capability of the host countries by using two variables "degree of property-right protection and measure of bureaucratic efficiency". Her regression results reveal that "the beneficiary effects of FDI are stronger in countries with a higher level of institutional capability, the importance of bureaucratic efficiency being especially pronounced." (Olofsdotter, 1998, p.543).

A recent study by Ewing and Yang (2009) assesses the impact of "FDI in manufacturing sector" on economic growth by using the data of 48 states in USA over the 1977-2001 period. In their model, the dependent variable is the growth rate of real per capita Gross State Product (GSP) whereas the main independent variable is FDI as a share of GSP. They also employ some control variables namely; investment as a share of GSP, growth rate of state employment, and human capital (schooling). They estimate the regression by using panel data OLS estimation method and allowing for fixed effects for states. They clearly conclude that FDI promotes growth but the growth impact is not uniform across regions and sectors. Hence, they argue a FDI policy which takes regional differences into account. Furthermore, they find a positive coefficient for schooling which implies; states with a higher stock of human capital grow faster and might benefit from FDI to a higher extent (Ewing & Yang, 2009, p.515).

Lee (2009) examines the long-run productivity convergence for a sample of 25 countries from 1975 to 2004 by using panel unit-root procedures with a special importance to trade and FDI links. [2] His empirical findings reveal that "long-run productivity convergence in the manufacturing sector seemed to be a prevailing feature among countries that were linked

[2] In his study, although he claims that total factor productivity is a better productivity measure, he uses labor productivity data due to lack of TFP data for the whole sample.

internationally especially through trade and FDI" (Lee, 2009, p.237). Briefly, he concludes that as FDI takes place it triggers productivity in host countries.

Not all studies, as presented above, are in favor of FDI in assessing the positive impacts of FDI on productivity and economic growth. For example, Herzer et.al (2008) examine the FDI-led growth hypothesis for 28 developing countries in 1970-2003 period. They employ cointegration techniques while examining the countries. According to their empirical investigation, only in 4 out of 28 developing countries FDI contributes to the long-run growth. Another similar study is conducted by Blomström et.al (1994) by using the data of 78 developing countries. They put forward that only in the high-income developing countries FDI triggers growth whereas the low-income countries cannot enjoy the growth effect of FDI.[3]

Basu et.al (2003) employ panel cointegration techniques in searching for a long-run relation between FDI and growth by using a panel of 23 developing countries in 1978-1996 period. They find evidence for the existence of long-run relation between FDI and growth in developing countries. In particular, they find that this relation to be stronger in more open economies. Hansen and Rand (2006) search for cointegration and causality relation between FDI and growth in a sample of 31 developing countries for the period 1970-2000 and they confirm the existence of cointegration. Moreover, their results indicate that FDI has a lasting positive impact on GDP irrespective of level of development. They interpret this finding "as evidence in favor of the hypotheses that FDI has an impact on GDP via knowledge transfers and adoption of new technologies." (Herzer et.al, 2008, p.797).

There are also recent country-level studies which confirm the FDI-led growth. For instance, Ma (2009) examines to what extent FDI triggered growth rate of China by using data from 1985 to 2008. And he estimates a positive and significant coefficient for the FDI independent variable. Even though the growth impact seems to be significant for China, the impact of FDI on productivity is found limited and sector-specific by several studies such as Sjöholm (2008) and Buckley et.al (2006). In addition, Sasidharan (2006) reaches a similar conclusion by using

[3] In addition, De Mello (1999) and Carkovic & Levine (2002) find weak evidence for FDI-led growth in their panel studies.

Indian manufacturing sector data that FDI does not have any significant technology spillovers effect in India.

In a nutshell, as mentioned in the introduction, the empirical literature is somewhat mixed for the impacts of FDI on productivity and economic growth. Although growth impact of FDI seems to have more empirical support, technology spillover (productivity) impact of FDI has weaker empirical evidence.[4] Moreover, both of the impacts seem to be country and sector specific. Therefore, we believe that our empirical investigation in section 5 would provide further insights into this discussion. We close this section with Table 1 which summarizes some selected studies.

Table 1: Summary of Some Selected Empirical Studies on FDI

Study	**Sample**	**Dependent Variables**	**Independent Variables**	**Method**	**Result**
Johnson (2006)	90 countries, for 1980-2002 period	GDP growth	FDI, schooling, GDPinitial, Economic freedom index	Cross-section and panel OLS	FDI has a positive impact on growth in developed, but not in developing.
Neuhaus (2006)	13 countries, for 1991-2002 period	GDP growth	FDI, trade openness, inflation volatility, government consumption, government balance, and domestic investment	Pooled mean group estimation	FDI has a positive impact on growth.
Ewing and Yang (2009)	48 states in USA, for 1977-2001 period	GSP growth	FDI, investment as a share of GSP, growth rate of state employment, and human capital (schooling).	Panel OLS	FDI has a positive impact on growth, but vary across states.
Herzer et.al (2008)	28 countries, for 1970-2003 period	GDP growth	FDI	Cross-section and panel cointegration	FDI has a positive impact only in 4 out of 28.

[4] Technology spillovers, productivity, and capital deepening terms are used synonymously in the literature.

3. THEORETICAL BACKGROUND AND EMPIRICAL MODELS

In this section, we first briefly give the definitions related with FDI and explain the theoretical background of FDI, productivity, and growth relations. Then, we present and discuss the empirical models that we use in our analysis.

3.1 Definitions of FDI

What is FDI?

"Foreign direct investment is the category of international investment in which an enterprise resident in one country (the direct investor) acquires an interest of at least 10 % in an enterprise resident in another country (the direct investment enterprise)." (World Investment Report, 2007 and 2009). According to UNCTAD, subsequent transactions between affiliated enterprises are also direct investment transactions. Broadly speaking, FDI is a type of international capital flows from one country to another. What makes FDI different from financial capital flows is the usage of transferred capital in the host country. When foreign investors invest on financial instruments, it is called financial flows. Nonetheless, FDI implies that foreign investors either invest into an existing company or found a new company (factory) in the host country. Since FDI is a form of physical investment, it is expected to have direct and indirect impacts on macroeconomic variables such as growth, current account, gross capital formation, productivity, employment, and so on. In this regard, it gets a great deal of attention in empirical and theoretical studies.

Types of FDI

As mentioned above, FDI has direct and indirect impacts on economic variables. But these impacts might differ according to types of FDI. Therefore, we briefly define the types of FDI. *Greenfield FDI* includes the investments of foreigners by constructing totally new facilities of production, distribution or research in the host country. On the other hand, the investments of foreign investors into existing facilities in the host country are defined as *Brownfield FDI* (Johnson, 2006, p.13). Brownfield FDI is sometimes classified as *Mergers& Acquisitions* (see World Investment Report, 2009).

Another classification in FDI literature has been done according to investors' investment decisions. "When a company 'slices' its production chain by allocating different parts to those countries in which production costs are lower, it is known as *vertical FDI.*" (EUROSTAT, 2007, p.22). The improvements in supply chain management systems and reduced transport costs have given rise to the vertical FDI. "When a company 'duplicates' its production chain in order to place its production closer to foreign markets, it is known as *horizontal FDI.* The investment decision may result from a trade-off between fixed costs (the new plant) and variable costs (high tariffs and transport costs associated with exporting to that country)." (EUROSTAT, 2007, p.23). In both vertical and horizontal FDI, the main motivation of the foreign investors is to maximize the profits in the medium and long-run. Since physical investments possess risks in their nature especially in a foreign country, and due to the existence of transport and installation costs; investors expect to reap the benefits of investing in a foreign country in the medium and long-run.

3.2 The Impacts of FDI in Economic Growth Theory

The direct and indirect impacts of FDI are not limited with productivity and economic growth. Actually, it has several impacts on macroeconomic variables thereby on well-being of economic agents. However, in this study we limit ourselves with the impacts of FDI on productivity and economic growth, thus our discussion below is constructed on economic growth theory. In this respect, we discuss two anticipated impacts of FDI on capital accumulation and productivity (technology spillover) which ultimately affect the economic growth. The following two impacts are widely and deeply discussed in the FDI-growth literature therefore we keep the discussion short.[5]

3.2.1 The Impact of FDI on Capital Accumulation: Capital Widening

Since FDI is a type of physical investment it is expected to lead to an increase in the stocks of physical capital in host countries. Nonetheless, the impact might change regarding the type of FDI. When FDI leads to an establishment of a totally new facility (Greenfield investment), the increase in the stocks of capital would be significant. According to the neoclassical growth model of Solow (1956), this increase in physical capital, which stems from FDI, would increase per capita income level both in the short and long-run in the host economy by increasing the existing type of capital goods, but it would only enhance the growth rate of the

[5] For discussions; see Johnson (2006), Neuhaus (2006), and Ewing & Yang (2009).

economy during the transition period due to the existence of diminishing returns to capital. Nonetheless, the longevity of the transition period differs across countries but it still lasts for many years (Aghion & Howitt, 2009, p.59). Therefore, in capital-scarce developing countries "capital widening" effect may imply important welfare gains for the economic agents. In this regard, FDI can be seen an important growth enhancing factor for these countries which leads to pro-FDI policies.

On the other hand, a *brownfield* type of FDI would not lead to a considerable increase in the existing capital stock. In contrast, generally *brownfield* type of FDI changes the ownership status of the existing capital stock therefore its impact on per capita income level and growth might be limited (Johnson, 2006).

Formally, in the Solow growth model GDP equation can be written as $Y = K^{\alpha}(AL)^{1-\alpha}$ with a Cobb-Douglas type production function. Per effective labor GDP is given by $\varphi = \kappa^{\alpha}$; in where $\varphi = Y/AL$ (per effective labor income) and $\kappa = K/AL$ (per effective labor capital). In a similar manner, per capita income and per capita capital can be defined as y=Y/L, k=K/L respectively. When we write Y/L= $A\varphi = A\kappa$, then the growth rate can be expressed as; g=$\dot{A}/A + \alpha\,\dot{\kappa}/\kappa$. In the Solow growth model, due to the existence of diminishing returns, the long-run growth rate of the economy equals to the growth rate of technology ($\dot{A}/A$) whereas during the transition period the growth rate is also designated by ($\dot{\kappa}/\kappa$). It is worth mentioning that in here we assume FDI does not affect growth rate of technology and we relax this assumption in the following section.

As a summary, during the transition period (which can last many years); FDI ↑ → K ↑ → k ↑ → y↑ and g ↑. In the long-run, FDI ↑ → K ↑ → k ↑→ y ↑.

3.2.2 The Impact of FDI on Productivity: Capital Deepening

The second impact that we consider is known as "capital deepening" which implies the transfer of knowledge and technology together with FDI into the host economy. It is supposed that TNE (transnational enterprises) do not only bring physical capital into the host economy, but also they transfer the technology and managerial skills since they want to maximize their profits. This basic reasoning implies that as FDI takes place productivity levels tend to increase which ultimately enhances per capita income levels and growth rate of per capita income. Unlike capital widening impact, capital deepening impact triggers both short and long-run growth rates. We explain this impact mechanism with economic growth models in turn.

As showed in the previous section, the neoclassical growth model of Solow (1956) assumes that capital falls into diminishing returns thereby the long-run growth rate equals to the growth rate of technology. Since capital deepening argument assumes that FDI triggers productivity (technology) hence the long-run growth rate increases with FDI. Per capita GDP growth rate evolves according to g=$\dot{A}/A + \alpha\, \dot{\kappa}/\kappa$. Due to the existence of capital deepening impact it is expected that FDI ↑ → $(\dot{A}/A)$ ↑ → y ↑ and g ↑ in the short and long-run. In words, economy can be prevented from falling into diminishing returns due to increased growth rate of technology which stems from FDI.

The AK growth model of Frankel (1962) and Romer (1986) is known as the first wave of endogenous growth models. Because the proponents of the AK growth model assume that during capital accumulation, externalities may help capital from falling into diminishing returns. In here, externalities are created by "learning-by-doing" argument of Arrow (1962) and knowledge spillovers effect. Therefore, according to the AK model as a country continues to attract FDI; not only its capital stock enlarges but also productivity increases. Put differently, in existence of learning by doing externalities country will keep growing both in the short and long-run since its productivity (technology) grows as it goes on attracting FDI.

