



**LUND UNIVERSITY**

School of Economics and Management

Department of Economics

# **The Effects of Foreign Direct Investment on Turkish Economy**

## A Sectoral level Empirical Analysis

*Master's Thesis*

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## Abstract

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This study's ambition is to investigate the effects of Foreign Direct Investment for Turkey at the individual sector level. To the best of our knowledge, this is the first endeavor to investigate the sector-specific effect of FDI on GDP for Turkey. The main research is carried out by support of basic neo-classical growth theory and new endogenous growth paradigms. The study mainly employs empirical models, such as the panel data estimation, panel cointegration and pooled/panel estimation techniques. Moreover, Granger-Causality, Arellano-Bond Dynamic panel-data estimation with one-step system GMM estimator techniques is indispensable to the accomplishment of this work. By choosing panel estimation technique, the author intends to control unobserved sector-specific effects, and consequently to reduce the omitted variable bias. The essential findings for the study suggest that Foreign Direct Investment contributed growth rate overall positive in Turkish economy. Foreign Direct Investment seems to benefit growth rate most in the Manufacturing, Electricity, Gas and Water, Wholesale and Retail Trade sectors. It justifies that FDI utilizes the labor productivity and consequently the growth rate at the sector-specific level in variety of magnitudes. Moreover, one way causality from FDI to GDP is found.

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**Keywords:** Foreign Direct Investment, Growth Theory, Panel Cointegration, Panel Estimation, Panel Granger Causality, Panel Unit Root, Turkish Economy.

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*To my Daughter*

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## Abbreviations

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AGR	Agriculture
CBRT	Central Bank of the Republic of Turkey
COMM	Communication
CON	Construction
EGLS or FGLS	Estimated or Feasible Generalized Least Squares
EGW	Electricity, Gas and Water
EHS	Education Health and Social works
FDI	Foreign Direct Investment
FINB	Financing, Insurance and Business Services
GDP	Gross Domestic Product
GMM	General Methods of Moments
GO	Gross Output
HNC	Homogenous Non Causality
HRS	Hotels and Restaurants
ISIC	International Standard Industrial Classification
IV	Instrumental Variable
LPR	Labor Productivity
MAN	Manufacturing
MGE	Mean Group Estimator
MIN	Mining and Quarrying
MNE	Multinational Enterprise
OECD	Organization for Economic Co-operation and Development
SER	Service
TFP	Total Factor Productivity
TL	Turkish Lira
TURKSTAT	Turkish Statistical Institute
WHS	Wholesale and Retail Trade and Restaurants and Hotels
XPR	Export

# 1 Introduction

There have been numerous studies which have investigated the impact of FDI on economic growth. It is thought that foreign direct investment (FDI) is a potential mechanism for economic growth, especially in developing countries. Thus there is an increasing trend in developing countries to open the doors to Multinational enterprises (MNE), with the expectation that with FDI would flow economic improvements. Weinhold et.al (2001) finds that FDI in developing economies has increased by 17 percent each year during the last two decades. The common theories in the literature suggest that FDI triggers economic growth via different channels. First of all, FDI accumulates the total domestic capital stock in the country, which leads to an increased growth rate in total output. The other important channel is through the MNE which have advanced R&D activities. MNEs can apply their advanced technology and know-how, which can in turn, improves productivity by inducing human capital development. Thereafter, the technology spillovers can contribute to the country, which in return increases economic growth (Mello 1999).

The pioneering neo-classical framework Solow (1956) proposes, that output is a function of the stock of capital and labor. In the neo-classical framework, the growth rate of output is exogenous. Due to diminishing physical capital accumulation, additional physical capital input into the production function cannot contribute to the growth rate of output after the steady state. Because of this reason, FDI has no long-run impact on GDP. The new endogenous growth paradigms however, argue that stock of capital may not be diminishing and growth might not be coming “manna from heaven”. These theories consist of the “innovation-based” growth model, which claims that innovation causes productivity growth by either creating new technology and a variety of new products or improving existence technology by R&D (Aghion, P. et.al, 1992). Nevertheless, there are some skeptical arguments in the literature when it comes to the impact of FDI on economic growth and direction of causality between FDI and GDP in the single country perspective. Hence, there are wide research interests about this subject and in particular the factors that attract MNE and FDI to the host country.

This study aims to investigate the sectoral impact of the FDI on economic growth in a single country perspective for Turkey. To the best of our knowledge this study is the first endeavor

to use sectoral level data to study the FDI impact on GDP across different sectors in Turkey. It should be emphasized that this kind of country-specific research on sectoral level has not been conducted for many other countries either. In this respect this is important, because the most recent empirical studies have focused on homogenous country groups where Turkey was included. They agree with the consensus that FDI has spillovers that affect and contribute to economic growth in the country level. However, the remaining questions still remain unanswered; questions such as whether the impact of FDI on economic growth is different for the different sectors, and if not the nature of the characteristics of these sectors that give lift to the economy. At this point, it is conceivable that this study has given a distinctive contribution to the literature not only for Turkey, but also for other countries as well.

Further, it justifies our study and the attempt to answer the question of whether FDI triggers GDP growth in the country, or whether Turkey in fact attracts Multinational Enterprise (MNE) to flow FDI into the country due to increasing GDP growth over the last decades.

In this study, panel data techniques have been used in order to analyze the impact of FDI on GDP. The empirical analyses start with panel unit root tests and panel cointegration tests, which have become a compulsory procedure in the econometrics literature. When it is found that all data are in the same integration order  $I(1)$ , then the panel cointegration test is carried out and long-run relationships between variables are found. The Granger causality test has been used to answer the particular question whether FDI causes GDP growth, or vice versa. The result indicates that there is one-way causality from FDI to GDP and GDP does not influence the FDI in Turkey. The magnitude of the impact has been analyzed by a panel estimation technique and it is found that there is positive and statistically significant effect of FDI on GDP.

The important components such as labor productivity and export are also used as control variables in a different estimation model. They exhibit positive coefficients as expected. The core questions about which sector have leading impacts upon GDP is analyzed with a pooled panel estimation technique. The results are ambiguous in terms of individual sector specified analyses.

There are some limitations in this study though, such as the time interval in the data set spans only ten years. This is mainly because there is no data available for all sectors for the longer periods of time and, second, although there was data, this study with the longer periods of time would raise the structural break issue in our analyses. It is possible to analyze this issue though; however this would widen the study further. In this study, we would like to only focus on our main consideration, specifically the level affect of FDI stock and productivity on GDP as well as causality between these two variables.

The following section gives an overview of previous empirical studies and discusses the key findings. In section 3, the basic theoretical background for this study will be explained, and then the description of the model specification will be addressed, which is one of the essential parts of this study. Section 4 will describe the data and explain the econometric methodology in subsections. Empirical findings and the results will be reported in section 5. Finally in section 6, we will conclude our study and give plausible motivation for further studies, along with some implications that might be considered by policy makers.

## **2 Reviews of Empirical Studies**

This section will briefly review a number of key empirical studies. The impact of FDI on economic growth is documented in several of studies, however, single country studies on the sectoral level FDI effects on economies have not been given much attention due to lack of proper data availability. The consensuses of most studies are that the effect of FDI on GDP is positive in the long-run. However, when country specification is considered, the results become more open to discussion. The studies on the impact of FDI on economic growth at country level make unrealistically strong homogeneity assumptions. Although some groups of countries, such as EU member states, OECD countries, developing and developed countries have common characteristics, in reality they are significantly heterogeneous in many aspects. Thus, there is the need to investigate the individual country at the sectoral level in order to observe the real impact of FDI on economic growth and further analyze which sector has more influence on the country's economy. For instance, the service sector can be leading in India while the manufacture sector might be much stronger in Turkey. In this respect, it is conceivable that studies on single-country perspective are deemed necessary for more concentration from researchers.

This study proposes an empirical analysis, with models presented by Basu, et al. (2003) and Khan, A.M. & Khan, S.A. (2011) in their studies.

Basu, et al. (2003) have studied both long-run and short-run relationships between FDI and GDP by using Panel Cointegration, Vector Error Correction (VEC) and Granger Causality on 23 developing countries over an 18 year period. They argue that, despite several empirical studies concerning the effect of FDI on growth, there is no serious attempt to analyze the two-way link between GDP and FDI. In particular they explain that, the two-way link between FDI and GDP stems from the fact that increased FDI flow promotes growth in host countries, whereas high growth rate prospects in the host country attract FDI flow (Basu, et al. 2003). They have even considered open and closed economy dynamics and found that there is positive long-run relationship between FDI and GDP. However, when they measured the direction of causality of GDP and FDI they found that the long-run causality mainly runs from GDP growth to FDI in the closed economies. In contrast, in the open economies the causality exhibits bidirectional nature over both the long and short-run. In this study we have considered similar matter for Turkey and conducted panel cointegration and Granger causality analyses in order to light this particular issue.

Khan, A.M. & Khan, S.A. (2011) have examined the impact of FDI on economic growth at the sectoral level in Pakistan. They applied panel cointegration and granger causality tests to 23 industries over the period of 1981-2008. They have also used dynamic OLS methods to form a comparison with the other methods. The greatest difficulties in their studies emerged due to the lack of data at the sectoral level.

They have found a positive long-run relationship between FDI and GDP. However, they observed that, despite of the generous conditions are offered in order to attract FDI, there is still insignificant level of FDI inflows. Furthermore, the FDI inflow that country has received could not be utilized sufficiently. These conclusions confirm the fact that the consensus positive effect of FDI on growth with strong homogenous assumption on country level might be imperfect. As Chakraborty and Nunnenkamp (2008) point it out that the type of FDI and its structural compositions play significant role on economic growth. In many previous studies the type of FDI and its structures are assumed to be homogenous on

country level. On the subject of the effect of FDI on growth studies in literature, their research is one of the few work for a single country at the sectoral level.

Further they have found that the causality in the long-run between FDI and GDP is evidently unidirectional. In contrast, in the short-run null of “*no short-run causality*” between FDI to GDP and vice versa is rejected in favor of strong short-run causality between them.

Another study for a single country at the sectoral level has been carried out by Mathiyazhagan, M.K. (2005) for India. He has collected data for 9 sectors between 1990 and 2000. He studied the long-run relationship between Foreign Direct Investment (FDI), Gross Output (GO), Export (EX) and Labor Productivity (LPR) by using panel Cointegration techniques.

His analytical models include OLS (FMOLS), Dynamic OLS (DOLS) and Panel group (FMOLS). He examines the individual effect of sectors on Foreign Direct Investment Inflow (FDII) by using different OLS methods and then he tests the long-run relations by applying panel cointegration methodology. The FMOLS result shows that FDI and GO appear to be positively cointegrated, however his results suggest a negative relationship between FDI and Export. According the empirical result, FDI pushed up the labor productivity in sector Food Processing (FP) and Industrial Machinery (IN). With OLS (DOLS) on the other hand, it is found that FDI has a positive relationship with other control variables such as export, labor productivity and gross output (GO). After running Panel Cointegration he found a weak relationship between FDI and the explanatory variables; GO, EX and LPR.