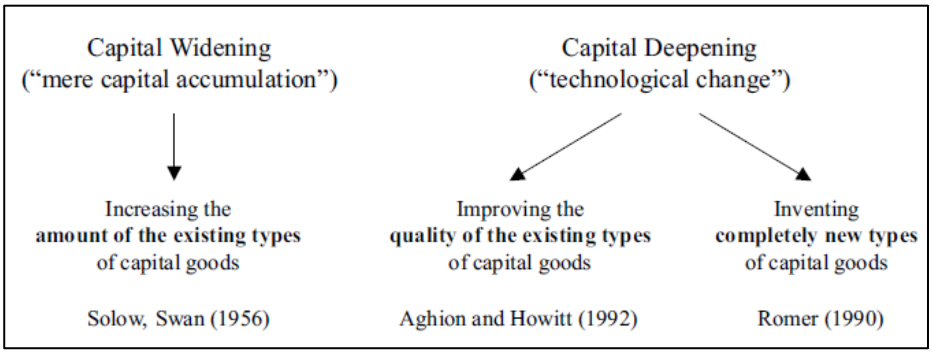
The product variety model of Romer (1990) argues that "productivity growth comes from an expanding variety of specialized intermediate products" (Aghion & Howitt, 2009, p.69). Therefore, in a closed economy the only way of increasing the variety of intermediate products is conducting research and development activities in a productive manner. By opening the economy, however, the economy can reap the benefits of research and development activities which are conducted in foreign countries. The country may transfer different types of intermediate goods either by import or through FDI in open economies.[6] Thus, it is expected that FDI induces economy-wide productivity and economic growth by expanding the variety of intermediate products. In this respect, technology spillover

[6] Broda et. al (2006) empirically show that international trade increases TFP levels on average 10 % by applying Romer model to a panel dataset of 73 countries over the period 1994-2003.

externalities, which stem from FDI, would also increase the knowledge stock of researchers and productivity of research activities in the host country. As a result, researchers might become more likely to invent new intermediate products which again trigger the economic growth.

The Schumpeterian model of Aghion and Howitt (1992) constitutes the second wave of endogenous growth models together with the product variety model of Romer (1990). Basically, both models point out the importance of research and development activities for sustained long-run growth rates and they explicitly explain the mechanisms how research and development activities affect economic growth. The key difference between the product variety and Schumpeterian models lies in their assumption how capital goods enhance the economic growth. As mentioned above, in the Romer model, invention of "new" capital goods triggers productivity and economic growth. Nonetheless, the Schumpeterian model concentrates on the improvement of the quality of the existing types of capital goods. In other words, by conducting research and development activities, firms would become able to improve the quality of existing capital goods which makes old ones obsolete. This process is called as "creative destruction" by Schumpeter (1942). Therefore, the economy can sustain long-run growth as it innovates by carrying out research and development activities. By using a similar argument above, in an open economy, the country would transfer the innovative technology with FDI inflows and new quality improving mechanisms which would give rise to productivity and economic growth.

Figure 1: The Role of Capital in Economic Growth Models



Source: Neuhaus, 2006, p.48.

Figure 1 summarizes the role of capital in different economic growth models and it also clarifies the discussion above. All in all, FDI is seen as an important stimulus to the productivity and growth in economic growth theory, even though there are differences in the transmission mechanisms.

3.3 Empirical Models

3.3.1 Empirical Models: The Impact of FDI on Economic Growth

In here, we present our empirical models concerning the impact of FDI on economic growth that we use in our analysis. The economic background of the models is presented in the previous section. In order to reach testable empirical models, we need to start with a Cobb-Douglas production function. We use the framework of Barro (1991) and Mankiw, Romer, and Weil (1992) by following Neuhaus (2006).

Mankiw, Romer, and Weil (1992) successfully integrated the human capital into the Solow growth model. They used the following specification:

$$Y = K^{\alpha} H^{\beta} (AL)^{1-\alpha-\beta} \qquad (1)$$

In where; K: capital stock, H: human capital, A: technology, L: labor.

Replacing human capital (H) in equation (1) with (K_F) generates:

$$Y = {K_D}^{\alpha} {K_F}^{\beta} (AL)^{1-\alpha-\beta} \qquad (2)$$

In where; K_D: capital stock held by domestic investors, K_F: capital stock held by foreign investors (FDI stock), A: technology, L: labor.

Starting with equation (2), and using the steady state equations of k and y along with logarithmic transformation; we can write the following testable equation[7]:

$log\ (PGDP_{i,t}) = \beta_0 + \ \beta_1\ log\ (FDI_{i,t})\ + error\ term$ (benchmark model: **Model 1)**

In where; PGDP: per capita GDP, FDI: inward FDI stock as a percentage of GDP.

This model aims to analyze the impact of FDI stock on PGDP in isolation. Although we disregard some important explanatory variables of economic growth such as technology growth, by running this model we can see the "pure impact" of FDI stock on log (PGDP). In the literature, some authors use FDI inflows data instead of FDI stock data (e.g. Herzer et.al,

[7] See the derivation of model 1 in Appendix A.

2008; Johnson, 2006) as a proxy of the rate of FDI stock (s_F). However, Neuhaus (2006, p.98) mentions that "the ratio of FDI stock to GDP is more accurate than the FDI flows in capturing the sustaining effect of FDI on economic growth". For this reason, we follow Neuhaus (2006) and Olofsdotter (1998) and use the data of "inward FDI stock as a percentage of GDP" instead of "inward FDI inflows as a percentage of GDP" in our models. In some studies, authors do not choose taking the log values of percentage variables that they can get semi-elasticities by estimating their coefficients. But in this study, we employ double-log (log-log) type empirical models that β coefficients can be interpreted as the (full) elasticity parameters of respective independent variables (Ewing &Yang, 2009).

By estimating model 1 both for developing and developed countries, we would make a comparison between the magnitudes of β_1 coefficient. We expect a positive β_1 coefficient for developing and developed countries and it is more likely that the impact of FDI on economic growth in developing countries would be higher due to two reasons. First, according to the "convergence phenomenon" there is a negative relation between distance to world per capita income level frontier and growth rate (Aghion & Howitt, 2009, p.158). It implies that developing countries have more room to grow in comparison with developed countries. Secondly, countries who are more far away from world technology frontier can achieve fast economic growth rates and productivity gains simply by imitating technology which becomes available to them via FDI and international trade.

Nonetheless, the expected positive impacts of FDI on economic growth rates in developing and developed countries are closely dependent on some factors. Absorption capacity is the first factor that is widely discussed and used in similar empirical FDI studies (e.g. Johnson, 2006). Several proxies are used by authors to model absorption capacity of a country. In the literature, the most common proxy for absorption is the "schooling or educational attainment rates" by following Barro (1991). Fortunately, we have found another absorption capacity proxy namely "labor quality" which is developed by Bonthuis (2010). Labor quality index is a more complete proxy then schooling data since it takes differences among schooling indicators across countries. To reflect the role of absorption capacity we add "labor quality" as an independent variable into model 1 and reach model 2. In model 2, we expect a positive β_2 coefficient in developing and developed countries. Unlike FDI impact, we cannot predict the relative magnitude of β_2 in developing and developed countries since absorption (labor quality) is critically important in assessing the impacts of FDI in all countries. It is expected that as countries raise their labor quality indices, they can both attract more FDI and reach high growth rates. Additionally, "learning by doing" process takes place in a faster way among high quality workers which reduces the installation costs and time for adaptation of new investments which held by foreign investors.

$$log\ (PGDP_{i,t}) = \beta_0 + \beta_1\ log\ (FDI_{i,t}) + \beta_2\ log\ (LQ_{i,t}) + error\ term \qquad \textbf{(Model 2)}$$

The second important factor that we consider in our analysis is "openness". Together with absorption, it is commonly used as an additional explanatory variable in FDI-led growth studies (e.g. Neuhaus, 2006). According to international trade theory, more open economies tend to grow faster which is supported by several empirical studies such as (Soysa & Neumayer, 2005; Frankel & Romer, 1999).

With regard to FDI, openness has a special importance. First of all, more open economies can attract more FDI.[8] The case of China is a good example of this. As China has started to open its economy to the world markets then it has become the leading country in terms of volumes of total FDI inflows. Not only China experienced FDI surge for several years but also enjoyed high and sustained economic growth rates while its openness is rising. In this regard, in model 3 we expect a positive β_3 coefficient that implies openness triggers economic growth. However, the magnitudes of the β_3 coefficient may differ across the samples of developing and developed countries due to the different degrees of openness.

$$log\ (PGDP_{i,t}) = \beta_0 + \beta_1\ log\ (FDI_{i,t}) + \beta_2\ log\ (LQ_{i,t}) + \beta_3\ log\ (OPEN_{i,t}) + error\ term$$

(Model 3)

The last factor that we consider as an additional independent variable in our analysis is the annual inflation rate. In the literature, it is discussed that high inflation implies price instability which decreases FDI attractiveness of the country (Neuhaus, 2006). Strictly speaking, high inflation distorts the macroeconomic stability, expectations, and investment decisions of domestic and foreign investors in a country (Fischer, 1993; Bleaney, 1996). Gokal and Hanif (2004, p.11) summarize this: "through its impact on capital accumulation, investment and exports, inflation can adversely impact a country's growth rate". Furthermore, there is strong empirical evidence that inflation is detrimental to growth and capital

[8] See Figure 2 in Appendix B, which demonstrates the positive association between openness and FDI.

accumulation (e.g. Briault, 1995; Bleaney, 1996). In our FDI-growth context, we use annual inflation rate as an independent variable to model macroeconomic instability by following Ismihan et. al (2002). We use the logarithms of the inflation rate variable to obtain consistency with other variables and also to be able to interpret β_4 coefficient as the full elasticity of inflation rate with respect to PGDP.[9] Since it is treated as an instability factor, we expect a negative sign for β_4 coefficient in model 4. Apart from this dominant view, there are also other views concerning the impact of inflation on growth. Tobin (1965) in his classic article argues that higher inflation rates may raise the level of output permanently and growth rate of output temporarily.[10] Nonetheless, according to Solow (1956) inflation is an exogenous factor for growth that it does not have any real impact on growth (Todaro, 2000).

$$log\ (PGDP_{i,t}) = \beta_0 + \beta_1\, log\ (FDI_{i,t}) + \beta_2\, log\ (LQ_{i,t}) + \beta_4\, log\ (INF_{i,t}) + error\ term$$

(Model 4)

With model 4, we conclude the presentation of our models which aim to analyze the impact of FDI and some other additional variables on log (PGDP). In other words, estimation of models 1 to 4 would put forward the impact of FDI on economic growth which encapsulates both "capital widening and deepening impacts". To sum up, by estimating models 1 to 4 we aim to reveal:

- Whether FDI is an important factor for economic growth (capital deepening + capital widening impacts).
- To what extent the impact of FDI on economic growth alters between the samples of developing and developed countries.
- Whether the additional independent variables have expected signs and the possible implications of these results.
- To what extent the impact of FDI on economic growth alters across models which can be seen as an informal way of checking the robustness of β_1 coefficient.

[9] The standard deviation of inflation rate can also be used instead of raw inflation data (e.g. Neuhaus, 2006) but we follow Ismihan et. al (2002) and use raw inflation data on consistency grounds.

[10] See Gokal and Hanif (2004) for an extensive review of the impact of inflation on growth.

3.3.2 Empirical Models: The Impact of FDI on Productivity

After having completed the presentation of empirical models concerning the impact of FDI on economic growth, in this section we go further and present four additional models in which the dependent variables are productivity measures instead of PGDP. The theoretical background of these models is discussed in section 3.2.2 where capital deepening impact is explained.

In models 5 and 6, we use "labor productivity" as the dependent variable and employ FDI and labor quality (absorption capacity) as the independent ones.[11] In models 7 and 8, we employ "total factor productivity" as the dependent variable instead of labor productivity and use FDI and labor quality (absorption capacity) as the independent variables.

$$log\ (LP_{i,t}) = \beta_0 + \beta_1\, log\ (FDI_{i,t}) + error\ term \qquad \textbf{(Model 5)}$$
$$log\ (LP_{i,t}) = \beta_0 + \beta_1\, log\ (FDI_{i,t}) + \beta_2\, log\ (LQ_{i,t}) + error\ term \qquad \textbf{(Model 6)}$$
$$log\ (TFP_{i,t}) = \beta_0 + \beta_1\, log\ (FDI_{i,t}) + error\ term \qquad \textbf{(Model 7)}$$
$$log\ (TFP_{i,t}) = \beta_0 + \beta_1\, log\ (FDI_{i,t}) + \beta_2\, log\ (LQ_{i,t}) + error\ term \qquad \textbf{(Model 8)}$$

By estimating these additional four models both for the samples of developing and developed countries, we aim to analyze:

- Whether FDI is an important factor for productivity (capital deepening impact).
- Whether the impact of FDI on productivity differs significantly between the samples of developing and developed countries.
- Whether the labor quality (absorption capacity) matters for productivity.
- Whether the use of labor productivity or total factor productivity measures might affect the results.

A final remark on our model set-up is concerning the interaction terms. As you see, in our models we do not employ the interaction terms of FDI with other independent variables. Because the use of interaction terms distorts our estimation results remarkably moreover they are estimated as insignificant probably due to the multicollinearity problem. In a similar

[11] It is worth noting that in models 5-8, we do not consider openness and inflation as additional independent variables to concentrate on the impacts of FDI and labor quality on productivity.

study, Olofsdotter (1998) faced with the same problem that she could find only one of the interaction term out of four to be significant at 10 percent level. She explains these insignificant interaction terms with multicollinearity problem (high correlation among independent variables) which stems from the use of independent variables and their interaction terms simultaneously (Olofsdotter, 1998, p.541; Ewing &Yang, 2009).

We close this section with Tables 2 and 3 in which we present the explanations of the variables and expected signs of the coefficients of the respective independent variables.[12]

Table 2: Definitions of the Dependent and Independent Variables

PGDP	: Real per capita gross domestic product (per capita income)
FDI	: Value of inward stock of foreign direct investment in country i as a percentage of GDP
LQ	: The level of labor quality index
OPEN	: The level of openness index, calculated as (EX+IMP) / GDP
INF	: Inflation rate based on consumer price index
LP	: The level of labor productivity
TFP	: The level of total factor productivity

Table 3: Expected Signs of the Coefficients of Independent Variables

Model No	Dependent Variable	Independent Variables			
		log (FDI)	log (LQ)	log (OPEN)	log (INF)
Model 1	log (PGDP)	+			
Model 2	log (PGDP)	+	+		
Model 3	log (PGDP)	+	+	+	
Model 4	log (PGDP)	+	+	+	-
Model 5	log (LP)	+			
Model 6	log (LP)	+	+		
Model 7	log (TFP)	+			
Model 8	log (TFP)	+	+		

[12] Technical details and calculation of the datasets are explained in section 4.

4. DATA

In this section, we first present the sources and description of datasets. Then, in section 4.2 we define our sample groups.

4.1 Sources and Description of Data

To analyze the impacts of FDI on productivity and economic growth, we have developed eight models in the previous section. In these models, totally we use different seven variables. Below we explain briefly how we gathered and constructed the datasets of each variable in turn.

Real per capita GDP data are gathered from The Conference Board-Total Economy database which are in 1990 US$ (converted at Geary Khamis PPPs). After collecting the real per capita GDP level data, we converted level data into the logarithmic form and gathered PGDP variable to use in our estimations as Mankiw et.al (1992), and Herzer et.al (2008) did.

We collected the data of "inward FDI stock as a percentage of GDP" data for "FDI" variable from UNCTAD-FDI database.[13] It is important to note that we do not use the level data of the "value of FDI stock" since it is only available at current prices at the database and for 20 countries it is difficult to construct a common deflator to convert current measures into real terms. After collecting the data of "inward FDI stock as a percentage of GDP", we took the logarithms of the series to use in our estimations, as Ewing & Yang (2009) did.

We collected the data for "labor quality" from The Conference Board-Total Economy Database. Originally, labor quality index is constructed by Bonthuis (2010) which uses educational attainment as the key variable for labor quality with attaining special importance to cross-country differences. He constructs his labor quality index by employing three different datasets regarding educational attainment to reduce cross-country differences in measurement of educational attainment data. In this respect, we believe that his labor quality index is a more complete "absorption capacity" measure than a raw "schooling" data. At the Conference Board-Total Economy Database, labor quality data are available in growth rates

[13] "FDI stock is the value of the share of their capital and reserves (including retained profits) attributable to the parent enterprise, plus the net indebtedness of affiliates to the parent enterprises" (World Investment Report, 2009).

form (log differences). In order to use in our estimations, first we calculated the levels of labor quality from the growth rates by assuming an initial labor quality level value of 100. Finally, we took the logarithms of the levels of labor quality values to use in our analysis.

Openness data are calculated by us using the IMF-IFS database. In order to calculate level of openness index values, we gathered the data of dollar values of total Exports, Imports and GDP (in current US$). By using the formula of (Exports + Imports)/GDP, we calculated openness index for all 20 countries (e.g. Frankel & Romer, 1999). Finally, we took the logarithms of the openness index values to use in our analysis.

Inflation data are derived from the IMF-IFS database. We collected the inflation data, which is based on consumer price index, from the database and converted into logarithmic form to use in our estimations by following Ismihan et.al (2002).

Labor productivity (output per employed person) is used as a proxy variable of economy-wide productivity in our analysis. And data for labor productivity is derived from The Conference Board-Total Economy Database which are in 1990 US$ (converted at Geary Khamis PPPs). Put differently, our labor productivity level data are the level values of real output per employed person in 1990 US$. In our analysis, the log values of the labor productivity data are used.

The second productivity measure that we use is total factor productivity. TFP is defined as “the portion of output not explained by the amount of inputs used in production” (Comin, 2008, p.1). In this respect, TFP is a difficult indicator to measure moreover it is not generally available for many countries and for a long time period.[14] Fortunately, The Conference Board-Total Economy Database presents the growth rates of TFP for different countries and for a sufficient length of time, which is estimated as Tornqvist index.[15] However, to use in our estimations we need log values of level TFP data. Therefore, first we calculated the levels of TFP from the growth rates of TFP by assuming an initial TFP level value of 100. Then, we converted these calculated level TFP values into logarithms to use in our analysis.

[14] See the discussion in Tica and Druzic (2006, p.11) and Lee (2009) on this issue.

[15] “Tornqvist index allows both quantities purchased of the inputs to vary and the weights used in summing the inputs to vary, reflecting the relative price changes.” (Bureau of Labor Statistics, 2010).

Table 4: Summary of Data Sources and Description

Variables Gathered from Databases	Data Source	Data Conversion	Logarithmic Form of Level Values
Real per capita GDP (in 1990 US$ at Geary Khamis PPPs)	The Conference Board Total Economy Database	No	log (PGDP)
FDI stock as a percentage of GDP	UNCTAD-FDI Database	No	log (FDI)
Growth of Labor Quality Index	The Conference Board Total Economy Database	Levels are calculated from growth rates	log (PGDP)
Openness index	IMF-IFS Database (calculated by us)	No	log (OPEN)
Inflation (Consumer price index is used)	IMF-IFS Database	No	log (INF)
Labor productivity (output per person employed) (in 1990 US$ at Geary Khamis PPPs)	The Conference Board Total Economy Database	No	log (LP)
Total Factor Productivity Growth (Estimated as Tornqvist index)	The Conference Board Total Economy Database	Levels are calculated from growth rates	log (TFP)

4.2 Definition of Samples

We collected and constructed our dataset over the period 1984-2008 and for two different sample groups namely "developing" and "developed" countries. Each sample group consists of 10 countries. In our panel dataset, T is 25 years and N is 20 countries. Thus, we have totally (20*25) 500 observations for each series. In this study, totally we employ seven different series hence number of total observations equals (500*7) 3500.

We chose our sample countries according to their classifications in UNDP Human Development Report, 2009. In this report, countries are classified in four main different categories namely; "very high human development (developed countries)", "medium human development (developing countries)", "high human development (developing countries)", and "low human development (least developed countries)" according to their development indices.

Table 5: Sample Groups

G1 (Developing countries)	G2 (Developed Countries)
1. Brazil	1. Austria
2. China	2. Denmark
3. Colombia	3. France
4. Egypt	4. Italy
5. India	5. Japan
6. Mexico	6. Netherlands
7. South Africa	7. Sweden
8. Thailand	8. Switzerland
9. Turkey	9. UK
10. Uruguay	10. USA

In our developing countries sample, there are 5 medium human development category (China, Egypt, India, South Africa, Thailand) and 5 high human development category (Brazil, Colombia, Mexico, Turkey, Uruguay) countries. Our developed countries sample contains 5 relatively large (France, Italy, Japan, UK, USA) and 5 relatively small countries (Austria, Denmark, Netherlands, Sweden, Switzerland) in terms of their amount of total GDP. By adding different types of counties into the sample groups, we aim to increase the homogeneity within sample groups which help us in reducing sample selection bias. Nonetheless, one may argue that 10-country might not be sufficient to reduce the sample selection bias. But the data limitation has enforced us to work totally with 20 countries for 25-year period in this study.

Last but not least, we use annual data in our estimations. In some empirical studies (e.g. Ewing & Yang, 2009; Neuhaus, 2006), authors choose using 5-year averages to reduce the impact of business cycles to the coefficients of the regression models. In fact, the use of annual or 5-year averages did not alter our estimation results remarkably (see Table 6 in Appendix B). Therefore, we have always used data in annual form throughout this study. [16]

5. METHODS AND ESTIMATION RESULTS

In this section, we first describe the methods that we use in the analysis. Then, we present and discuss the results of the tests and estimations in sections 5.2, 5.3, and 5.4.

[16] See Olofsdotter (1998), Herzer et.al (2008), and Lee (2009) for studies which use annual data.

5.1 Methods

As mentioned in introduction, one of the distinguishing features of the study is its use of both panel cointegration and panel estimation methods in analyzing the impacts of FDI on productivity and economic growth in developing and developed countries. We carry out the analysis in four steps and Table 7 summarizes the tests and methods that we employ throughout the analysis.

Steps of the Analysis:

- First, we conduct panel unit root tests for our seven series. In order to be able to search for panel cointegration among series, they should have the same order of integration. Therefore, we first need to carry out panel unit root tests.
- Second, we conduct panel cointegration tests among the variables that we use in eight different models. By doing this, we analyze whether there are long-run relations among variables in our models.
- Third, we run eight models by using panel OLS method to estimate the coefficients of the variables. The panel cointegration analysis only provides qualitative evidence whereas the estimation of the coefficients would provide quantitative evidence. Therefore, we can make comparisons regarding the sizes and significance of the coefficients across models and samples.
- Finally, we interpret the estimation results in section 5.4.