Sen, C. (2011) has taken another aspect of single country sectoral level studies in India. He has investigated service-led growth in India by using data running between 1970 and 2008 on major sectors with 114 observations. He has used time series data and constructed models where GDP is a dependent variable and FDI, service (SER), Agriculture (AGRI) and Industrial sector (IND) are explanatory variables. Then he constructed other models where FDI and service sector (SER) are dependent variables. Concerning the model where service sector (SER) modeled as a dependent variable, the results show that control variable FDI in the service sector in India has been significant and has a positive effect on economic growth. As Sen, C. (2011) cited in his study, Clark (1940), Kuznets (1957) and Cheney (1960)

demonstrate that service-led growth is a common phenomenon in terms of economic growth theory. The general evidence suggests that service-led growth has been associated with the tertiary phase of growth; however, in India the manufacturing sector and the service sector are independent from each other (Sen, C. 2011). Again according to Sen, C. (2011), the major drawback comes from Gordon and Gupta (2003), as they suggest that the service sector growth largely remains jobless, and has not been able to push up the employment rate.

Nair-Reichert, U. and D. Weinhold (2001) have taken one step further and made an unrealistic homogeneity assumption. They have taken into consideration 24 developing countries over a time period of 25 years. They examine the contemporaneous correlation of FDI and GDP growth and test Granger causality between FDI and GDP. They have proposed a different panel data approach by imposing mixed, fixed and random effects (MFR). By applying this method, they attempt to catch the heterogeneity in the causal relationship between FDI and economic growth. Their study differs from traditionally panel estimators because Mixed, Fixed and Random (MFR) effects exhibit substantially different results. Their study confirms that there is strong evidence for heterogeneity among the 24 developing countries. The traditional panel data estimations imposed homogeneity assumptions in order to measure the magnitude of the effect of FDI on economic growth. They draw a clear line, namely that incorrectly imposing such a strong assumption on the data might lead to biased estimates and faulty policy implications (Weinhold, et al. 2001).

Another Country level study concerning the impact of FDI on economic growth has been carried out by Ma (2009). In this particular study, she used data which covered the years between 1985 and 2008. It is shown that China has exhibited FDI-led economic growth; however FDI has not contributed to productivity. Similar results have been found on sector level studies by authors such as Sjöholm (2008).

In a nutshell, although the consensus of the empirical studies shows a positive effect of FDI on economic growth in homogeneous country groups, there are however some contradictions when it comes to the single country and sector level study. Due to heterogeneity among the countries, Weinhold, et al. (2001) emphasized the importance of single country studies. Although, it is not much enough, single country studies about the

effect of FDI on growth start to increase. In this respect, this study will contribute one aspect of this case by studying a single country at the sectoral level. To sum up this section, the selected empirical studies are reported in table 1<sup>1</sup>.

*Table 1: Summary of Previous Empirical Studies*

Study	Method and Data	Model Specification		Findings
		Dependent Variables	Control Variables	
Basu, et al. (2003) 23 Developing countries, 18 years. 414 Obs. Unbalanced data.	Panel Cointegration, VEC, Granger Causality, (short –run & Long-run relation)	FDI	GDP	Using open economy and closed economy specification, there is long-run relationship between FDI and GDP. Long-run causality from GDP to FDI in closed economies. Bidirectional causality both short and long-run. FDI can lead permanent change in GDP.
Khan, A.M. & Khan, S.A. (2011). Pakistan, 23 Industries and 27 years. Total 621 obs.	Panel Cointegration, Error Correction, Granger Causality and DOLS.	Log GDP	Log FDI Where i=23 sectors and t= 27 years.	Positive relationship between GDP & FDI. Long-run uni-directional causality between FDI and GDP.  Uni-directional causality found between Service sector and GDP.
Mathiyazhagan, M.K. (2005). India, 9 sectors and 10 years. Total 90 obs.	OLS (FMOLS), OLS (DOLS), Panel Cointegration.	FDI Inflow to sectors “i”	There are three sectors specific: Gross Output, Export, and Labor Productivity.	Positive Relationship between FDI and Labor Productivity and Export in some sectors. Very minimal positive relations between FDI and controls in sectoral levels.
Nair-Reichert, U. and D. Weinhold. (2001). 24 developing Countries, 25 years. Total 600 obs.	Panel Regression, Granger Causality. (Mixed Fixed and Random Effect)	GDP Growth rate,	FDI Growth rate, EXPORT Growth rate, INFLATION Growth rate, HUMAN capital, OPEN.	Positive effect of FDI on GDP Growth with traditional Panel under homogeneity assumption. Causality between FDI and GDP is varies across the country. Author hesitates to draw strong line though due to strong assumption of homogeneity.

<sup>1</sup> Source: Own construction

### **3 Theoretical Framework and Empirical Model Specifications**

This section will start with a brief theoretical background, and then testable empirical models will be derived, which are explicitly based on the given theoretical frameworks.

In this study the impact of FDI on GDP has been analyzed. The analysis is based on a number of different economic theories, which justifies why FDI is regarded as an important catalyst for growth in a host country. There are two main streams in the literature regarding the relevant economic growth theory. Firstly, Solow- Swan (1956) posit the neo-classical economic theory, which is an extension of the Harrod-Domar Growth model, where economic long-run growth is not explained as a function of capital and labor input, rather, it is in the residuals and can be explained with only exogenous technological progress. In this type of economic growth model, capital is said to be “widening” due to physical capital stock accumulation.

The new theories of growth, mainly pioneered by Romer (1990) and Aghion & Howitt (1992) however, consider the technological progress endogenously on the right hand side of the production function. In this type of economic growth model, capital is said to be “deepening” due to the improvement of existing technology or the invention of completely new types of capital and goods. We will examine the theoretical specifications of these theories a later section. Therefore, before going into detail, it is convenient to give a brief explanation about how FDI is defined and how it is linked to capital accumulation and technological change, as well as what the transmissions channels are.

Neuhaus (2006, pp. 42-43) refers to the OECD, which has provided a broad definition of FDI (“OECD Benchmark definition of FDI”, 1999, p. 7): “FDI reflects the objective of obtaining a lasting interest by a resident entity in one economy (direct investor) in an entity resident in an economy other than that of the investor (direct investment enterprise). The lasting interest implies the existence of a long-term relationship between the direct investor and the enterprise and a significant degree of influence on the management of the enterprise. Direct investment involves both the initial transaction between the two entities and all subsequent capital transactions between them and among affiliated enterprises, both incorporated and unincorporated.”

According to the OECD definition, FDI is simply a capital flow into a foreign country by the building of a production plant or the taking over of an existing production plant. This is a Foreign Investment for the host country. FDI has an impact on physical capital stock and spillover of technological progress throughout these two basic transmission channels; thus FDI generates the growth rate on output. In the first example, where foreign investors *directly* utilize new technologies and production plant in the host country, it is called “*green-field FDI*” whereas the latter is called “*brown-field FDI*”. Foreign investors set up either entire production chain or some sub-production of main production, also called vertical and horizontal FDI, respectively. Neuhaus (2006) states that, “Purchasing a *sufficiently high equity share* in a foreign company with the intention of building up a long-lasting relationship is also considered a foreign direct investment.”<sup>2</sup>

Another fundamental concept in this context is absorptive capacity. This factor plays a crucial role for the host country’s endowment of physical capital formation, human capital quality and importantly technological level. The magnitude of absorptive capacity can be captured by differences in the stage of development between the foreign country and host country (Fillat et al. 2009)<sup>3</sup>.

Another important aspect stated by De Backer et al. (2003). They argue that, “in line with theoretical occupational choice models that predict foreign direct investment would crowd out domestic entrepreneurs through their selections in product and labor markets”, thus, one should not neglect domestic investment and dispirit domestic entrepreneurs to enter the market or even stimulate them to exit.

### **3.1 Theoretical Specifications**

This section proposes a very general and brief outline for growth theory. For more detailed discussion on the theoretical background, we refer mainly to Aghion et al. (1992), Howitt (1998), Solow, R. M. (1956), Solow, Mankiw, N. G., D. Romer, and D. N. Weil (1992).

As has been mentioned earlier, there are two basic growth theories; one is neo-classical economic growth theory and second one is the new endogenous growth theory. However,

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<sup>2</sup> For detailed reading see Neuhaus, M. (2006).

<sup>3</sup> For further reading see Neuhaus, M. (2006)

the new endogenous growth theory will be distinguished in three growth paradigms. We now explain very briefly these “Four Growth Paradigms” all together in the same manner as Aghion et al. (1992). We start with pioneering growth theory, which has a very important role in the economic literature.

### 3.1.1 The Neoclassical Growth Theory

*“All theory depends on assumptions which are not quite true. That is what makes it theory.”*  
 -Robert M. Solow (1956).

To begin with, we look at the neo-classical paradigm on economic growth nexus. The key point of this model is that, it assumes only one commodity and the production of this good as a whole, defined  $Y_t$ . Some of this output is consumed and remainder is saved and invested. In order to produce this output, it is assumed that there is only labor ( $L$ ) and capital ( $K$ ), and level of technology ( $A$ ).  $L$  and  $A$  are assumed to grow exogenously at the rate of  $g$  and  $n$ . The production function is expressed as with Cobb-Douglas, where current flow of output is a function of the current stock of capital and labor; thus we arrive to very fundamental and important production function.

$$Y(t) = K(t)^\alpha (A(t) L(t))^{1-\alpha} \quad (1)$$

Where  $A_t$  is productivity and parameter  $\alpha$  is,  $0 < \alpha < 1$ .

The fraction of  $Y_t$  is saved thus; rate of saving can be defined as  $sY_t$ . Capital accumulation will be aggregate saving which is invested, and capital depreciation  $\delta K_t$ . The Net investment can be in this case just the rate of increase of capital stock  $dK/dt$  or denoted  $\Delta K$  and law of motion.

$$\Delta K = sY - \delta K \quad (2)$$

Where  $sY$  is aggregate saving and  $\delta K$  denotes aggregate depreciation of capital. In this benchmark model economic growth of per capita GDP  $Y/L$  cannot grow in the long- run unless we assume that labor productivity  $A$  grows over time, as Solow (1956) called this “technological progress” Aghion et al. (2009). In fact, “technological progress” emerges as an exogenous increasing factor of  $A_t$  and it is assumed to be changing at a constant rate:

$$A_{t+1} = (1+g) A_t \quad (3)$$

In equation (3)  $g$  is net growth rate of  $A_t$ , and given technological level is at some arbitrary initial level  $A_0$ , then in period  $t$  it would be  $A_t = (1+g)^t A_0$  and the approximate growth rate from (3), yields  $g_t^A = \ln(1+g) = g$ ; hence, technology according to this simple Solow growth model, connected with  $A_t$  and “Technological progress” with any increase in  $A_t$ . However,  $A_t$  is not any input in the production function (1) rather, it has a residual interpretation as comprising of all unexplained other factors. Any positive increasing  $g$  in equation (3) corresponds to progressively advancing “technological progress” that comes exogenously.