Table 7: Employed Tests and Methods

	Name of the Employed Tests and Methods
Test for: Panel Unit Root	IPS individual unit root and Breitung common unit root tests
Test for: Panel Cointegration	Johansen-Fisher panel cointegration test
Estimation Method	Panel OLS with fixed effects

5.2 Panel Unit Root Tests

After presenting the methodology that we follow, we start our analysis with panel unit root tests, which is the usual way of starting cointegration analysis to identify whether the series are stationary or non-stationary. A non-stationary series is not a mean-reverting series in which a shock (innovation) in the series does not die away. It is formulated as "non-stationary series have long memory" (Harris and Sollis, 2005, p.29). Therefore, linear combinations of non-stationary series might lead to estimation of spurious regressions in which the estimated coefficients are biased (Gujarati, 2003, p.806-807). In this regard, the identification of the existence of non-stationarity (unit root) and its order is important in two respects:

- First, we need to know the order of unit root in the series to be able to conduct panel cointegration tests that we can only conduct panel cointegration tests among series which have the same order of integration. For instance, we can seek panel cointegration in model 1, if log (PGDP) and log (FDI) are I (1).[17]
- Second, the order of unit root in the series is also important to get rid of spurious regression risk when the existence of panel cointegration is not verified. In these cases, the unit root test results are useful in converting series into the stationary form by taking first or second differences. Otherwise, the use of non-stationary series which are not cointegrated will lead to estimation of biased coefficients.[18]

Basically, in the literature of panel series there are two strands of "panel unit root tests" which are the individual and common panel unit root tests. The IPS (Im-Peseran-Shin), Fisher ADF, and Fisher PP tests are in the class of individual panel unit root tests whereas the Breitung, Hadri, Levin-Li-Chu tests are the common panel unit root tests. Intuitively, the individual panel unit root tests are less restrictive than the common panel unit root in the sense that they allow ρ^* (the coefficient of level of the series in eq.3) to vary within the panel series (Im et al., 1997). However, in the literature it is noted that none of the panel unit root tests have an exact superiority over another one (Verbeek, 2008, p.392-393). Put differently, there is no common way in selecting the type of panel unit root tests to test whether there is panel unit root. In here, to be able to eliminate the shortcomings of both types of tests, we choose to conduct one individual panel unit (IPS) and one common unit root test (Breitung).[19]

The Im-Peseran-Shin (IPS) Individual Panel Unit Root Test

The IPS test estimates the value of ρ^* by using the following equation in testing the existence of unit root:

[17] If a series is becoming stationary after taking the first difference, it is known as integrated of order 1 or I (1).

[18] As you will see in section 5.3, we have not faced with this problem since we have found panel cointegration among all series in the models.

[19] See Baltagi & Kao (2000), Banerjee (1999), and Harris & Sollis (2005, p.191-200) for an extensive review of panel unit root tests. See Mishra & Smyth (2010) and Apergis & Payne (2010) for some empirical examples.

$$\Delta y_{it} = \rho^* y_{i,t} + \sum_{L=1}^{\rho i} \vartheta_{iL} \Delta y_{i,t-L} + u_{it} \qquad (3)$$

Basically, the IPS tests the following hypotheses:

H_0: $\rho^*=0$ for all i; (All series in panel have a unit root)

H_1: $\rho^*<0$ for at least one i; (At least, one series in panel does not have a unit root)

We present the IPS test results in Table 8. By using the values in Table 8, we test unit root as follows:

For example, according to Table 8, the level of "log (PGDP)" panel series of developing countries is not stationary at 5% level. Because the IPS-W stat of the "level series of log (PGDP)" is 7.02 and it is not significant at 5% level since its probability value is 1. Thus, we accept the null hypothesis that all series in panel have a unit root. On the other hand, the "first differences of log (PGDP)" is stationary. Because the IPS-W stat of the "first differences of log (PGDP)" is -5.82 and it is significant at 5% level since its probability value is 0. Thus, we accept the alternative hypothesis in this case and conclude that log (PGDP) is I (1) for developing countries. Put differently, non-stationary series of log (PGDP) series turns to stationary by taking the first differences thereby it is integrated of order 1. In a similar fashion, when we conduct the IPS test for all panel series of developing and developed countries, we reach the same conclusion that they are I (1).

The Breitung Common Panel Unit Root Test

The Breitung test uses the equation (3) as the IPS does, but it tests the following hypotheses:

H_0: $\rho_i^*=0$ for all i; (All series in panel have a unit root)

H_1: $\rho_i^*<0$ for all i; (All series in panel do not have a unit root)

We present the Breitung test results in Table 8. By using the values in Table 8, we test unit root as follows:

For example, according to Table 8, the level of "log (PGDP)" panel series of developing countries is not stationary at 5% level. Because the Breitung t-stat of the level series of log (PGDP) is -1.016 and it is not significant at 5% level since its probability value is 0.15. Thus, we accept the null hypothesis that all series in panel have a unit root. On the other hand, the “first differences of log (PGDP)” series is stationary. Because the Breitung t-stat of the “first differences of log (PGDP)” is -2.55 and it is significant at 5% level since its probability value is 0.0053. Thus, we accept the alternative hypothesis in this case and conclude that log (PGDP) is I (1) for developing countries. Put differently, non-stationary series of log (PGDP) series turns to stationary by taking the first differences thereby it is integrated of order 1. In a similar fashion, when we conduct the Breitung test for all panel series of developing and developed countries, we reach the same conclusion that they are I (1).

All in all, there is full consistency between the findings of the IPS and Breitung tests. Actually, it is not surprising that we have found out that all series are integrated of order one since we use macroeconomic variables such as per capita GDP, labor productivity which tend to be non-stationary over time. The main conclusion from panel unit root tests is that we can search for panel cointegration among the series in our models since they all have the same order of integration and we conduct panel cointegration tests in the next section.

5.3 Panel Cointegration Tests

When two non-stationary series are being individually nonstationary, their linear combination can be stationary. “Economically speaking, two variables will be cointegrated if they have a long-term, or equilibrium, relationship between them.” (Gujarati, 2003, p.822 and 830). Basically, the Engle-Granger approach is used in existence of two individual time series. With the contribution of Johansen (1988), multivariate cointegration analysis (cointegration in existence of more than two time-series variables) has become available to researchers, which has been widely used for several years.

Nonetheless, cointegration in panel series is a more complex issue than time series which stems from the existence of cross-section units and their impacts on cointegration vectors. Several scholars studied on panel series cointegration issue (e.g. Pedroni, 1999; Kao, 1999; Maddala & Wu, 1999) to deal with these kinds of problems and they developed the panel cointegration tests which are available in today’s modern econometric software programs. Unfortunately, as mentioned by Verbeek (2008, p.392) “the drawbacks and complexities in panel unit root tests are also relevant for the panel cointegration tests”. It implies that panel cointegration tests still have some shortcomings such as Pedroni test reports 7 different test statistics and while one of them is rejecting the null hypothesis of "no cointegration", the other one can accept it.

Although problems still persist, in empirical panel studies panel cointegration tests are widely used. Because performing panel cointegration tests is the unique way of testing whether there is a "long-run relation" among non-stationary panel series. At this stage, we put aside the discussion on panel cointegration tests which is beyond the scope of this study, and concentrate on the Johansen-Fisher panel cointegration test that we have conducted.[20]

The Johansen-Fisher Panel Cointegration Test

The Johansen-Fisher panel cointegration test is a Fisher-type test using an underlying Johansen methodology (Maddala & Wu, 1999). The Johansen-Fisher panel cointegration test fills an important gap in the literature that enables scholars to test whether there is a long-run relation among panel series. Moreover, it identifies the rank of cointegration relation as the Johansen cointegration test does in time-series datasets. In this regard, it has an advantage over the Kao and Pedroni panel cointegration tests.

The Johansen-Fisher panel cointegration test uses two types of Fisher test statistics which are computed from "trace and max-eigen value tests" in testing the null of "no cointegration". While conducting the Johansen-Fisher panel cointegration test, one should decide the intercept and trend specification in the panel data, and the number of lags. A shortcoming of the Johansen-Fisher panel cointegration test is that it does not suggest any systematic approach while choosing the lag and trend specification as in the Johansen test. Nonetheless, to make robust inferences from the Johansen-Fisher panel cointegration test results, it is suggested to reach consistent "results" between trace and max-eigen test results. In this respect, we have tried all five trend specification options in *E-views 7* software program under the Johansen-Fisher panel cointegration test with the smallest possible lags to get consistent results.[21]

[20] See the discussions in Banerjee (1999), Verbeek (2008, p.392-393), Harris & Sollis (2005, p.200-206).

[21] We employ "general to specific" approach which is suggested in the literature (Harris and Sollis, 2005) that we keep the number of lags as small as possible according to Hannan-Quin lag-length selection criteria.

Hence, we have started to our tests with one lag and tried it under five different trend specifications. In most of the cases, we have reached consistent results with one lag. Only in two cases, we have used two lags for consistency purposes. Overall, we have reported the panel cointegration test results in Tables 9 and 10 (see Appendix B) and have determined the rank of cointegration in respective models according to these reported values.

For example, to test the existence of cointegration and determine its rank in model 1, which includes only log (PGDP) and log (FDI) series, we follow two steps:

Step 1:

H_0: r = 0 (no cointegration); H_1: $r \leq 1$ (at most one cointegration relation)

In Table 9, the reported Fisher stat from *trace* test for model 1 is 38 for developing countries sample. It is significant at 5% level since its probability value is 0.0089. Therefore, we reject the null and accept the alternative hypothesis. According to the reported Fisher stat from *max-eigen* value test in Table 10, we reject the null and accept the alternative hypothesis as well. Because the reported Fisher stat from max-eigen value test is 33.57 for model 1 in developing countries sample. And it is significant at 5% level since its probability value is 0.0292. In sum, both of the test statistics have confirmed the existence of at most one cointegration relation.

Step 2:

H_0: $r \leq 1$ (at most one cointegration relation); H_1: $r \leq 2$ (at most two cointegration relations)

In Table 9, the Fisher stat from *trace* test for model 1 is 26.2. It is not significant at 5% level since its probability value is 0.1592. Therefore, we accept the null hypothesis in this case. According to the reported Fisher stat from *max-eigen* value test in Table 10, we accept the null hypothesis as well. Because the reported Fisher stat from max-eigen value test is 26.2 for model 1 in developing countries sample. And it is not significant at 5% level since its probability value is 0.1592. In conclusion, according to the both trace stats and max-eigen values under the Johansen-Fisher panel cointegration test; we have determined that there is panel cointegration relation between "log (PGDP) and log (FDI) series", and the rank of the cointegration relation is 1.

In a similar fashion, when we repeat the similar steps for our eight models for developing and developed country samples, we confirm the existence of cointegration in all cases. And in our test results it is found out that the rank of cointegration lies between 1 and 4.[22] Put differently, we have found long-run relations among all variables that we use in our models. By finding cointegration relations among the series that we use in our models, the estimation of spurious regression risk has been eliminated.

5.4 Estimation Method and Results

5.4.1 Estimation Method

After finding the existence of long-run relations among the panel series, now we need to estimate the size and sign of these relations. In other words, cointegration analysis has only verified the existence of long-run relations among the variables of eight models. But we need quantitative values to be able to make interpretations and comparisons. We do this by estimating our models, in which variables are cointegrated, by using panel OLS method allowing for fixed effects and along with White heteroscedasticity consistent standard errors.[23]

In panel estimation literature, panel OLS (fixed effect estimator) and dynamic OLS methods are in the class of parametric approaches whereas FM (fully modified) OLS is a non-parametric approach. Nonetheless, as in panel unit root and cointegration tests, there is no consensus among scholars which estimation method performs better in estimating less-biased and more robust coefficients. For example, Kao and Chiang (2000) showed that FMOLS may be more biased than DOLS" (Harris and Sollis, 2005, p.207). But Banerjee (1999) claims FMOLS or DOLS are asymptotically equivalent for more than 60 observations.[24] Apart from these approaches, in some panel studies, authors prefer estimating the coefficients of the cross-section units separately by using OLS and calculate the mean coefficients for the whole panel by taking the simple average of the estimated coefficients of cross-section units. This method is known as mean group estimation. Bearing the discussion above in mind, we employ panel OLS method because:

- Many scholars are skeptic about the use of either recently developed FMOLS or DOLS method. Because none of them has distinct superiority over the other method.

---

[22] For model 4, the trace test finds the rank of cointegration as 3, but max-eigen test finds it as 4. Additionally, we have also verified the existence of cointegration by Kao panel cointegration test among the series of model 4.

[23] See Olofsdotter (1998) and Ewing & Yang (2009) for studies which use panel OLS method.

[24] See Harris and Sollis (2005, p.207) for discussion.

- Panel OLS method is the most common estimation technique which is available in almost all econometric software programs. With panel OLS method, researchers can easily estimate their equations with taking fixed or random effects, and heteroscedasticity-consistent standard errors into consideration. Nonetheless, in many software programs, researchers should write their own code to estimate a panel regression with DOLS or FMOLS method which sometimes lead inconsistent results.[25]
- Finally, the use of DOLS method requires inclusion of lags into the models. Since we use more than one independent variables, it might lead further econometric problems (e.g. multicollinearity, endogeneity). Therefore, we choose to employ panel OLS method in this study.