Considering Cobb-Douglas production function given in equation (1), we can now derive the definition of the output per worker  $y_t = Y_t/L_t$  and capital per worker  $k_t = K_t/L_t$  in line with the basic Solow model, that in turn derives the “per capita production function”

$$y_t = k_t^\alpha A_t^{1-\alpha} \quad (4)$$

It is noted that, in equation (5) capital per productive labor unit is derived instead of capital per worker<sup>4</sup>.

$$\frac{K(t)}{L(t) A(t)} \quad (5)$$

Similarly, we also note that output per productive labor is;

$$\frac{Y(t)}{L(t) A(t)} \quad (6)$$

Or after a couple of rearrangements, it can be written as:

$$\frac{d}{dt} k(t) = s f(k) - (g + n + \delta) k(t) \quad (7)$$

Equation (7) explains the motion of capital in the Solow Growth Model and proposes that capital will increase/decrease when the amount of savings  $s f(k)$  is greater/smaller than the combined cost of technology growth  $g k(t)$ , labor (population) growth  $n k(t)$  and depreciation of capital  $\delta k(t)$ .

Subsequently, taking logs and time differences of (4), yields:

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<sup>4</sup> In empirical growth studies these two different terms are used synonymously See Mankiw, Romer, and Weil (1992) and Neuhaus, M. (2006).

$$\ln y_t - y_{t-1} = \alpha(\ln k_t - \ln k_{t-1}) + (1-\alpha)(\ln A_t - \ln A_{t-1}) \quad (8)$$

Alternatively, the general notation for the approximate growth rate is:

$$g_t^Y = a g_t^k + (1-a) g_t^A \quad (9)$$

Equation (9) reveals the core proposal of the Solow (1956) Neo-classic Growth Theory Model which says that any increase in output growth ( $g^Y$ ) can be obtained in only two ways: capital accumulation and “technological progress” Sørensen et al. (2010, pp. 57-211).<sup>5</sup>

### 3.1.2 The AK Model

The first paradigm of endogenous growth theory is the AK model. What we have seen in the neo-classical growth model is that growth appears exogenously via the production function. In contrast, in the AK paradigm, growth rate is assumed to be endogenous. This model argues that as in the Solow (1956) model, when “technological progress” has been taken place, there is no need to assume this new progress will diminish. Thus, with the physical capital accumulation, human capital and intellectual capital also will be accumulated. In other words the AK model does not make any explicit distinction between capital accumulation and technological progress. With a more formal expression, AK model is said to be the neo-classical model without diminishing returns Aghion et al. (1992, pp. 47-68)<sup>6</sup>.

### 3.1.3 The Product-Variety Model

The second wave of endogenous growth theory is the product-variety model, which was proposed by Romer (1990) and is based upon “innovation”. This theory suggests that “innovation” in an economy creates new products and technology, which in return causes the aggregate productivity in an economy. This theory is generally linked to the international trade theory. Hartwig (2009) argues that considering the international trade theory, specialization in an economy can be increased by allocating more labor to R&D, which induces new intermediate products, human capital productivity and physical capital deepening and also technology spillovers through the FDI in an economy; hence, final

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<sup>5</sup> For the complete general Solow Model derivation see Solow, R. M. (1956), Neuhaus, M. (2006), Sørensen et al. (2010), Aghion et al (1992), Mankiw, N. G., D. Romer, and D. N. Weil (1992).

<sup>6</sup> For further discussion see Solow, R. M. (1956), Aghion et al (1992), Neuhaus, M. (2006).

production in an economy increases. Thus increased product variety is what sustains growth in this model (Howitt et al. 2009, pp.14-15)<sup>7</sup>.

### **3.1.4 The Schumpeterian Model**

The fourth and final paradigm is the Schumpeterian Model, which is constituted by Aghion and Howitt (1992). The theory is a different version of the innovation-based Product-variety model. Although, these two theories appear similar in the sense that they both consider the R&D activities concerning new innovations and products, the Schumpeterian theory concentrates on “*quality-improving*” innovations rather than new innovation. The Product-Variety Paradigm suggests that GDP growth is determined by the aggregate productivity, and does not take into account “*creative destruction*”. The Schumpeterian growth theory, however, mainly argues that “*quality-improving*” innovations enable the improvement of new productions and make obsolete the old products, in line with what Schumpeterian theory termed “*creative destruction*”. Similar to the previous discussion, through the transition channels, country with advanced R&D and innovation, bring these technologies through the FDI into the host country which induces the spillover effect; thus productivity and finally economic growth<sup>8</sup>.

## **3.2 Empirical Model Specification**

Now we are ready to specify explicitly our testable econometric regression models based upon the theoretical background that is explained in the previous section. In order to analyse the effects of FDI on economic growth in Turkey, we follow the work of Basu et al. (2003), Mathiyazhagan, M.K (2005), and Chakraborty and Nunnenkamp (2008).

We start with an uncomplicated level effect of FDI stock on GDP. It should be noted that, in this study the main consideration is the long-run impact of FDI on GDP at a steady state level. It is also noted that in this study we use FDI stock, rather than FDI flow to measure foreign-owned capital stock. Taking logs on both sides of the production function (1) as with equation (8) and denoting the variables in accordance in our data set respectively, allows us to derive the first benchmark econometric regression function. By taking logarithms, the

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<sup>7</sup> For detail discussion see Romer (1990), Howitt et al. (2009, pp. 69-82).

<sup>8</sup> For further discussion see Howitt et al. (2009, pp. 69-82).

coefficients become elasticity. Thus the first benchmark testable econometric specification is:

$$\log \text{GDP}_{it} = \alpha_i + \beta \log \text{FDI}_{it} + \varepsilon_{it} \quad (\text{Benchmark Model 1}) \quad (10)$$

Where  $\log \text{GDP}_{it}$  is the logarithm of GDP in constant prices in sectors  $i$  at time  $t$ ,  $\log \text{FDI}_{it}$  is inward FDI stock, the coefficient  $\beta$  is the output elasticity of the factor inputs, and  $\varepsilon$  is the error term.

With this benchmark regression model, we would like to analyse whether the log of FDI stock has an impact on GDP in log level. The magnitude of impact of inward FDI stock is measured with  $\beta$  and we expect  $\beta$  to be positive, however, due to heterogeneity among the sectors, the magnitude of coefficient might exhibit an ambiguous result on sector-based analysis. One of the factors of FDI that has an impact on GDP growth is convergence. This phenomenon is a comprehensive subject in the literature, which claims that developing countries have faster growth rates than developed countries. Due to different economic states between developed and developing countries, increasing a unit of physical FDI stock in the host country induces higher growth rate than what it does in developed countries. This is because diminishing return of capital in developing countries is lower compare to developed countries; hence, marginal product of capital is higher than developed countries. In addition, this catching-up mechanisms necessitate an absorptive capacity in developing countries.

Since we do not have other variables, but only foreign capital stock (FDI) in this particular model, the magnitude of all other factors that have impact on growth will be collected in the error term. In particularly, it should be noted that domestic investment and its residuals will appear in the error term. Ideally, domestic investments are essential to be controlled in this particular model in order to isolate technological effect from both type of investment. Subsequently, it would be much more convenient to interpret the residuals as “technological progress”. Unfortunately there is no available statistic which accounts the domestic investment or technological growth at the sectoral level for Turkey.

Balasubramanyam et al. (1996) argue that, FDI is regarded as the prime source of human capital, and new technology transfer to the developing countries. They further explain that

this variable is commonly included in production function in order to capture factors such as learning-by-doing and spillover effect in addition to total capital accumulation and TFP, which are linked to the FDI.

We are aware though, that some researchers, such as Diana et al. (2001), are interested in approaching this question from a different perspective, and provide the answer to the question as to whether the changes in the share of FDI in one period lead to changes in GDP growth in a subsequent period. The model specifically measures whether an increase in FDI growth will lead an increase in GDP growth. This would be the dynamic growth rate model, which is less constrained than the direct equivalent of the level version (Diana et.al 2001, pp. 158-163). It is also noted that we use LogFDI rather the LogFDI/logGDP ratio like Grangnes et al. (2007) did in their studies for China and Vietnam. In general, researchers like Weinhold (2001) are using the logFDI-to-logGDP ratio because FDI is itself regarded as a component of GDP via the national income accounting identity; thus this part might be endogenous to GDP. However, they do not take Export-to-GDP or Import-to-GDP ratios, which are also components of GDP. Thus, using logFDI in this study is considered a relatively trivial concern.

In the second specification, we have included labor productivity. Adding this component in the benchmark model, we will enable us to measure the absorption capacity. In some sense, this is very difficult factor to measure when it comes to the sectoral level analyses. First of all, there is not accurate data available at the sectoral level. Second, the data available is useful to calculate the GDP per worker but, in many studies the GDP hours worked is the preferred proxy. This component appears as an independent variable in this particular model and has a significant importance of comprehensible impact of FDI on growth. As FDI stock increases, the labour productivity is expected to increase due to spillover effect, thus the marginal cost decreases which in turn attracts the FDI inflow. This factor has crucial role and has been subjected to many empirical studies. In the literature, different studies have used different proxies to capture the effect of this factor however, schooling and educational attainment are the most common proxy which are generally applied.

The coefficient  $\beta_2$  will measure the magnitude of absorption effect and it is expected to be positive, however, at the sectoral-specific analysis, the results can be ambiguous. Hence, we arrive to our next regression model with variable labor productivity is as follows:

$$\text{Log GDP}_{it} = \beta_0 + \beta_1 \log \text{FDI}_{it} + \beta_2 \log \text{LPR}_{it} + \varepsilon_{it} \quad (\text{Model 2}) \quad (11)$$

In the third specification, we have added export in line with section 3.1.3. In addition to section 3.1.3., export is regarded one of the proxies which indicates countries openness. One of the stunning examples in regard to the positive effect of openness on economic development is China. China, as well as India has shown tremendous growth rate since they have started to open their doors to the foreign direct investors. Additionally, Howitt et al. (2009) and Balasubramanyam et al. (1996) refer to Salvatore and Hatcher (1991), where they explain why exports are explicitly exert into the production function. It is argued that exports are likely to alleviate serious foreign exchange constraints and can thereby provide greater access to international markets. Furthermore, exports as well as FDI are expected to cause spillover affects through the high rate of technological innovation and dynamic learning from abroad.