Panel OLS Method

After this quick overview on panel estimation methods, we briefly explain panel OLS estimation method-with fixed effects. The panel OLS method, is the application the of the usual OLS method to the panel series. A panel series dataset has both time-unit dimension (T) and cross-unit dimension (N). Thus, neither cross-section nor time-series estimators of OLS method can generate unbiased results. In this respect, panel OLS estimators take both time and cross-section units into consideration in estimation process. However, there can be cross-country differences within time-series which can lead endogeneity problem (Aghion & Howitt, 2009, p.452). Hence, estimation results without taking cross-country differences into consideration might lead misinferences about coefficients. To deal with this problem, "the *fixed effect* estimators of panel OLS is developed, which captures the omitted variables that are present in each country and that are constant over time" (Aghion & Howitt, 2009, p.453). Basically, the fixed effect can be applied by constructing a dummy variable for each cross-section unit (country) which does not change over time. Fortunately, in *E-views* software program this can be done automatically by selecting cross-section fixed-effects from panel options while estimating the regressions that we do not need to construct these dummy variables separately.

Another factor that can lead misinferences by leading biases in standard errors of the coefficients is heteroscedasticity problem in use of panel series. To eliminate this possibility

[25] For example, E-views 7 software program, which is developed in 2009, still does not allow FMOLS method in estimation of panel series.

we choose White cross-section heteroscedasticity consistent co-variance method in *E-views* software while running our regressions, which is a standard procedure in panel estimations (see Olofsdotter, 1998).

To sum up econometric issues concerning the estimation of our models:

- We have eliminated spurious regression risk in existence of non-stationary series, which might lead biased estimators, by searching and finding cointegration relations among the variables of all models.
- The cross-country differences which do not change over time might lead endogeneity problem. And this possibility is eliminated by allowing for fixed effects in estimations of the models.
- The possibility of biased standard errors which might lead to make misinferences about estimated coefficients is eliminated by choosing White's cross-section heteroscedasticity consistent co-variance method in estimations of the models.

5.4.2 Estimation Results

By using the framework described above, we run our models and present the estimation results in Tables 11, 12, and 13.

5.4.2.1 Estimation Results: The Impact of FDI on Economic Growth

Table 11: Estimation Results of Models 1 to 4

Dependent: log (PGDP)	Model 1		Model 2		Model 3		Model 4	
	G1	G2	G1	G2	G1	G2	G1	G2
Intercept	**7.7563 (0.0000)**	**9.4765 (0.0000)**	**-2.6096 (0.0006)**	**-0.4360 (0.0071)**	**-2.0910 (0.0002)**	**-0.4289 (0.0005)**	**-2.6984 (0.0000)**	**-0.5435 (0.0097)**
log (FDI)	**0.2554 (0.0000)**	**0.1718 (0.0000)**	**0.1543 (0.0000)**	**0.0680 (0.0000)**	**0.0836 (0.0002)**	**0.0688 (0.0000)**	**0.0870 (0.0001)**	**0.0810 (0.0000)**
log (LQ)			**2.2681 (0.0000)**	**2.1794 (0.0000)**	**2.2403 (0.0000)**	**2.1768 (0.0000)**	**2.3623 (0.0000)**	**2.1886 (0.0000)**
log (OPEN)					**0.1998 (0.0006)**	-0.0038 (0.9337)	**0.1968 (0.0006)**	-0.0258 (0.5550)
log (INF)							0.0129 (0.1013)	0.0127 (0.0727)
Adjusted R-sq	0.8901	0.857	0.9136	0.8983	0.9204	0.8979	0.9205	0.9083

Notes: (1) Values without parentheses are estimated coefficients. **(2) Bold numbers** denote that they are significant at 5 % significance level. **(3)** Probabilities of t-statistics are in parentheses. **(4)** G1: Developing countries sample and G2: Developed countries sample.

Table 11 documents the estimation results of models 1 to 4 in which the dependent variable is log (PGDP).[26] According to estimation results for the samples of developing and developed countries:

- In model 1 (the benchmark model), the coefficient of log (FDI) is estimated as positive and significant, as expected. It is 0.25 for developing and 0.17 for developed countries. And in both samples the coefficients of log (FDI) are significant at 5% level. Thus, 1 percent rise in "FDI stock/GDP ratio" increases economic growth 0.25 percent in developing and 0.17 percent in developed countries.[27] The findings are also consistent with the prediction of the convergence phenomenon of economic growth theory. Since developing countries are more far away from the "world average per capita income" that they can reach fast growth rates simply by transferring foreign capital (capital widening impact) and imitating the technology which is improved by developed countries (capital deepening impact). In addition, model 1 has a high goodness of fit (R-square) that 89 and 85 percent of the variation in log (PGDP) can be explained by log (FDI) in developing and developed countries respectively.[28]

- In model 2, our interest variable is labor quality. According to estimation results, the coefficient of log (LQ) is estimated as positive and significant at 5% level which is 2.26 for developing and 2.17 for developed countries. Therefore, 1 percent rise in labor quality increases economic growth 2.26 percent in developing and 2.17 percent in developed countries. Model 2 has high explanatory power for both of the samples. Unlike the coefficient of log (FDI), we do not see a considerable difference in the magnitudes of the coefficient of log (LQ) across developing and developed countries. This implies that labor quality is an important factor for absorption in both developing and developed countries.[29] Put differently, as countries raise the quality of labor by increasing the number of schooling years and quality of education, they can experience high growth rates since their absorption capacities increase in accordance with labor quality. Moreover, these countries

---

[26] In our interpretations of the estimation results, we do not make comments on the intercept terms since they do not have any economic importance in our model set-up.

[27] Our estimation results are in line with the findings of several authors such as Neuhaus (2006), Olofsdotter (1998) in terms of positive and significant growth impact of FDI.

[28] High R-square values do not only stem from high explanatory power of the models but also stem from the use of panel series.

[29] See a similar conclusion in Johnson (2006) and Ewing & Yang (2009).

can start enjoying the benefits of FDI in a shorter time due to high pace of "learning by doing", as discussed in section 3. Finally, the countries which have higher quality labor stock can attract more FDI (e.g. Ireland) which further triggers growth.

- In model 3, we add openness as an additional independent variable to model 2. Therefore, we concentrate on the size and significance of the coefficient of openness variable. According to estimation results, the coefficient of log (OPEN) is estimated as 0.19 which is significant at 5% level for developing countries and model 3 has a high explanatory power. This result is consistent with our expectation and implies that openness triggers economic growth significantly in developing countries (Soysa and Neumayer, 2005; Frankel and Romer, 1999). Nonetheless, the coefficient of log (OPEN) is found as -0.038 which is not significant at 5% level for developed countries. In other words, -0.038 is neither economically nor statistically important for developed countries which is against our prediction.

  A possible explanation for this result can be made by looking at our developed countries sample. As mentioned in section 4, to increase the homogeneity within our developed countries sample, we have used 5 relatively large and 5 relatively small developed countries in terms of amount of total GDP. And it is a well known fact that small economies such as Sweden, Switzerland have higher openness index than large economies such as USA, UK. Therefore, the use two kinds of countries within the same sample group might lead to estimation of the coefficient of log (OPEN) as insignificant. Therefore, we avoid making such a strong conclusion that openness does not matter for economic growth in developed countries. In contrast, as the coefficient of the developing countries sample has shown, openness is an important factor regarding growth and FDI. Firstly, foreign investors tend to make investments into more open economies (see Figure 2 in Appendix B). Secondly, in relatively more open economies (e.g. Egypt) foreign investors might be more eager to make exports which helps enhancing productivity and economic growth in these countries.

- In model 4, we add inflation as an independent variable into model 3. And we investigate whether inflation affects economic growth together with FDI, labor quality, and openness. According to estimation results, the coefficients of log (INF) are estimated as 0.0129 for developing and 0.0127 for developed countries which are insignificant at 5% level. In other words, inflation variable does not significantly affect economic growth in both of the samples which is against our prediction. In addition, the explanatory power of model 4 is very close to the value of model 3 since the coefficients of log (INF) are found as insignificant. The insignificance of the coefficient of log (INF) can be explained by some econometric and economic factors. As explained above, sample selection bias might be an important factor for insignificant results for inflation since our developed and developing country samples include only 10 (not randomly selected) countries due to data limitation. Additionally, the economic argument of Solow (1956) might be true for our samples that he claims inflation does not have any real impact on economic growth.

On the other hand, the insignificant coefficients for inflation variable do not necessarily imply that inflation variable should be left out that some studies have found significant negative relation between inflation and growth (e.g. Neuhaus, 2006; Ismihan et .al, 2002). In this regard, if we think it as an indicator of macroeconomic instability, it would have important implications for growth and productivity concerning FDI. First, foreign investors take host country's macroeconomic stability into account while deciding to make a physical investment. Second, macroeconomic stability is also important to reap the benefits of FDI for the host country. For example, after the initial investment decision of a foreign investor, his decisions in medium and long-run on upgrading the machinery park, transferring the latest technology together with managerial skills are somewhat dependent on the host country's macroeconomic stability which would affect the productivity and economic growth in the host country.

- A final comment can be made regarding the robustness of estimated coefficients in models 1 to 4 by looking at the estimation results. In models 1 to 4, although the size of the impact of FDI on economic growth (β_1) changes across models owing to the additional independent variables, β_1 remains positive and significant in all models. Therefore, we can conclude that the positive impact of FDI on economic growth is robust. A similar comment can also be made for the coefficients of labor quality and openness because they remain almost unchanged across models 3 and 4 in both samples. For example, in model 3, for the sample of developing countries, the coefficient of labor quality is estimated as 2.24 (significant at 5% level) and in model 4 it is 2.36 (significant at 5% level) which imply that β_2 is robust.

5.4.2.2 Estimation Results: The Impact of FDI on Productivity

Table 12: Estimation Results of Models 5 and 6

Dependent: log (LP)	Model 5		Model 6	
	G1	G2	G1	G2
Intercept	**8.7979 (0.0000)**	**10.2890 (0.0000)**	**0.8164 (0.0023)**	**3.1523 (0.0000)**
log (FDI)	**0.2165 (0.0000)**	**0.1479 (0.0000)**	**0.1386 (0.0000)**	**0.0731 (0.0000)**
log (LQ)			**1.7464 (0.0000)**	**1.5693 (0.0000)**
Adjusted R-sq	0.9063	0.8927	0.9176	0.9191

Notes: (1) Values without parentheses are estimated coefficients. **(2) Bold numbers** denote that they are significant at 5 % significance level. **(3)** Probabilities of t-statistics are in parentheses. **(4)** G1: Developing countries sample and G2: Developed countries sample.

Table 12 documents the estimation results of models 5 and 6 in which the dependent variable is log (LP). According to estimation results for the samples of developing and developed countries:

- In model 5, the coefficients of log (FDI) are estimated as positive and significant, as expected for both samples. It is 0.21 for developing and 0.14 for developed countries which are significant at 5% level. Thus, 1 percent rise in “FDI stock/GDP ratio” increases labor productivity 0.21 percent in developing and 0.14 percent in developed countries. This finding is also consistent with the prediction of economic growth theory and the convergence phenomenon. Although developing countries carry out relatively less research and developed activities, they have a higher coefficient for log (FDI) variable, as in model 1. Because they have more room to imitate the technology transferred via FDI. Additionally, developing countries might not only imitate the transferred technology legally but also they might do this illegally due to the existence of weak property-rights in these countries. Hence, FDI might trigger labor productivity in developing countries to a higher extent. Briefly, positive and significant coefficients for log (FDI) variable for the samples of developing and developed countries imply that “capital deepening” takes place as FDI stocks increase. Finally, model 5 and 6 have high goodness of fit (R-square) which are 0.90 and 0.89 in developing and developed countries, respectively.
- In model 6, we add labor quality variable to model 5. According to estimation results, the coefficients of log (LQ) are estimated as positive and significant at 5% level which is 1.74

for developing and 1.56 for developed countries. The findings are also in line with the estimation results of model 2 that improvements in labor quality enhance labor productivity. Put differently, labor quality does not only important for economic growth but also for productivity. Thus, the importance of absorption capacity variable has been verified in both samples of developing and developed countries.

Table 13: Estimation Results of Models 7 and 8

Dependent: log (TFP)	Model 7		Model 8	
	G1	G2	G1	G2
Intercept	**4.5101 (0.0000)**	**4.6069 (0.0000)**	**3.3791 (0.0173)**	**1.6031 (0.0008)**
log (FDI)	0.0071 (0.3946)	**0.0365 (0.0000)**	-0.0290 (0.0959)	0.0050 (0.3682)
log (LQ)			0.2599 (0.3864)	**0.6604 (0.0000)**
Adjusted R-sq	0.7598	0.8092	0.7673	0.8285

Notes: (1) Values without parentheses are estimated coefficients. **(2) Bold numbers** denote that they are significant at 5 % significance level. **(3)** Probabilities of t-statistics are in parentheses. **(4)** G1: Developing countries sample and G2: Developed countries sample.

Table 13 documents the estimation results of models 7 and 8 in which the dependent variable is log (TFP). According to estimation results for the samples of developing and developed countries:

- In model 7, the coefficient of log (FDI) is estimated as 0.0071 but insignificant at 5% level for the sample of developing countries, which is against our prediction. On the other hand, it is estimated as 0.0365 for the sample of developed countries which is significant at 5% level. Thus, 1 percent rise in "FDI stock/GDP ratio" increases total factor productivity by 0.03 percent in developed countries. Hence, one can conclude that log (FDI) does not significantly enhance total factor productivity in developing countries but weakly in developed countries. Such a conclusion might be explained by several econometric and economic factors:
    a) Sample-selection bias and country-heterogeneity in the sample of developing countries might lead insignificant result for the coefficient log (FDI) in model 7.
    b) Miscalculation of TFP data might also lead insignificant result for the coefficient log (FDI) in model 7. As it is known, calculation of TFP requires both data of "capital and labor stock" of a country. On the other hand, poor data quality

problem is a well-known fact especially for developing countries. Therefore, poor data quality, which lead miscalculation of TFP, might be an explanation for insignificant result in developing countries. (Sargent & Rodriguez, 2000, p.43).

c) We also need to consider other studies findings regarding the impact of FDI on productivity in developing countries. Several authors have found out that productivity impact of FDI is not significant in China and India (e.g. Sjöholm, 2008; Buckley et.al, 2006; Sasidharan, 2006). In this regard, for our developing countries sample, the insignificant coefficient for log (FDI) might be a correct estimation. But then, this result seems not to be consistent with the estimation result of model 5. Because in model 5, we have concluded above that FDI triggers "labor productivity" in developing countries sample. This inconsistency brings us to a well-known discussion in economics about the use of best productivity measure. We refer discussion to the literature and conclude that FDI weakly triggers TFP in developed countries but not in developing countries.[30]

- In model 8, we add labor quality to model 7. Thus, our interest variable is labor quality. According to estimation results, the coefficient of log (LQ) is estimated as 0.25 but it is insignificant at 5% level for developing countries. However, for developed countries it is found as 0.66 and significant at 5% level, as expected. Additionally, in model 8, the coefficient of log (FDI) is estimated as insignificant at 5% in both samples. Aforementioned, poor TFP data quality discussion for developing countries might be also applied to here in explaining positive but insignificant coefficient of log (LQ). Because, in all other models we have always found that labor quality enhances productivity and economic growth in developing countries.

6. CONCLUSIONS AND IMPLICATIONS

In this final section, we gather the major findings of panel cointegration analysis and estimation results and interpret them without technical details. Moreover, we discuss the possible implications of these major findings and conclude the study.

[30] See the discussion in Sargent & Rodriguez (2000). According to them, TFP seems to be a better productivity measure but there are also proponents of LP therefore there is no clear conclusion in the discussion.

The study's major findings reveal that:

- There is a long-run relation between "log (PGDP) and log (FDI)" variables. And the coefficient of the long-run relation is estimated as positive and significant for both samples in model 1. In other words, it is verified that FDI triggers economic growth in developing and developed countries. Besides, the impact of FDI on economic growth is found in developing countries relatively higher than developed countries which can be explained by the convergence phenomenon.
- Although long-run relation is found between "log (LP) and log (FDI)", and "log (TFP) and log (FDI)" variables, the positive impact of FDI on productivity is only partly verified. By using labor productivity as the dependent variable, we conclude FDI enhances productivity in both developing and developed countries. But when we use total factor productivity as the dependent variable, the positive and statistically significant impact of FDI on productivity is only found for "developed countries sample" in model 7.
- The magnitudes of productivity impacts of FDI are smaller than the magnitudes of growth impacts of FDI in estimations. Because the magnitudes of growth impact (β_1 in model 1) reflect both capital widening and deepening effects whereas the magnitudes of productivity impact (β_1 in model 5 and 7) reflect only capital deepening effect. Put differently, the productivity impact of FDI is limited in comparison with growth impact of FDI, as expected. It is also consistent with the prediction of the endogenous growth models in which the research and development activities conducted within the country are the key element for technology (productivity) growth rather than other factors such as FDI, international trade (Aghion & Howitt, 2009).
- The impacts of a number of additional independent variables have been investigated in the study. First of all, in all models the existence of long-run relations among variables is verified by cointegration tests. Secondly, the labor quality (absorption capacity) is found as a significant factor in promoting growth and productivity in both developing and developed countries. Thirdly, it is showed that more open developing economies tend to grow faster that the coefficient of openness is estimated as positive and significant. Finally, the impact of inflation on growth could not be verified due to insignificant coefficients for inflation variable in both developing and developed countries.

The possible implications of these major findings can be summarized as follows:

- The major implication of the finding "FDI triggers economic growth" is that; both developing and developing countries need to pursue pro-FDI policies to attract more FDI which will boost their economic growth. Nonetheless, as discussed in section 3, the size of the growth impact can alter regarding the type of FDI (greenfield versus brownfield; vertical versus horizontal FDI). In this respect, pro-FDI policies should not only designed for attracting high volumes of FDI but also right kinds of FDI to induce economic growth to a higher extent. For example, governments can promote investments of foreigners into some selected or prioritized sectors (e.g. IT, R&D) for long-run growth and development. A successful example of pro-FDI policies with a long-run development perspective is followed by Ireland. Önis and Senses (2007) summarize this issue very well: "States try to adopt pro-active policies through various direct and indirect mechanisms to upgrade the performance of national firms as well as attracting in competition with other states the right kinds of FDI needed for long-term transformation. As the experience of Ireland clearly testifies the approach towards FDI is not a passive policy of creating the right environment, but a strategy that goes beyond this and tries to actively encourage the desired types of FDI through a variety of promotion and inducement mechanisms." (Önis and Senses, 2007, p.28).
- Attracting FDI is the half of the way whereas internalization and adoption of new working techniques is the other half for creating the productivity and economic growth impacts of FDI. Presumably, internalization and adoption of new working techniques can be accomplished with high quality labor which helps triggering economy-wide productivity and economic growth. Thus, policies aiming to improve labor quality shall be the integral part of pro-FDI policies both for developing and developed countries. As discussed in section 3, high quality labor can help the absorption of the new technologies in a short time and to a higher extent which naturally implies the inducement of economy-wide productivity and economic growth.
- The finding of "limited impact of FDI on (total factor) productivity" suggests that the contribution of foreigners to productivity of a country can be important but not as important as the contribution of research and development activities conducted domestically. Thus, especially developing countries shall try to boost their research and development activities irrespective of amount of FDI stock that they have for long-run sustainable growth and development.

- The estimation of positive openness coefficient for developing countries suggests that policies which aim to reduce trade barriers can affect economic growth significantly and in a positive manner. By following pro-trade policies, these countries might attract high volumes of FDI and reap the benefits of FDI to a higher extent, as Ireland and China did.

To sum up, the study's main findings show that FDI triggers (labor) productivity and economic growth in a positive way but at different degrees. Nonetheless, the magnitudes of these impacts differ remarkably across developing and developed countries. Moreover, the findings strongly suggest that the impacts of FDI on productivity and economic growth can be improved with high labor quality. Finally, it is also emphasized and discussed that higher openness and macroeconomic stability might be other important factors in assessing the positive impacts of FDI concerning economic growth.

There are several points which will be explored by researchers in the future. The findings of the study can be improved or questioned in further studies by using a more composite and reliable "productivity" measure. A further study can also employ FMOLS non-parametric approach in estimating the models instead of panel OLS method. Apart from inflation control variable, some other "macroeconomic instability" indices can be developed and employed by researchers in analyzing the impacts of FDI on economic growth in the future. Finally, the study can be repeated in the future with larger samples to increase robustness and reduce country heterogeneity, as more comparable datasets become available in databases.

REFERENCES

Aghion, P., and P. Howitt (1992), "A Model of Growth through Creative Destruction", *Econometrica*, 60, pp.323-351.

Aghion, P., and P. Howitt (2009), *The Economics of Growth*, MIT Press.

Apergis, N., and J.E. Payne (2010), "Renewable Energy Consumption and Economic Growth: Evidence from a Panel of OECD Countries", *Energy Policy*, 38, pp.656-660.

Arrow, K.J. (1962), "The Economic Implications of Learning by Doing", *Review of Economic Studies*, 29, pp.155-173.

Baltagi, B. H., and C. Kao (2000), "Nonstationary Panels, Cointegration in Panels and Dynamic Panels: A Survey", *Center for Policy Research-Working Paper*, No. 16, Maxwell School of Citizenship and Public Affairs, Syracuse University.

Banerjee, A. (1999), "Panel Data Unit Roots and Cointegration: An Overview", *Oxford Bulletin of Economics and Statistics*, 61 (Special Issue), pp.607-629.

Barro, R.J. (1991), "Economic Growth in a Cross Section of Countries", *The Quarterly Journal of Economics*, Vol.106, No.2, pp.407-443.

Basu, P., C. Chakraborty, and D. Reagle (2003), "Liberalisation, FDI, and Growth in Developing Countries: A Panel Cointegration Approach", *Economic Inquiry*, 51, pp.510-516.

Bleaney, M. F. (1996), "Macroeconomic Stability, Investment and Growth in Developing Countries", *Journal of Development Economics*, 48, pp.461-477.

Blomström, M., R.E. Lipsey, and M. Zejan (1994), "What Explains Developing Country Growth?", *NBER Working Paper*, No. 4132.

Bonthuis, B. (2010), "Measuring Labour Quality", *Working Paper*, University of Groningen. Available at: http://www.conference-board.org/economics/downloads/Paper_b_bonthuis.pdf.

Briault, C. (1995), "The Costs of Inflation", *Bank of England Quarterly Bulletin*, 35, pp.33-45.

Broda, C., J. Greenfield, and D. Weinstein (2006), "From Groundnuts to Globalization: A Structural Estimate of Trade and Growth", *NBER Working Paper*, No.12512.

Buckley, P.J, J. Clegg, and C. Wang (2006), "Inward FDI and Host Country Productivity: Evidence from China's Electronics Industry", *Transnational Corporations,* Vol. 15, No. 1, pp.13-37. Available at: http://www.unctad.org/en/docs/iteiit20061a2_en.pdf.

Bureau of Labor Statistics (2010), "Multifactor Productivity", Available at: http://www.bls.gov/mfp/mprover.htm.

Carkovic, M., and R. Levine (2002), "Does Foreign Direct Investment Accelerate Economic Growth?", *Working Paper,* Department of Finance, University of Minnesota.
Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=314924.

Comin, D. (2008), *Total Factor Productivity*, The New Palgrave Dictionary of Economics Online, Palgrave Macmillan.

De Mello, L.R. (1999), "Foreign Direct Investment-Led Growth: Evidence from Time Series and Panel Data", *Oxford Economic Papers*, 51, pp.133-151.

EUROSTAT (2007), *European Union Foreign Direct Investment Yearbook 2007*, Luxembourg.

Ewing, B.T., and B. Yang (2009), "The Differential Growth Effect of FDI across US Regions", *International Economic Journal*, Vol.23, No.4, pp.511-525.

Fischer, S. (1993), "The Role of Macroeconomic Factors in Growth", *NBER Working Paper* No. 4565.

Frankel, J. A., and D. Romer (1999), "Does Trade Growth Cause Growth?", *American Economic Review*, Vol. 8, No. 3, pp.379-399.