In this particular model,  $\beta_3$  capture the magnitude of effect of export on GDP. It is expected again that there will be a positive coefficient however; results at the individual sectoral level analysis can change significantly. It should be mentioned that Turkey has been known to be an agricultural export oriented country for a relatively long time, however, after increasing FDI inflow, this might shift to other sectors. The third economic regression model is designed to analyse these topics as has been explained above.

$$\text{Log GDP}_{it} = \beta_0 + \beta_1 \log \text{FDI}_{it} + \beta_2 \log \text{LPR}_{it} + \beta_3 \log \text{XPR}_{it} + \varepsilon_{it} \quad (\text{Model 3}) \quad (12)$$

In addition, it is of interest of the study to figure out whether FDI has an impact on labor productivity. This will reveal how FDI stocks contribute the capital deepening. It is also important to answer whether export contributes the labour productivity. The positive coefficients would confirm the benchmark theoretical statement in 3.1.1., that the effect of “technological progress” exhibits economic growth. For these purposes, the dependent variable is now chosen as LogLPR. The positive coefficients can be interpreted as the spillover effect, hence the fourth empirical model becomes:

$$\log LPR_{it} = \beta_0 + \beta_1 \log FDI_{it} + \varepsilon_{it} \quad (\text{Model 4}) \quad (13)$$

In the same vein, we add the export variable to see whether the spillover effect has a positive correlation with export activities in the economy (see section 3.1.3).

$$\log LPR_{it} = \beta_0 + \beta_1 \log FDI_{it} + \beta_3 \log XPR_{it} + \varepsilon_{it} \quad (\text{Model 5}) \quad (14)$$

The second type of methodology that has been used in this study is causality. For simple purposes, it is reasonable to answer a couple of questions. First, is there short-run Granger causality between FDI and GDP in Turkey? Second, if so, what is the direction of causality? In order to answer and analyse these issues, we need to form a different kind of methodology, which is explained in section 4.2.4.

In order to analyse the granger causality, the Arellano-Bond Dynamic panel-data estimation, with one-step system GMM estimation technique, has been applied with the following models.

$$\text{LogdGDP}_{i,t} = \alpha_i + \gamma_i \text{LogdGDP}_{i,t-1} + \gamma_i \text{LogdGDP}_{i,t-2} + \beta_i \text{LogdFDI}_{i,t-1} + \beta_i \text{LogdFDI}_{i,t-2} + \varepsilon_{i,t} \quad (\text{Model 6}) \quad (15)$$

$$\text{LogdFDI}_{i,t} = \alpha_i + \gamma_i \text{LogdFDI}_{i,t-1} + \gamma_i \text{LogdFDI}_{i,t-2} + \beta_i \text{LogdGDP}_{i,t-1} + \beta_i \text{LogdGDP}_{i,t-2} + \varepsilon_{i,t} \quad (\text{Model 7}) \quad (16)$$

In model 6 (15), LogGDP is the dependent variable and LogFDI is tested in order to determine whether it causes logGDP, and in the same manner, we apply the same test vice versa to model 7 (16). The interesting questions for these models are: does FDI cause GDP growth in Turkey, or does good economic growth performance attract the FDI?

Basu, et al. (2003) explained the apparatus of the two-way link between FDI and GDP (see section 2). They have argued that this two-way linkage between FDI and GDP has not been analyzed to great extent in the literature. In this respect, it is convincing that this study gain additional windfall with this particular contribution.

The following five models have the final, but also the heart of proposals for this study. The aim for these models is the same as has been explained in detail previously. By following

these models, we are going to specify individual sector levels coefficients in order to capture sectoral-specific effects.

For the similar purposes we have proceeded to the Pooled EGLS econometric methodology. A brief technical background is given in section 4.2.5. The empirical regression models are:

$$\text{Log GDP}_{it} = \alpha_i + \beta_i \log \text{FDI}_{it} + \varepsilon_{it} \quad (\text{Models 8}) \quad (17)$$

$$\text{Log GDP}_{it} = \alpha_i + \beta_i \log \text{LPR}_{it} + \varepsilon_{it} \quad (\text{Models 9}) \quad (18)$$

$$\text{Log GDP}_{it} = \alpha_i + \beta_i \log \text{XPR}_{it} + \varepsilon_{it} \quad (\text{Models 10}) \quad (19)$$

$$\log \text{LPR}_{it} = \alpha_i + \beta_1 \log \text{FDI}_{it} + \varepsilon_{it} \quad (\text{Models 11}) \quad (20)$$

$$\log \text{LPR}_{it} = \alpha_i + \beta_3 \log \text{XPR}_{it} + \varepsilon_{it} \quad (\text{Models 12}) \quad (21)$$

Where,  $i = \text{AGR, COMM, CON, EGW, EHS, FINB, HRS, MAN, MIN, WHS}$  and  $t = (2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009)$

From model 8 to model 10 we have pooled three explanatory variables independently where logGDP were being dependent variable and measured the coefficients of 10 sectors individually. With models 11 and 12 we have proceed the same methodology in order to capture the individual sector-specific coefficients. It should be noted that in models 1 to 5 we have common coefficients for there control variables, whereas in model from 8 to 12 we measure the coefficients for each sectors of each control variable independently.

The expected coefficients for these models are ambiguous. It will clearly vary between sectors and variables. The result will also indicate which sector has more influence on the Turkish economy. The result for these empirical models will lead to a better understanding of the characteristics of Turkish economy and also informative for the policy makers in order to make policy on which sectors need to be considered substantial for FDI inflow.

The summary of the model specifications and an expected sign of coefficients are presented in table 2<sup>9</sup>.

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<sup>9</sup> Source: Own construction

Table 2: Summary of Model Specifications

<u>Models</u>	<u>Dependent Variables</u>	<u>Independent Variables</u>		
Model 1	$\text{Log GDP}_{it}$	$\text{logFDI}_{it}$ (+)		
Model 2	$\text{Log GDP}_{it}$	$\text{logFDI}_{it}$ (+)	$\text{logLPR}_{it}$ (+)	
Model 3	$\text{Log GDP}_{it}$	$\text{logFDI}_{it}$ (+)	$\text{logLPR}_{it}$ (+)	$\text{logXPR}_{it}$ (+)
Model 4	$\text{Log LPR}_{it}$	$\text{logFDI}_{it}$ (+)		
Model 5	$\text{Log LPR}_{it}$	$\text{logFDI}_{it}$ (+)	$\text{logXPR}_{it}$ (+)	
Model 6	$\text{LogdGDP}_{i,t}$	$\text{LogdGDP}_{i,t-1}$ ; $\text{LogdGDP}_{i,t-2}$ ; $\text{LogdFDI}_{i,t-1}$ ; $\text{LogdFDI}_{i,t-2}$		
Model 7	$\text{LogdFDI}_{i,t}$	$\text{LogdFDI}_{i,t-1}$ ; $\text{LogdFDI}_{i,t-2}$ ; $\text{LogdGDP}_{i,t-1}$ ; $\text{LogdGDP}_{i,t-2}$		
Model 8	$\text{Log GDP}_{it}$	$\text{logFDI}_{it}$	<i>Pooled in Sectors:</i> <i>i</i> = AGR, COMM, CON, EGW, EHS, FINB, HRS, MAN, MIN, WHS. Signs are ambiguous; (+) / (-)	
Model 9	$\text{Log GDP}_{it}$	$\text{logLPR}_{it}$		
Model 10	$\text{Log GDP}_{it}$	$\text{logXPR}_{it}$		
Model 11	$\text{Log LPR}_{it}$	$\text{logFDI}_{it}$		
Model 12	$\text{Log LPR}_{it}$	$\text{logXPR}_{it}$		

Notes: The expected coefficient signs are in parenthesis.

## 4 Data and Methodology

Most of the studies of the relations between FDI and GDP have focused on macro level country-wise data, or a group of homogenous country groups such as the OECD, EU, developed and developing countries, etc., due to the best comparable data available at this level.

Most recently, sector level data series have been released and studies on sector level for single countries have started to increase. In this study panel data techniques have been used. Due to its more powerful characteristics to compare to a single cross-section or a single time-series, the panel data method has become increasingly common in macro economic analysis. We will give a detailed overview of this method in section 4.2.1.

### 4.1 Data

In order to assess the linkage between GDP and FDI, we have constructed a panel for 10 sectors between periods of year 2000 and 2009, with a total 100 observations. Although

there was no longer data available, choosing a wide span time would raise the structural break issue in our data set. The detailed breakdown of sectors is given in appendix A.

The most challenging part for this thesis was, however, of finding and collection of the appropriate data. Sector-specific data on FDI with constant prices or with the appropriate deflator and the amount of hours worked as labor input measure were not found. One of the major sources for the data was TURKSTAT which has carried out data collection in Turkey since 1998. However we found some difficulties while we obtain the data from this source. For instance the links to the data location in web-based data sources have errors and they have not been directed to the correct location. Under the National account section, one can seek constant GDP prices by main economic activity, but it may appear irrelevant page. Some data are not clear whether they are reported with constant price or current price. Further, we have experienced lack of labeling where we were not able to identify the data if they indicate the flow or stock, thus we needed to contact the department to clarify these issues. Another considerable issue is that the values in data can change frequently. It is explained that they make revision at a certain time period that could change the values, alas they did not notice it on the data source. Consequently we could not get perfect data in order to proceed with what we really wanted to attain. However, we have taken the latest obtainable data from the respective data sources, and clarified them. And now will do the best we can with the available data in order to come to a reasonable conclusion. Despite these issues, the data we have collected and then clarified can now be used for the analyses, though we will take appropriate caution when interpreting the results. In this context, as far as we know, this study is the first attempt for a single country study on sectoral level data for Turkey. However, due to data insufficiency we are aware of the possibility of bias in the results. Hopefully better data collection in the future will make it possible to repeat this study more accurately.

#### **4.1.1 Data Sources and Descriptions**

The sectoral level data in this study has been collected from three main sources. Gross Domestic Product (GDP), Export (XPR) have been collected from *Turkish Statistical Institute* (TurkStat), foreign Direct Investment (FDI) from *The Central Bank of the Republic of Turkey* (CBRT), and Labor Productivity (LPR) from the *Organization for Economic Co-operation and Development's* (OECD) STAN indicators.

Real GDP, by kind of economic activity is reported in Turkish domestic currency, the TL (Turkish Lira). The data is available in TURKSTAT under the section *“Gross Domestic Product in constant prices-By kind of economic activity in basic prices”*<sup>10</sup>.

The Data for *Export* by sector, in accordance with the ISIC, Rev.3, is also available from TURKSTAT and is reported in thousands of US Dollar in current prices. A export deflator or export price index, which covered all sectors from 2000 to 2009 were not provided, thus, we have to transform the data to constant prices by using a GDP deflator.

The data for FDI is taken from Central Bank of the Republic of Turkey (CBRT) under the data selection section, which enables us to choose annually FDI inward stock by sectors and it is reported in current prices in millions of US Dollars<sup>11</sup>. It is difficult to obtain an appropriate common deflator in order to transform the data to constant prices; however, the transformation has been conducted with a GDP deflator by our own calculation, which soon after will be presented.

Despite of missing one year’s observation, we have found reliable real Labor Productivity (LPR) data via the OECD STAN indicators. According to the OECD explanation, these values are calculated as the ratio of value added volumes to the number engaged. GDP per person engaged is obtained by dividing GDP by employment. It is one of the measures of labor productivity. Although hours worked would be preferable as a measure of labor input, at the present time, consistent hours worked data at the industry level are not available in STAN Database for all OECD countries. Series for this indicator are presented as indices, data for the reference year for Turkey is taken to be 2000 = 100 (source OECD).

We also needed annual currency exchange rate and GDP deflator in order to carry out data transformation process, thus we have collected GDP deflator from World Bank indicators<sup>12</sup>. The currency exchange rates, of national units per US-Dollar (monthly average) have been collected from OECD databank. According to OECD these data are calculated by the OECD as averages of daily interbank rates on national markets of daily closing rates<sup>13</sup>.

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<sup>10</sup>Source: [http://www.turkstat.gov.tr/PrelstatistikTablo.do?istab\\_id=993](http://www.turkstat.gov.tr/PrelstatistikTablo.do?istab_id=993)

<sup>11</sup> Source: <http://evds.tcmb.gov.tr/yeni/cbt-uk.html>

<sup>12</sup> Source: <http://databank.worldbank.org/ddp/home.do?Step=3&id=4>

<sup>13</sup> Source: <http://stats.oecd.org/Index.aspx?QueryId=169#>

In the second step, the transformation process has been carried out. Since GDP is reported in constant prices, we did not transform this data other than by taking natural logarithms. Furthermore, FDI and XPR were given in a different currencies and units, thus, they needed to be transformed into the same unit and currency. As we have mentioned before, there is no appropriate deflator for FDI or XPR available, however we have used a common GDP deflator in order to transform these data into constant prices. These transformations have been processed in three steps: since FDI and XPR are reported in current USDs, we first had to multiply FDI and XPR by the currency exchange rate that we have extracted from the OECD, and then divided by a GDP derived common deflator in order obtain constant prices in TL, and finally they are taken of the logarithm. However, Turkish Lira had been adjusted in 2005, and this caused some measurement issues, which should be explained. According to the OECD's explanation, "On 01/Jan/2005 the New Turkish Lira (TRY) was introduced, replacing the Turkish Lira (TRL). This was achieved by taking six zeros off: i.e. TRY = TRL divided by 1 million". OECD states that, "in theory, this should not change any of the statistics except to move the decimal point". However, the OECD has reported the adjusted currency, so we do not need to consider this in any great detail. After converting FDI and XPR data from USD to TL into constant prices, they are taken as logarithms.

Due to the mismatch between some sectors concerning GDP, FDI, EXPORT and LPR, we needed to merge certain sectors under a single sector and give it a new variable name. We did not want to drop out mismatched data due to the limited data available, because we do not want to lose valuable information.

Agriculture, forestry and fishing were collected under *agriculture* (AGR); financial intermediation and real estate, renting and business activities were collected under the new variable *Financing, Insurance and Business* (FINB); education, Health and social work and other community, social and personal service activities were collected under the new variable *Education Health and Social* (EHS). Public administration, defense and compulsory social security have been discarded due to the zero value over the selected time frame.

In the export variable, data for construction (CON), hotels and restaurants (HRS) and communication (COMM) sectors are missing, thus only 7 sectors are included. In variable

LPR, the data for year 2009 is missing, thus we have one year less data in terms of time series.

In sum, FDI, GDP, EXP and LPR have now been sorted under ISIC Rev.2. (International Standard Industrial Classification) standards and all variables: Gross Domestic Product, (GDP), Foreign Direct Investment (FDI), Export (XPR) and level labor productivity (LPR) are in logarithmic form in order to utilize for our panel data analyses. A summary of data sources, descriptions and transformation methods are reported in table 3<sup>14</sup>.

*Table 3: Summary of Data Sources and Descriptions*

Original Data	Sources	Transformation	Form of Variable
GDP, Constant Prices in TL.	TURKSTAT	No Transformation applied.	Log(GDP)
FDI Stock, Current Prices in USD.	CBRT	Converted to Constant prices in TL.	Log(FDI)
Export, Current Prices in USD.	TURKSTAT	Converted to Constant prices in TL.	Log(XPR)
Real Labor Productivity indices (output per engaged)	OECD	No Transformation applied.	Log(LPR)
Currency, National units per US-Dollar (monthly average)	OECD	N/A	N/A
GDP Deflator	WB	N/A	N/A

Notes: CBRT; *Central Bank of the Republic of Turkey*, TURKSTAT; *Turkish Statistical Institute*, OECD; *Organization for Economic Co-operation and Development*, WB; *World Bank*.

## 4.2 Methodology

In this section, a brief introduction of the empirical methodologies that are used in this study will be given. There are wide range econometric techniques in the literature. We will not attempt to give a deep account of these techniques as it is beyond the scope of this study; rather, we will concentrate on the basic intuition behind these theories for our purposes. Commonly, most of the macroeconomic series have been tested either with

<sup>14</sup> Source: Own construction

single time-series data analyses or single cross-section analyses. However, panel data analyses have become more and more popular in macro economic analyses. In this context panel data estimation, panel unit root, panel cointegration and panel Granger causality have become more widely used in the macroeconomic research area.

In this study we have mainly used panel data analyses. Following common procedure in the literature, we started with testing for panel unit root and panel cointegration. After the long-run relationship had been confirmed, we turned to panel Granger-Causality test. For this particular test we had to use the Arellano-Bond Dynamic panel-data estimation. Panel estimation methods with OLS are used to estimate the magnitude of coefficients of the three main variables. However, in order to specify each sector's coefficient, we needed to apply a pooled EGLS-LSDV estimation technique. In the following subsections, a brief description of these methods will be outlined.

#### **4.2.1 Panel Data**

Considering univariate models, it is generally known that if the variables contain a stochastic trend it is possible to remove it and make it stationary by taking first difference. Then the stationary variables can be estimated by applying Box- Jenkins techniques. However this is not straightforward in a multivariate approach such as in Panel data.

Panel data sets contain both time-series and cross-section data characteristics. And in this case contains repeated observations on the individual series over the limited time period. This repeated observation allows a researcher to analyze more complicated and more specific empirical models than what actually a single cross-section and time-series analyses allow (Verbeek, M. 2008). Baltagi (2000) points out some of the major advantages of adding a cross-section dimension into a time-series when testing for unit root and cointegration. He explains further that "the addition of the cross-section dimension, under certain assumptions can act as repeated draws from the distribution. Thus, as the time and cross-section dimension increase, panel test statistic and estimators can be derived that converge in distribution to normally distribute random variables." Further, he argues that, by applying a panel data method, it is possible to specify heterogeneity in individual member in panel data such as countries, regions and sectors. It also provides less collinearity among the variables and more degrees of freedom; thus offers more efficiency, which generally provides more reliable parameter results in estimation. Considering the limitation of the

panel, Baltagi (2001) states that panel data is usually difficult to design, and the collection of data might be inconvenient (Harris& Sollis 2005).

The time dimension of panel data is ( $t = 1, \dots, T$ ) and cross-section dimension is ( $i = 1, \dots, N$ ) where  $i$  can be specified countries or sectors. Thus, we can simply specify a standard linear panel data regression model as:

$$Y_{it} = \beta_0 + \mathbf{X}'_{it} \beta + \varepsilon_{it} \quad (22)$$

Where  $\mathbf{X}'_{it}$  is K dimensional vector of control variables. This model imposes that intercept  $\beta_0$  and slope  $\beta$  are common for all individual units ( $i$ ) and time periods ( $t$ ). The error term  $\varepsilon_{it}$  varies over the all individual units and time and collects the total unobservable factor that affects the dependent variable  $Y_{it}$ .

In Panel Models we assume that the errors are homoscedastic and serially independent, both within and between individuals that;  $\varepsilon_{it} = \alpha_i + U_{it}$  where  $U_{it}$  is assumed to be homoskedastic and not correlated over time, and  $\alpha_i$  is time invariant and homoskedastic across the individuals. The expected value  $E[X_{it} \varepsilon_{it}] = 0$  this means error terms are uncorrelated with explanatory variables. This model is called the **random effect model**.

In contrast to (22), when the constant terms  $\alpha_i$  is allowed to vary from individual to individual and exhibits different intercepts we specify our traditional panel data as:

$$y_{it} = \alpha_i + \mathbf{X}'_{it} \beta + U_{it} \quad (23)$$

Where ( $i = 1, \dots, N$ ) are fixed unknown constants and  $\beta$  is to be estimated and slope of  $\beta$  are the same for all individual units and also  $U_{it} \sim \text{IID}(0, \sigma_u^2)$ .

When  $\alpha_i$  is assumed to be variant among the explanatory variables, and every individual  $i$  would have its own intercept, then it is appropriate to assume that  $E[X_{it} \varepsilon_{it}] \neq 0$ ; this means that at least one of the explanatory variables in  $X_{it}$  is correlated with the error term  $\varepsilon_{it}$ . This is also known as a **fixed effect model**. The fixed-effect estimates rely on homogeneity among the individual members in panel to impose common slope in pooled regression. The fixed-effect estimator also reduces biases due to omitted variables (Mello 1999, pp. 145-146).

#### 4.2.2 Panel Unit Root

The theory behind ARMA estimation is based on a stationary time series. A series is regarded to be *stationary* if the mean and autocovariances of the series do not depend on time or contains a stochastic trend, also called *random walk*;

$$y_t = \phi y_{t-1} + \varepsilon_t \quad (24)$$

Where  $\varepsilon_t$  is white noise with variance  $\sigma^2$ . Equation (24) is AR(1) when  $\phi=1$ . Subtracting  $y_{t-1}$  from both sides we obtain the first difference that, changing in  $y_t$  depends only randomly change in error term.

$$y_t - y_{t-1} = \pi y_{t-1} + \varepsilon_t \quad (25)$$

Where it is assumed  $\phi=1$ , then  $\pi = (1 - \phi)$  which yields  $\pi=0$  hence we get:

$$\Delta y_t = \varepsilon_t \quad (26)$$

Variables with stochastic trends, but whose first differences contain no stochastic trends, are Integrated to Order One, written  $I(1)$  and it is said to be *nonstationary*. Variables that follow a *random walk* are integrated to order  $I(0)$ .

It is well known that many macroeconomic variables contain stochastic trends. Before proceeding panel data estimation and panel cointegration, one must consider potential spurious regressions and cointegration. Spurious regression occurs when the series share a common stochastic trend although they do not have any relation with each other whatsoever. A spurious regression is not valid and does not make any economical sense at all. In simple words they are nonsense.

Hence, It is imperative that one makes sure all series in the data sets contain the same order of integration  $I(1)$  before proceeding to a cointegration test.

There are a number of approaches to perform unit root tests in panel data and it is developing rapidly, and many software packages offer frequently used unit root tests in their programs. EViews software packages, which we use for our analysis, provide most of them.