Frankel, M. (1962), "The Production Function in Allocation of Growth: A Synthesis", *American Economic Review*, 52, pp.995-1022.

Gokal, V., and S. Hanif (2004), "Relationship between Inflation and Economic Growth", *Working Paper*, No. 2004/04, Reserve Bank of Fiji.

Gujarati, D. (2003), *Basic Econometrics*, McGraw-Hill.

Hansen, H., and J. Rand (2006), "On the Causal Links between FDI and Growth in Developing Countries", *The World Economy*, 29, pp.21-41.

Harris, R., and R. Sollis (2005), *Applied Time Series Modeling and Forecasting*, John Wiley & Sons Ltd., England.

Herzer, D., S. Klasen, and D. F. Nowak-Lehmann (2008), "In Search of FDI-Led Growth in Developing countries: The Way Forward", *Economic Modelling*, 25, pp.793-810.

Im, K., H. Pesaran, and Y. Shin (1997), "Testing for Unit Roots in Heterogeneous Panels", *Discussion Paper*, University of Cambridge.

Ismihan, M., K. Metin-Ozcan, and A. Tansel (2002), "Macroeconomic Instability, Capital Accumulation and Growth: The Case of Turkey 1963-1999", *Discussion Paper*, No. 02-05, Bilkent University. Available at:
http://www.bilkent.edu.tr/~economics/papers/02-05%20DP%20Kivilcim%20Metin.pdf.

Johansen, S. (1988), "Statistical Analysis of Cointegration Vectors", *Journal of Economic Dynamics and Control*, 12, pp. 231-254.

Johnson, A. (2006), "The Effects of FDI Inflows on Host Country Economic Growth", *CESIS Electronic Working Paper Series,* No. 58.
Available at: http://www.infra.kth.se/cesis/documents/WP58.pdf.

Kao, C. (1999), "Spurious Regression and Residual Based Tests for Cointegration in Panel Data", *Journal of Econometrics*, 90, pp.1-44.

Kao, C., and M. Chiang (2000), “On the Estimation and Inference of a Cointegrated Regression in Panel Data”, *Nonstationary Panels, Panel Cointegration and Dynamic Panels*, 15, pp.179-222.

Lee, J. (2009), “Trade, FDI, and Productivity Convergence: A Dynamic Panel Data Approach in 25 Countries”, *Japan and the World Economy*, 21, pp. 226-238.

Ma, X. (2009), “An Empirical Analysis on the Impact of FDI on China's Economic Growth”, *International Journal of Business and Management*, Vol.4, No.6, pp.76-80.

Maddala, G.S., and S. Wu (1999), “A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test”, *Oxford Bulletin of Economics and Statistics*, 61, pp.631-652.

Mankiw, N. G., D. Romer, and D. N. Weil (1992), “A Contribution to the Empirics of Economic Growth”, *The Quarterly Journal of Economics*, Vol.107, No.2, pp. 407-437.

Mishra, V., and R. Smyth (2010), “Female Labor Force Participation and Total Fertility Rates in the OECD: New Evidence from Panel Cointegration and Granger Causality Testing”, *Journal of Economics and Business*, 62, pp.48-64.

Neuhaus, M. (2006), *The Impact of FDI on Economic Growth: An Analysis for the Transition Countries of Central and Eastern Europe*, Physica-Verlag, Heidelberg.

OECD (2002), *Foreign Direct Investment for Development; Maximizing Benefits, Minimizing Costs*, Paris.

Olofsdotter, K. (1998), “Foreign Direct Investment, Country Capabilities and Economic Growth, *Weltwirtschaftliches Archiv*, Vol.134, No.3, pp.534-547.

Önis Z., and F. Senses (2007), “Global Dynamics, Domestic Coalitions and a Reactive State: Major Policy Shifts in Post-War Turkish Economic Development”, *METU Studies in Development*, Vol. 34. No.2, pp.1-36.

Pedroni, P. (1999), "Critical Values for Cointegrating Tests in Heterogeneous Panels with Multiple Regressors", *Oxford Bulletin of Economics and Statistics*, 61, pp.653-670.

Romer, P. (1986), "Increasing Returns and Long-Run Growth", *Journal of Political Economy*, 94, pp.1002-1037.

Romer, P. (1990), "Endogenous Technological Change", *Journal of Political Economy*, 98, pp.71-102.

Sargent C., and E. R. Rodriguez (2000), "Labour or Total Factor Productivity: Do We Need to Choose?", *International Productivity Monitor*, 1, pp.41-44.
Available at: http://www.csls.ca/ipm/1/sargent-e.pdf.

Sasidharan, S. (2006), "Foreign Direct Investment and Technology Spillovers: Evidence from the Indian Manufacturing Sector", *SSRN Working Paper*.
Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=881528.

Schumpeter, J. A. (1942), *The Theory of Economic Development*, Cambridge, MA: Harvard University Press.

Sjöholm, F. (2008), "The Effect of FDI on Employment and Technology in China", *IFN Working Paper*. Available at:
http://www.ifn.se/BinaryLoader.axd?OwnerID=249d8b5439ec431d9baf9e969bf4a631&OwnerType=0&PropertyName=File1&FileName=SjoholmChina10-20.pdf.

Solow, R. M. (1956), "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, 70, pp.65-94.

Soysa, I., and E. Neumayer (2005), "False Prophet or Genuine Savior? Assessing the Effects of Economic Openness on Sustainable Development", *International Organization*, Vol. 59, No. 3, pp.731-772.

Tica, J., and I. Druzic (2006), "The Harrod-Balassa-Samuelson Effect: A Survey of Empirical Evidence", *Working Paper Series*, No. 06-7/686, University of Zagreb.

Tobin, J. (1965), "Money and Economic Growth", *Econometrica,* 33, pp.671-684.

Todaro, M.P. (2000), *Economic Development,* Addison Wesley Longman, Inc., New York.

UNDP Human Development Report (2009), *Overcoming Barriers: Human Mobility and Development*, United Nations Development Programme, Palgrave Macmillan, New York.

Verbeek, M. (2008), *A Guide to Modern Econometrics*, 3.ed., John Wiley & Sons, Ltd., England.

World Investment Report (2007), *Transnational Corporations, Extractive Industries and Development*, UNCTAD, New York and Geneva.

World Investment Report (2009), *Transnational Corporations, Agricultural Production and Development,* UNCTAD, New York and Geneva.

APPENDICES

APPENDIX A: DERIVATION OF THE MODEL

In here, by using Neuhaus (2006, p.158) and Mankiw, Romer, and Weil (1992, p.416-418) we present the derivation of our benchmark model.

$$Y = {K_D}^{\alpha}{K_F}^{\beta}(AL)^{1-\alpha-\beta} \quad \text{(Eq.1)}$$

In where; K_D: capital stock held by domestic investors, K_F: capital stock held by foreign investors (FDI stock), A: technology, L: labor.

$$y = {k_D}^{\alpha}{k_F}^{\beta} \quad \text{(Eq.2)}$$

In where; $\mathrm{y} = \mathrm{Y/AL}$, $k_D = K_D/AL$, $k_F = K_F/AL$.

Per capita capital accumulation over time is defined by following equations:

$$\dot{k}_D = s_D y - (n + g + \delta)k_D \quad \text{(Eq.3)}$$

$$\dot{k}_F = s_F y - (n + g + \delta)k_F \quad \text{(Eq.4)}$$

In where; n: population growth rate, g: technology growth rate, δ: depreciation rate.

At steady state; we assume that growth rate of capital is 0. Therefore, $\dot{k}_D = 0$ and $\dot{k}_F = 0$.

Then, we can write from Eq.3 and Eq.4:

$$s_D \frac{y}{k_D} = (n + g + \delta) \quad \text{(Eq.5)}$$

$$s_F \frac{y}{k_F} = (n + g + \delta) \quad \text{(Eq.6)}$$

Equations 5 and 6 imply that:

$$k_D = \frac{s_D\, k_F}{s_F} \quad \text{(Eq.7)}$$

When we plug Eq. 2 into Eq. 5, we get:

$$s_D \frac{{k_D}^{\alpha}{k_F}^{\beta}}{k_D} = (n + g + \delta) \quad \text{(Eq.8)}$$

By using Eq.7 and after some arrangements we reach to the steady state level of k_F :

$$k_F = \left(\frac{s_D^{\alpha} s_F^{1-\alpha}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta}} \quad \text{(Eq.9)}$$

In a similar manner, we can find:

$$k_D = \left(\frac{s_D^{1-\beta} s_F^{\beta}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta}} \quad \text{(Eq.10)}$$

When we plug Eq.9 and Eq.10 into Eq.2, we can get steady state y:

$$y = s_F^{\left(\frac{\beta}{1-\alpha-\beta}\right)} s_D^{\left(\frac{\alpha}{1-\alpha-\beta}\right)} (n+g+\delta)^{\left(\frac{-(\alpha+\beta)}{1-\alpha-\beta}\right)} \quad \text{(Eq.11)}$$

Finally, we take the logarithms of the both sides of Eq.11 and we reach a testable equation:

$$log(y) = \frac{\beta}{1-\alpha-\beta} log\ (s_F) + \frac{\alpha}{1-\alpha-\beta} log\ (s_D) - \frac{(\alpha+\beta)}{1-\alpha-\beta} log\ (n+g+\delta) \quad \text{(Eq.12)}$$

In the study, we primarily concentrate on the impact of FDI stock on $\log(y)$ therefore we disregard the remaining terms and collect them into the error term and re-write Eq.12 as a regression:

$$log(y) = \beta_0 + \beta_1\, log(s_F) + error\ term \quad \text{(Eq.13)}$$

In where; y: PGDP (per capita GDP) and s_F: FDI (rate of FDI stock)

Substituting (y) and (s_F) in Eq.13 with abbreviations, we can write our benchmark model as follows[31]:

$$log\ (PGDP_{i,t}) = \beta_0 + \beta_1\, log\ (FDI_{i,t}) + error\ term \quad \text{(Eq.14)}$$

By using log (PGDP) as the dependent variable, we would analyze the impact of “one percent change in FDI stock” on the steady-state (equilibrium) value of log (PGDP). In this regard, we start our analysis with cointegration tests to verify whether there is a long-run (equilibrium) relation between “FDI stock” and PGDP variables.[32]

[31] Note that in equation 2; (y) is output per effective labor whereas in equation 14 it is output per capita. In empirical growth studies, these terms are generally used synonymously (see Mankiw, Romer, and Weil, 1992).

[32] In the study, due to lack of “FDI stock” data in real terms, we employ “FDI stock/GDP” data, as several authors did (e.g. Neuhaus, 2006; Olofsdotter, 1998).

APPENDIX B: ADDITIONAL TABLES AND FIGURES

Table 6: Estimation Results with Annual Data and 5-year Averages

This table shows that the use of annual data or 5-year averages do not lead significant differences in estimation results both in developing and developed countries. The estimation results for the remaining 7 models are also in line with this result. In this respect, throughout this study we always prefer using annual data.

Dependent: log (PGDP)	Model 1: G1 countries		Model 1: G2 countries	
	Annual Data	5-year Averages	Annual Data	5-year Averages
Intercept	7.7563* (0.0000)	7.7060* (0.0000)	9.4765* (0.0000)	9.4690* (0.0000)
log (FDI)	0.2554* (0.0000)	0.2753* (0.0000)	0.1718* (0.0000)	0.1742* (0.0000)
Adjusted R-sq	0.8901	0.8868	0.8570	0.8490

Notes: **(1)** Values without parentheses are estimated coefficients. **(2)** Values with (*) denote that they are significant at 1, 5, and 10 % significance levels. **(3)** Probabilities of t-statistics are in parentheses. **(4)** Estimation is conducted by using Panel OLS-fixed effects with White cross-section coefficient of covariance method. **(5)** G1: Developing countries sample and G2: Developed countries sample.