In this section we will review a few of the suggested and most used unit root tests, which are used in this study and also available in EViews software packages.

*Levin and Lin (1992)* common unit root test specified following equation

$$y_{it} = \rho_i y_{it-1} + Z'_{it} \gamma + u_{it}, \quad i = 1, \dots, \text{ and } t = 1, \dots, T \quad (27)$$

Where  $Z'_{it}$  is the deterministic component and  $U_{it}$  is the stationary process.  $Z'_{it}$  could be zero, one the fixed effects,  $\mu_i$  or fixed effect as well as a time trend,  $t$ . The Levin and Lin (1992) test assumes that  $U_{it}$  are  $U_{it} \sim \text{IID}(0, \sigma_u^2)$ . Referring to the equation (27), LLC assume homogeneous autoregressive coefficients between individual  $\rho_i = \rho$  for all  $i$ .

The null Hypothesis specified as (unit root)  $H_0: \rho_i = 1$  for all  $i$  and,

The alternative Hypothesis specified as (stationary)  $H_1: \rho_i = \rho < 1$  for all  $i$

In particular the null hypothesis states that each individual time series contains a unit root against the alternative hypothesis that each time series is stationary. In order to confirm that series contains a unit root, we need to fail to reject the null hypothesis. In other words, rejection of the unit root null hypothesis can be interpreted as providing evidence in favor of stationary (Baltagi et. al 2000).

*The Fisher's type p-test*; Maddala and Wu (1999) and Choi (2001) designed the shortcomings of both the LLC and IPS panel unit root test frameworks and consider an alternative methodology. In order to test unit root in panel data, they propose the use of a non parametric Fisher-type test which is based on a combination of the p-values of the test-statistics for a unit root in each cross-sectional unit (the ADF test or other non stationarity tests); which is:

$$P = -2 \sum_{i=1}^n \ln p_i \quad (28)$$

It has  $\chi^2$  -distribution with  $2N$  degrees of freedom. It is the same procedure as IPS except the specification in (28). It tests the significance levels for rejecting the null for unit root instead of using  $t$ -test values.

The null hypothesis is:  $H_0: \rho_i = 1$  for all  $i$

That all the time series are unit root.

The alternative hypothesis is:  $H_1: \rho_i < 1$  at least one  $i$

Or some  $i$  is none stationary.

The advantages of the Fisher test is that the data does not need to be as balanced a panel as is required in the IPS test; second, the fisher test can utilize different lag lengths for the individual ADF regression and can be applied to any other unit root test (Barbieri, 2006). We summarize the most commonly used panel Unit root tests in table 4<sup>15</sup>.

Table 4: Summary of Panel Unit Root Tests Methods

Test	Null Hypothesis	Alternative Null	Deterministic Components*	Autocorrelation Corrections Method
Levin Lin & Chu	Unit Root	No Unit root	N, F, T	Lags
Breitung	Unit Root	No unit root	N, F, T	Lags
IPS	Unit Root	Some cross-section with unit root	N, F, T	Lags
Fisher-ADF	Unit Root	Some cross-section with unit root	N, F, T	Lags
Fisher- PP	Unit Root	Some cross-section with unit root	N, F, T	Kernel
Hadri	Stationary	Unit root	F, T	Kernel

\*N: No exogenous variables, F: Fixed effect, T: Individual effect and individual trend

### 4.2.3 Panel Cointegration

Considering a multivariate approach, it is quite likely that there might be a linear combination of integrated variables which this linear combination exhibits as stationary. Such variables are said to be *cointegrated* (Enders, W. 2009).

In many macroeconomics variables characterized as nonstationary I(1) such as GDP, Interest rate, Investment. These variables can meander on it is own path and would have no tendency to return to their long-run level. However there is a linear combination of these variables which is stationary. This relationship is the concept of *cointegration* and interpreted as the long-run relationship between these nonstationary variables (Enders, W. 2009).

<sup>15</sup> Source: EViews user guide: Table summarizes the basic characteristic Panel Unit Root test that available in EViews.

There are two basic approaches that have been developed for the panel cointegration tests. One is the residual-based two step cointegration test initially - developed by Engle and Granger (1987) - and the second is maximum-likelihood-based. Engle Granger 1987 considers, if the basic model in (22),  $Y_{it}$  and  $\mathbf{X}'_{it}$  both are  $I(1)$  and  $\varepsilon_{it} \sim I(0)$  then these two variables are cointegrated of order  $CI(1,1)$ . In this case, if we would like to estimate the long-run relationship between  $Y_{it}$  and  $\mathbf{X}'_{it}$ , we only need to estimate (22). Our interest is whether or not  $\varepsilon_{it} \sim I(0)$ . Thus the null hypothesis in Engle-Granger framework is  $Y_{it}$  and  $\mathbf{X}'_{it}$  are not cointegrated or in other words  $\varepsilon_{it} \sim I(1)$  against the alternative  $\varepsilon_{it} \sim I(0)$  (Harris, R., & R. Sollis, 2005). Hence rejecting the null hypothesis confirms the cointegration between variables.

The panel cointegration test has been used to a great extent in the empirical studies due to its great advantages in multiple dimensions, and it has been further developed during the last two decades with some rapidity.

Johansen-Fisher used multi equation framework to test panel cointegration rank in heterogeneous panel based on the average of the individual rank trace statistics developed by the Johansen (1995). Johansen-Fisher panel cointegration tests estimate panel cointegration based on Johansen- methodology by using trace and max-eigen values. It is possible to determine whether series are cointegrated or not by applying *The Pantula principle*.

Pedroni (1995, 1999) developed the Engle- Granger residual-base cointegration test techniques applied to panel data. This technique is applied for cointegrating vectors of differing magnitudes between countries as well as intercept and time trend fixed effects (Basu et. al. 2003). Pedroni 1995, 1999 cointegration model specified as;

$$Y_{i,t} = \alpha_i + \alpha_i t + \alpha_{1i} X_{1it} + X_{2it} + \dots + \alpha_{mi} X_{mi,t} + \varepsilon_{i,t} \quad (29)$$

For  $t = 1, \dots, T$ ;  $i = 1, \dots, N$  and  $m = 1, \dots, M$

Where T is the number of observations over the time, N is the number of individual units in the panel, and M refers to the number of regression variables. The parameter  $\alpha_i$  is the intercept for every individual and the coefficients  $\alpha_{1i}, \alpha_{2i}, \dots, \alpha_{mi}$  are allowed to vary across the individual units in the panel. Notice that equation (29) estimates the long-run

relationship between variables and does not take in to consideration the direction of causality. The estimated residuals  $\varepsilon_{i,t}$  is the deviation from the modeled long-run relationship. If this deviation happens to be an integration order of  $I(0)$ , then this series is said to be *cointegrated* (Pedroni, P. 1999).

Pedroni (1997) derives seven different statistics. Four of them refer to be *within dimensions* and three of them *between dimensions*, which is based on pooling. Within dimension statistics are based upon estimators that effectively pool the autoregressive coefficient across different individuals in the panel for the cointegration test on the estimated residuals. Between dimension statistics, on the other hand, are based upon estimators that simply average the individual estimated coefficients for each member  $i$ . As a consequence, this null hypothesis differs between *within dimension* and *between dimensions* for no cointegration. Hence, between dimensions allows heterogeneity across the individual members in the panel.

The null hypothesis is  $H_0 : \alpha_i = 1$  (no cointegration for all  $i$ ) and, the alternative null is  $H_1 : \alpha_i = \alpha < 1$  and assumes  $\alpha_i = \alpha$

Both within and between panel cointegration statistics test the null hypothesis  $H_0$  : “all of the individuals of the panel are not cointegrated”, the alternative hypothesis  $H_1$  : is “all of the individual of the panel are cointegrated or at least one in the panel member are cointegrated”.

The first of simple panel cointegration statistics is a non-parametric  $v$ -statistic, the second one is also a non-parametric  $\rho$ -statistic, and third one is (Philips and Perron) PP-t statistic. The last one is a simple panel cointegration parametric statistic, which is analogous to the commonly known Dickey-Fuller t-statistic (Pedroni, P. 1999, pp. 6-8).

There has been a wide range cointegration analyses developed in panel data, and research in this area is growing. As mentioned before, the numbers of these tests are based on residuals. Nevertheless, the cointegration analysis in panel data has some drawbacks due to its complexity. Several studies have been conducted to overcome these issues.

In this study, we do not intend to pretend to analyze these issues' more technical details as this is beyond the purposes of this thesis. In this respect we rely on software packages that offer the most commonly used test in the research area.

#### 4.2.4 Panel Granger Causality

If we are going to find that  $Y$  and  $X$  are cointegrated, we might also need to examine the "causality" between these variables. The cointegration analyses which have been explained in the previous section are identifying only the long-run relationship between the variables. Given that there is cointegration among the variables, subsequently one must consider a causal relationship between these variables as well; otherwise it would indicate that something might be wrong with the data. Hence, in our cointegrated data set, our next interest is deciding the direction of causality between these related variables. The Granger (1969) - Causality test has been widely used as an ideal econometric tool in applied econometrics. According to Granger, the causality, in a stationary time series  $Y_t$  is said to "cause" another stationary time series  $X_t$  if, the addition of a past value of  $Y_t$  significantly reduces the predictive error variance of  $X_t$ . In practice the Granger-Causality test is carried out by regressing  $X_t$  on its own lags and on  $Y_t$  lags. If the lags of  $Y_t$  are found to be jointly statistically significant then the null hypothesis " $Y_t$  does not Granger-cause  $X_t$ " can be rejected Hartwig (2009).

As an extension of the Granger (1969) causality definition, Hurlin (2005) proposed panel data models with fixed coefficients effect. The panel data with simple two-variable linear models specified as,

$$y_{i,t} = \alpha_i + \sum_{k=1}^K \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^K \beta_i^{(k)} x_{i,t-k} + \epsilon_{i,t} \quad (30)$$

Where  $y$  and  $x$  are stationary variables observed on  $T$  periods and  $N$  individuals, thus  $i=1, \dots, N$  and  $t=1, \dots, T$  and  $\beta_i = (\beta_i^{(1)}, \dots, \beta_i^{(k)})$ . For simplicity  $\alpha_i$  are assumed to be fixed. Autoregressive coefficient  $\gamma_i^{(k)}$  and regression coefficients  $\beta_i^{(k)}$  are assumed to be different across the individuals  $i$  and parameters of  $\gamma_i^{(k)}$  and  $\beta_i^{(k)}$  are constant. Further the basic assumption for the model is I.I.D  $(0, \sigma^2)$ .

Standard time series causality tests are conducted by testing  $\beta_i$ , however in a panel data, heterogeneity among the individuals must be considered. There are two types of

heterogeneity to consider, first the heterogeneity that comes from the fixed effects of individual intercept  $\alpha_i$  and the second heterogeneity is on parameter  $\beta_i$  which will directly affect the conclusion about the causality.

Considering the Homogenous Non Causality (HNC), the null hypothesis is defined as:

$$H_0 : \beta_i^{(k)} = 0$$

For all  $i=1, \dots, N$ , for all lagged  $k$ , and,

$$H_0 : \beta_i \neq 0$$

Failing to reject null in this case allows us to conclude that,  $X$  is not Granger-causing  $Y$  in all the  $N$  individuals of the sample (Hurlin, 2005).

It is though important to mention that estimating eq. (30) might cause endogeneity issue because country-specific  $\alpha_i$  affects (dummy variables) GDP growth in lag one or lag two. But we can eliminate this individual effect issue by taking first difference. However, the issue now might raise a correlation between lagged variables and error terms. This issue has been dealt by Arellano and Bond (1991) by using lags of dependent variables as an instrument in a Generalized Method of Moment (GMM) estimator. Arellano and Bover (1995) and Blundell and Bond (1998) have suggested to difference the instrument instead of the regressors in order to make them exogenous to the fixed effect Hartwig (2009, pp.10-12).

#### **4.2.5 Panel Estimation**

After given a brief overview about panel data in section 4.2.1, we can now complete and give a short but explicitly outlined panel estimation methodology that we have applied in this study. With panel data technique, it is possible to control the individual-specific time invariant “fixed effect” and include the dynamic lag dependent variable which can control the omitted variable and endogeneity bias. Another solution is to assume that the intercepts are random outcome variables rather than fixed. In the random effect, the cross-sectional specific error term indicates the deviation of cross-section individuals- in our case sectors- should be uncorrelated with the error terms of the modeled variables. However, there is also drawback in this. According to Weinhold et al. (2001), one of the major -maybe much more serious- problems with the traditional panel data fixed effect estimator is the imposing homogeneity assumptions on the coefficients of the lag-dependent variable while,

they are in fact heterogeneous. Pearson (1995) argues that, this misspecification can lead to serious biases that cannot be solved by the imposition of an Instrumental Variable (IV). The potential solution to this problem is proposed by De Mello (1999). He suggests using the mean group estimator (MGE) for heterogeneous models.

“Fixed Effect” and “Random Effect” can be tested by the (incremental) F- test and Breusch-Pagan LM test, respectively. The *least squares dummy variable model* (LSDV) estimation can be applied to Fixed Effects while GLS and FGLS can be appropriate for Random Effects. Subsequent to the general explanation in this section, we now complete with a summary of the empirical methods in table 5<sup>16</sup>.

*Table 5: Summary of Empirical Methods*

<b>Empirical Methods</b>	<b>Empirical Techniques</b>	<b>Empirical Analysis</b>	<b>Software Used</b>
Panel Unit Root test	Levin and Lin (1992) common unit root test. <i>The Fisher’s type p-test</i> ; Maddala and Wu (1999)	Testing stationary every variable in data set.	EViews.7.1
Panel Cointegration	Pedroni (1995, 1999) Engle- Granger residual-base cointegration test	Testing long-run relationship between variables.	EViews.7.1
Panel Granger- Causality	Arellano-Bond Dynamic panel-data estimation (GMM). Arellano, M., Bond, S. R., (1991)	Testing and determines the direction causality between variables	Stata.11
Panel Estimation	Panel Least Squares	Estimates the coefficients of variables.	EViews.7.1
Pooled/Panel data Individual sector-wise Estimation	Estimated or Feasible Generalized Least Squares. ( EGLS/FGLS)	Estimates individual sector-specific intersections and coefficients	EViews.7.1

The intention of this thesis is not to analyze the deep technicality of these econometric theories; however, we believe that giving a reasonable background will help the reader better understand<sup>17</sup>.

<sup>16</sup> Source: Own construction

<sup>17</sup> For advanced reading, see Hurlin (2005), Hurlin and Venet (2001), Granger, C.W.J., (1969), Arellano and Bond (1991) and Holtz-Eakin, Newey, and Rosen (1998).

## 5 Empirical Results and Findings

The empirical results in this section will be presented in light of the empirical methodology that has been explained in previous section 4.2.

The first step presented in subsection 5.1, will provide the results of the unit root test, where we have examined the properties of every individual data series whether they are stationary or non-stationary. In the second step, the long-run relationships between variables are examined by applying the cointegration test. In this context it is imperative to proceed to the unit root test for every individual series before. If, and only if, all series are identified as integrated to order  $I(1)$ , then it is justified to continue to the second step. We will account these results in subsection 5.2 with appropriate tables.

In the third step, we are interested in revealing the direction of these cointegrations; hence, the granger causality test is carried out under the condition that the series are found to be cointegrated. Model 6 and model 7 are designed in order to perform these tests as mentioned in section 3.2. We present the granger causality tests in subsection 5.3.

The significance of the coefficients of the explanatory variables FDI, XPR, LPR on dependent variable GDP are examined by applying the panel OLS estimation technique. We can find the panel data estimation results in subsection 5.4. For this particular reason we have constructed five panel OLS based testable econometric models. These five models (model 1, model 2, model 3, model 4 and model 5) are accounted in section 3.2.

And finally, in subsection 5.5, a sectors-wise analysis is conducted in order to study the individual sector's impact on GDP within the variables of FDI, LPR and XPR by implying pooled EGLS-LSDV estimation methods. The models that are used for these particular analyses are; model 8 – model 12. With this particular methodology, we basically repeat from model 1 to model 5, despite the fact that now the magnitude of coefficients of individual sectors in each variable are analysed.

## 5.1 Panel Unit Root Test Results

We have given a brief technical background in section 4.2.2., why these tests are compulsory procedure. It is also explained different kind of test techniques and how these techniques can be applied to an empirical research. Due to our data characteristic, we have chosen LLC, and Fisher type unit root tests. According to Mathiyazhagan, M.K. (2005), the LLC test is also generally more suitable, because it covers the most general specification such as constant, a trend and lags. The Fisher unit root test on the other hand, can be used in almost every set of data. LLC performs the common unit root among the variables while Fisher-ADF tests the individual unit root among the series.

The Levin Lin Chu and Fisher type ADF tests require specification of the lag lengths in the panel unit root tests, however as Mathiyazhagan, M.K. (2005) points out, the data set we have unlikely to be more than 1 lag; first of all because our data is yearly macro data, secondly the time period is limited with only 10 years, and finally our control variables' vector consists of only three variables. Additionally, the common way to determine lag specification is to use the Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC). Fortunately there is a function for practical use in the EViews software program where one can choose automatic maximum lag selection. We have chosen automatic lag selection for Schwarz Information Criterion (SIC) which indicates 1 lag in our data set. The Bandwidth Newey-West selection is commonly used. We have also tested 1 lag specification separately that performed with similar results, though it is not reported here since we have enough evidence for the lag specification.

As we can see in table 6 that, it is tested every variable in log-level and log-first difference by including three possible combinations that are: individual intercept, individual intercept and trend and no intercept or trend. We have conducted both LLC and Fisher-ADF for robustness as the Levin Lin Chu tests use *common unit root process* whereas Fisher-ADF type tests use *individual unit root process*.

The results of Panel Unit root test are reported in table 6.

Table 6: Panel Unit Root Tests Results

(LLC) Levin Lin Chu (common unit root process)			
Variables	Constant	Constant & Trend	None
Level			
$\log GDP_{it}$	-7.588 (0.000)***	1.262 (0.896)	6.740 (1.000)
$\log FDI_{it}$	-3.020(0.001)***	-2.667 (0.003)***	4.459 (1.000)
$\log XPR_{it}$	-15.749 (0.000)***	-11.981 (0.000)***	2.659 (0.996)
$\log LPR_{it}$	-4.920 (0.000)***	-9.308 (0.000)***	1.115 (0.867)
First Difference			
$\log GDP_{it}$	0.355 (0.638)	-4.379 (0.000)***	-4.913 (0.000)***
$\log FDI_{it}$	-5.900 (0.000)***	-4.879 (0.000)***	-6.110 (0.000)***
$\log XPR_{it}$	-12.704 (0.000)***	-7.252 (0.000)***	-13.797 (0.000)***
$\log LPR_{it}$	-10.129 (0.000)***	-10.672 (0.000)***	-7.779 (0.000)***
Fisher-ADF (individual unit root process)			
Level			
$\log GDP_{it}$	40.197 (0.004)***	19.988 (0.458)	1.709 (1.000)
$\log FDI_{it}$	14.513 (0.803)	21.326 (0.378)	2.175 (1.000)
$\log XPR_{it}$	66.052 (0.000)***	28.722 (0.011)***	1.837 (1.000)
$\log LPR_{it}$	22.603 (0.308)	47.736 (0.001)***	11.789 (0.923)
First Difference			
$\log GDP_{it}$	31.692 (0.046)**	24.314 (0.228)	56.321 (0.000)***
$\log FDI_{it}$	55.579 (0.000)***	48.896 (0.000)***	58.746 (0.000)***
$\log XPR_{it}$	49.712 (0.000)***	36.940 (0.000)***	80.750 (0.000)***
$\log LPR_{it}$	62.350 (0.000)***	39.990 (0.005)***	77.642 (0.000)***

Notes: Null Hypothesis; *There is unit root*. P- Values are in brackets (.). \*\*\*, \*\* and \* indicate 1 percent, 5 percent and 10 percent significance level respectively. Automatic lag length selection based on Schwarz Information Criterion (SIC). Newey-West automatic bandwidth selection and Bartlett kernel.

The *rejection* of the panel unit root hypothesis should be interpreted as evidence that a statistically significant proportion of the units are *stationary*. Hence, the null hypothesis for unit root is rejected for all variables at 1 percent significance level in *first difference* when no intercept or trend is imposed; whereas it is not rejected at that *level*, when both unit root test methodologies are used. Concerning the case that no intercept or trend is imposed, the results evidently indicate that all variables in our data set contain *unit roots*. This will justify testing panel cointegration for the next step, which is to examine whether variables have long-run relationships with each other or not.

## 5.2 Panel Cointegration Test Results

After following results of the unit root test in previous section, it now makes good sense to proceed to the panel cointegration test as explained in section 4.2.3.

In order to examine the long-run relationship between our variables, Engle-Granger based Pedroni, P. (1999) panel cointegration test technique has been used. This technique allows for the cointegration vectors of differencing magnitudes between categories and also allows for cross-section fixed and time fixed (Basu, et al. 2003). In this respect we believe that this methodology fits better to our data set in comparison to other ones.

For these tests, first the intercept is included, then, intercept and trend, and finally it is tested with no intercept or trend. Automatic lag length selection has been chosen based on the Schwarz Information Criterion (SIC) and Newey-West automatic bandwidth selection and Bartlett kernel. The results of the panel cointegration test between logGDP and log FDI is reported in table 7.