Table 8: Panel Unit Root Test Results

		IPS Individiual Unit Root		Breitung Common Unit Root	
Variables	Country Groups	Level	First Difference	Level	First Difference
log(PGDP)	G1	7.02357 (1.0000)	**-5.82423** **(0.0000)**	-1.01661 (0.1547)	**-2.55749** **(0.0053)**
	G2	1.27669 (0.8991)	**-5.27889** **(0.0000)**	3.44080 (0.9997)	**-6.95556** **(0.0000)**
log(FDI)	G1	1.50619 (0.9340)	**-8.44000** **(0.0000)**	0.6998 (0.7580)	**-4.38060** **(0.0000)**
	G2	3.42465 (0.9997)	**-11.1024** **(0.0000)**	2.50313 (0.9938)	**-7.61975** **(0.0000)**
log(LQ)	G1	0.14194 (0.5564)	**-1.80721** **(0.0354)**	-0.43073 (0.3333)	**-1.7762** **(0.0378)**
	G2	3.36205 (0.9996)	**-7.67516** **(0.0000)**	2.45279 (0.9929)	**-4.23643** **(0.0000)**
log(OPEN)	G1	3.29020 (0.9995)	**-7.68833** **(0.0000)**	-0.32067 (0.3742)	**-7.10316** **(0.0000)**
	G2	3.48450 (0.9998)	**-8.29909** **(0.0000)**	0.19842 (0.5786)	**-7.37909** **(0.0000)**
log(INF)	G1	-0.22599 (0.41069	**-9.78695** **(0.0000)**	1.06338 (0.8562)	**-6.41305** **(0.0000)**
	G2	-1.17957 (0.1191)	**-5.73250** **(0.0000)**	1.00796 (0.84339)	**-8.58467** **(0.0000)**
log(LPI)	G1	4.52114 (1.0000)	**-7.48093** **(0.0000)**	-0.75924 (0.2239)	**-3.89356** **(0.0000)**
	G2	1.55487 (0.9400)	**-5.58935** **(0.0000)**	4.75342 (1.0000)	**-7.58073** **(0.0000)**
log(TFP)	G1	1.05695 (0.8547)	**-8.43190** **(0.0000)**	-0.85597 (0.1960)	**-3.49262** **(0.0002)**
	G2	-0.27773 (0.3906)	**-7.61952** **(0.0000)**	3.12426 (0.9991)	**-7.87910** **(0.0000)**

Notes: **(1)** Values without parentheses in IPS test results are "IPS-W-stats". **(2)** Values without parentheses in Breitung test results are "Breitung t-stats". **(3)** **Bold** numbers denote that they are significant at 5% level. **(4)** Probabilities are in parentheses. **(5)** Tests are conducted by including intercept. **(6)** Automatic lag length selection (Schwarz) is used. **(7)** The IPS test uses; H_0: All series in panel have a unit root, H_1: At least, one series in panel does not have a unit root. The Breitung test uses; H_0: All series in panel have a unit root, H_1: All series in panel do not have a unit root. **(8)** G1: Developing countries sample and G2: Developed countries sample.

Table 9: The Johansen- Fisher Panel Cointegration Test Results: Fisher Statistic from Trace Test

		Fisher Stat. From Trace Test					**Rank**	**Lag**	**Specification No**
Model No and Variables	**Country Groups**	**tr (r=0)**	**tr (r ≤ 1)**	**tr (r ≤ 2)**	**tr (r ≤ 3)**	**tr (r ≤ 4)**			
Model 1: log(PGDP), log(FDI)	**G1**	**38.00 (0.0089)**	26.20 (0.1592)				**1**	1	3
	G2	**40.86 (0.0039)**	16.33 (0.6959)				**1**	1	3
Model 2: log(PGDP), log(FDI), log(LQ)	**G1**	**93.92 (0.0000)**	**35.81 (0.0162)**	17.03 (0.6510)			**2**	1	3
	G2	**126.1 (0.0000)**	**50.27 (0.0002)**	20.42 (0.4318)			**2**	2	4
Model 3: log(PGDP), log(FDI), log(LQ),	**G1**	**169.7 (0.0000)**	**74.17 (0.0000)**	**40.83 (0.0039)**	19.39 (0.4967)		**3**	1	3
	G2	**174.3 (0.0000)**	**85.81 (0.0000)**	**49.57 (0.0003)**	23.25 (0.2767)		**3**	1	2
Model 4: log(PGDP), log(FDI), log(LQ),	**G1**	**319.9 (0.0000)**	**155.6 (0.0000)**	**71.11 (0.0000)**	**39.90 (0.0051)**	21.75 (0.3543)	**4**	1	2
	G2	**212.1 (0.0000)**	**115.8 (0.0000)**	**67.97 (0.0000)**	**32.70 (0.0181)**	25.13 (0.1214)	**4**	1	2
Model 5: log(LP), log(FDI)	**G1**	**36.44 (0.0136)**	20.75 (0.4119)				**1**	1	3
	G2	**52.73 (0.0001)**	26.49 (0.1503)				**1**	1	3
Model 6: log(LP), log(FDI), log(LQ)	**G1**	**113.7 (0.0000)**	**57.42 (0.0000)**	18.39 (0.5617)			**2**	2	3
	G2	**110.1 (0.0000)**	**56.10 (0.0000)**	30.20 (0.0666)			**2**	1	2
Model 7: log(TFP), log(FDI)	**G1**	**38.71 (0.0072)**	14.08 (0.8265)				**1**	1	4
	G2	**32.49 (0.0384)**	22.55 (0.3113)				**1**	1	3
Model 8: log(TFP), log(FDI), log(LQ)	**G1**	**71.44 (0.0000)**	**37.57 (0.0100)**	22.46 (0.3159)			**2**	1	3
	G2	**101.9 (0.0000)**	**44.06 (0.0015)**	25.66 (0.1773)			**2**	1	2

Notes: (1) Values without parentheses are Fisher statistics from trace test. **(2) Bold** numbers denote that they are significant at 5% level. **(3)** Probabilities are in parentheses. **(4)** Rank column denotes the rank of cointegration; lag column denotes the number of lags is used for the test. **(5)** Specification numbers are as in E-views 7. Specification No 2: Intercept in level data (no trend), no trend and intercept in VAR. Specification No 3: Linear trends in level data, not in VAR. Specification No 4: Intercept and linear trends in level data and no trend in VAR. **(6)** The following null hypotheses are tested in turn: H_0: r = 0, H_0: r ≤ 1, H_0: r ≤ 2, H_0: r ≤ 3, H_0: r ≤ 4. **(7)** G1: Developing countries sample and G2: Developed countries sample.

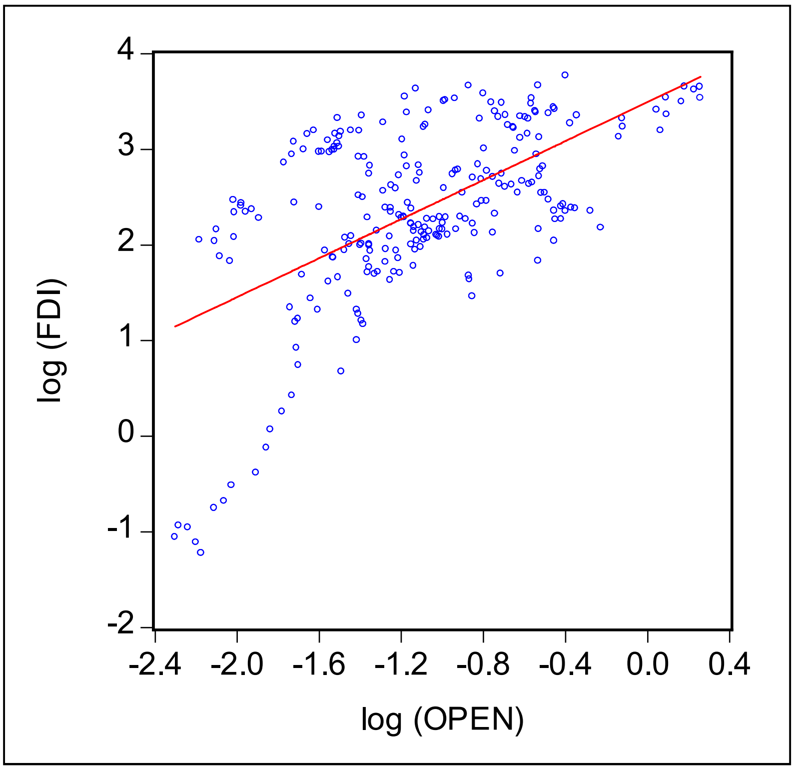
Table 10: The Johansen- Fisher Panel Cointegration Test Results: Fisher Statistic from Max-Eigen Test

		Fisher Stat. From Max-Eigen Test					Rank	Lag	Specification No
Model No and Variables	**Country Groups**	**λ (r=0)**	**λ (r ≤ 1)**	**λ (r ≤ 2)**	**λ (r ≤ 3)**	**λ (r ≤ 4)**			
Model 1: log(PGDP), log(FDI)	**G1**	**33.57 (0.0292)**	26.2 (0.1592)				**1**	1	3
	G2	**43.19 (0.0019)**	16.33 (0.6959)				**1**	1	3
Model 2: log(PGDP), log(FDI), log(LQ)	**G1**	**79.17 (0.0000)**	**36.45 (0.0136)**	17.03 (0.6510)			**2**	1	3
	G2	**96.35 (96.35)**	**46.95 (0.0006)**	20.42 (0.4318)			**2**	2	4
Model 3: log(PGDP), log(FDI), log(LQ),	**G1**	**120.6 (0.0000)**	**50.85 (0.0002)**	**40.05 (0.0049)**	19.39 (0.4967)		**3**	1	3
	G2	**109.7 (0.0000)**	**54.08 (0.0001)**	**46.22 (0.0008)**	23.25 (0.2767)		**3**	1	2
Model 4: log(PGDP), log(FDI), log(LQ),	**G1**	**205.5 (0.0000)**	**104.8 (0.0000)**	**49.70 (0.0002)**	**39.72 (0.0054)**	21.75 (0.3543)	**4**	1	2
	G2	**126.6 (0.0000)**	**62.00 (0.0000)**	**52.97 (0.0000)**	24.31 (0.1453)	25.13 (0.1214)	**3**	1	2
Model 5: log(LP), log(FDI)	**G1**	**36.37 (0.0139)**	20.75 (0.4119)				**1**	1	3
	G2	**49.81 (0.0002)**	26.49 (0.1503)				**1**	1	3
Model 6: log(LP), log(FDI), log(LQ)	**G1**	**77.53 (0.0000)**	**60.03 (0.0000)**	18.39 (0.5617)			**2**	2	3
	G2	**73.31 (0.0000)**	**46.81 (0.0006)**	30.20 (0.0666)			**2**	1	2
Model 7: log(TFP), log(FDI)	**G1**	**40.92 (0.0038)**	14.08 (0.8265)				**1**	1	4
	G2	**32.31 (0.0401)**	22.55 (0.3113)				**1**	1	3
Model 8: log(TFP), log(FDI), log(LQ)	**G1**	**51.90 (0.0001)**	**36.45 (0.0136)**	22.46 (0.3159)			**2**	1	3
	G2	**79.50 (0.0000)**	**37.50 (0.0102)**	25.66 (0.1773)			**2**	1	2

Notes: (1) Values without parentheses are Fisher statistics from max-eigen test. **(2) Bold** numbers denote that they are significant at 5% level. **(3)** Probabilities are in parentheses. **(4)** Rank column denotes the rank of cointegration; lag column denotes the number of lags is used for the test. **(5)** Specification numbers are as in E-views 7. Specification No 2: Intercept in level data (no trend), no trend and intercept in VAR. Specification No 3: Linear trends in level data, not in VAR. Specification No 4: Intercept and linear trends in level data and no trend in VAR. **(6)** The following null hypotheses are tested in turn: H_0: r = 0, H_0: r ≤ 1, H_0: r ≤ 2, H_0: r ≤ 3, H_0: r ≤ 4. **(7)** G1: Developing countries sample and G2: Developed countries sample.

Figure 2: Openness and FDI Relation in Developing Countries

Given country heterogeneity within our developing countries sample, as can be seen from the regression line, there is a significant positive relation between openness and FDI stock/GDP ratio. (Number of observations (N*T): 10*25= 250).



Source: Author's own calculation.