Table 7: Panel Cointegration Tests Result (A)

<i>logGDP &amp; logFDI</i>			
<i>Test-statistic</i>	Within Dimension		
	Constant	Constant & Trend	None
<i>Panel-v Statistic</i>	1.035 (0.150)	3.527 (0.000)***	-2.397 (0.991)
<i>Panel-rho Statistic</i>	-1.112 (0.132)	0.838 (0.799)	-0.226 (0.410)
<i>Panel-pp Statistic</i>	-2.358 (0.009)***	-0.287 (0.386)	-3.395 (0.000)***
<i>Panel-ADF Statistic</i>	-2.400 (0.008)***	-2.676 (0.003)***	-2.832 (0.002)***
	Between Dimension		
<i>Panel-rho Statistic</i>	0.064 (0.525)	2.096 ( 0.982)	2.296 (0.989)
<i>Panel-pp Statistic</i>	-3.682 (0.000)***	-1.796 (0.036)**	-2.712 (0.003)***
<i>Panel-ADF Statistic</i>	-3.558 (0.000)***	-2.880 (0.002)***	-2.788 (0.002)***

Notes: Null Hypothesis: No Cointegration. *P-values* are in parenthesis. \*\*\*, \*\* and \* indicate 1 percent, 5 percent and 10 percent significance level respectively. Automatic lag length selection SIC imposed.

Comparing GDP and FDI, we have seen an expected result as it is shown in the first part of table 7. The PP rejects the null at 1% when no deterministic trend and no deterministic intercept or trend components are imposed and the ADF statistic rejects the null when three deterministic components are imposed.

The result for between dimensions in the second portion of table 7 shows that both PP and ADF reject the null at 1 percent significance level, indicating that series have long-run relationship.

The null hypotheses are rejected by 6 of 12 test statistic in within dimension and by 6 of 9 tests in between dimension. Thus we are convinced to conclude that, there is long-run relationship between logFDI and logGDP.

In the next test, additional variable logXPR is included and tested the long-run relation between them. Our interest is the same as previous test, that is to find out if the long-run relationship will hold even this variable controlled. The result of cointegration test for these three variables reported in table 8.

*Table 8: Panel Cointegration Tests Result (B)*

<i>logGDP, logFDI &amp; logXPR</i>			
<i>Test-statistic</i>	Within Dimension		
	Constant	Constant & Trend	None
<i>Panel-v Statistic</i>	1.369 (0.085)*	4.532 (0.000)***	-2.027 (0.978)
<i>Panel-rho Statistic</i>	-0.224 (0.411)	1.780 (0.962)	-0.802 (0.211)
<i>Panel-pp Statistic</i>	-1.896 (0.028)**	0.603 (0.726)	-3.814 (0.000)***
<i>Panel-ADF Statistic</i>	-0.512 (0.304)	0.278 (0.609)	-4.141 (0.000)***
	Between Dimension		
<i>Panel-rho Statistic</i>	0.811 (0.791)	3.393 (0.999)	-0.078 (0.468)
<i>Panel-pp Statistic</i>	-3.216 (0.000)***	-0.267 (0.394)	-5.498 (0.000)***
<i>Panel-ADF Statistic</i>	-1.504 (0.066)*	0.620 (0.732)	-6.855 (0.000)***

Notes: Null Hypothesis: No Cointegration. *P-values* are in parenthesis. \*\*\*, \*\* and \* indicate 1 percent, 5 percent and 10 percent significance level respectively. Automatic lag length selection SIC imposed.

The result in table 8 shows that, there is long-run relationship between these variable. The rejection the null hypothesis weakened slightly and 21 of 9 test statistics reject the null hypothesis, however, we are still convinced that the long-run relationships between these three variables are exist.

And finally we add our last variable logLPR and go on with panel cointegration test. The result show slightly less than pervious test result and still confirms the long-run relationship

between our variables. The null hypothesis are rejected mostly when the component of constant & trend and no constant or trend imposed. The results of these tests are presented in table 9.

As we e can see from table 9 that, the null hypotheses are rejected by 7 tests out of 21, and strong enough to conclude to long-run relationship between variables.

Table 9: Panel Cointegration Tests Result (C)

<i>logGDP, logFDI, logXPR &amp; logLPR</i>			
Test-statistic	Within Dimension		
	Constant	Constant & Trend	None
<i>Panel-v Statistic</i>	-0.221 (0.587)	3.389 (0.000)***	-2.205 (0.986)
<i>Panel-rho Statistic</i>	1.458 (0.927)	2.952 (0.998)	0.913 (0.819)
<i>Panel-pp Statistic</i>	0.531 (0.702)	-1.592 (0.055)*	-2.120 (0.017)**
<i>Panel-ADF Statistic</i>	0.679 (0.751)	-0.734 (0.231)	-1.870 (0.030)**
	Between Dimension		
<i>Panel-rho Statistic</i>	3.001 (0.998)	4.111 (1.000)	1.904 (0.971)
<i>Panel-pp Statistic</i>	-0.264 (0.395)	-4.892 (0.000)***	-5.001 (0.000)***
<i>Panel-ADF Statistic</i>	0.5105 (0.695)	-0.534 (0.296)	-2.500 (0.006)***

Notes: Null Hypothesis: No Cointegration. *P-values* are in parenthesis. \*\*\*, \*\* and \* indicate 1 percent, 5 percent and 10 percent significance level respectively. Automatic lag length selection SIC imposed.

When other variable combinations are added to the panel cointegration test, it is clear to see that the more variables added to the test, the less rejection of null hypothesis there will be. This is maybe not surprising due to heterogeneity among the individual members in the panel data set.

In a nutshell, the long-run relationships between variables are evidently confirmed in both within and between dimensions. In general, the panel pp and panel-ADF tests rejected null of *no cointegration* in favor of accepting alternative that there is *cointegration* in data series.

As Maeso-Fernandez, et al. (2006) pointed out, panel rho and panel pp are assumed to be more reliable tests of panel cointegration, hence, we have enough backing to conclude that FDI, GDP, XPR and LPR have long-run relationships. In particular, our panel cointegration

test results confirm the common consensus concerning the long-run relationship between GDP and FDI. It also confirms that the risk of spurious cointegration and later spurious panel data estimation has been eradicated.

### 5.3 Panel Granger-Causality Tests Results

In the previous section it was found that  $\log$ GDP and  $\log$ FDI have a long-run relationship. However, we do not know in which direction this relationship is linked. We are now interested to find out whether FDI has triggered the country's GDP or an economic performance in the country's GDP has attracted Multinational Enterprises (MNE).

Basu et al. (2003) argues that there are two-way linkages between FDI and GDP can be formed which occurs in both short-run and long-run dimensions. They further discuss that: the new technology brought by FDI might have a long-run effect on Total Factor Productivity (TFP) in the host country through the spillover of technological progress and accumulated human capital as has been discussed in section 2. It is also plausible to consider reverse causality from GDP to FDI. There are consensuses that bilateral trade could help the foreign country to glean more information about the host Country's economic performance, consequently, increase international investment opportunities in this country with evidence for which found in Liu et al. (1997). According to Basu et al. (2003, pp.510-512), the bidirectional short-run causality between FDI and GDP could take place in the following way: "An infusion of FDI, while bringing the economy to a higher long-run growth path, raises growth in short-run as well. The growth of the economy thus increases in the short run while the economy traverses along its transition path. The reverse causality could arise from various pull factors associated with home country's opportunity. In the short-run context, growth of national income in host countries could create a positive income effect. This could generate a highest aggregate demand in the host countries, thus attracting FDI in the short run."

In light of the theoretical background explained in section 4.2.4, we are now ready to propose the Granger-(none) Causality test. In order to test Granger-Causality, all variables should be stationary. Thus, we make sure that all variables in our data are now integration order  $I(0)$ . In order to obtain variables to be stationary, we have taken first logs of all

variables and worked in first-differenced and name it as *LogdGDP* and *LogdFDI*. Finally we set up equations 15 (model 6) and 16 (model 7) which are practically testable.

The Granger-Causality test (model 6) and (model 7) are conducted based on equation (30) and we are testing causality particularly between *LogdGDP* and *LogdFDI*. The results of the panel homogenous Granger (none)-Causality tests results for (model 6) and (model 7) are accounted in table 10<sup>18</sup>.

Table 10: Panel Granger-Causality Test Results (Model 6-7)

<b>A) Dependent Variable <i>LogdGDP</i></b>		Est. Coefficients
<u><i>LogdFDI</i></u>		
	Lag 1	0.011 (0.010)
	Lag 2	-0.000 (0.984)
<u>Wald- Chi-Sq. Causality Test:</u>		
	Chi-Sq.	7.17
	<i>P-Value</i>	0.0278**
<b>B) Dependent Variable <i>LogdFDI</i></b>		Est. Coefficients
<u><i>LogdGDP</i></u>		
	Lag 1	1.340 (2.726)
	Lag 2	-0.161 (0.984)
<u>Wald- Chi-Sq. Causality Test:</u>		
	Chi-Sq.	2.89
	<i>P-Value</i>	0.235
Number of Obs.		79
Number of Sectors.		10

Notes: Null Hypothesis; **A)** *LogdFDI* does NOT Granger Cause *LogdGDP*, **B)** *LogdGDP* does NOT Granger cause *LogdFDI*. \*\*\*, \*\*, \* Indicates 1 percent, 5 percent and 10 percent significant level respectively. Robust Std. Err. In parenthesis.

As has been mentioned in section 4.2.4., the null hypothesis is that the control variable, say, X does not granger cause to the dependent variable, say Y. In our data set Y corresponds to

<sup>18</sup> For this particular test we have used software Stata11. I would like to thank to Ph.D. Fredrik NG Andersson for his courtesy valuable contribution for this particular test. Any possible error is my responsibility.

*LogdGDP* and *X* corresponds to *LogdFDI*. It is worth mentioning that all *i* in the panel are assumed to be homogenous. This is also known as the Homogenous Non-Causality (HNC) test. Under the alternative null, we allow at least one subgroup among the individuals sector granger causes to the dependent variable.

In the first step, we have proceeded to Arellano-Bond Dynamic panel-data estimation, with one-step system GMM estimator. Before carrying out the dynamic estimation, we have also checked the data to see if they are sensitive to the lag length. We have found that data is sensitive to the lag length, and we run the model with lag length between 1 and 5 which performed better. In the second step we applied the Wald- Coefficient diagnostic test in order to find out whether first lag of *LogdFDI* is different from the second lag and in the same manner we run model (7) where the *LogdFDI* is dependent variable and tested whether *LogdGDP* first and second lag are equal to zero. In more straightforward, if we fail to reject the null hypothesis, then we can conclude that there is no granger causality from FDI to GDP in model (6) and vice versa in model (7).

In part **A)**, of table 10 shows that coefficients are statistically significant and the *p*-value is 0.0278 which is less than 5 percent thus, null hypothesis is rejected at five percent significance level. This allows us to conclude that *LogdFDI* Granger causes *LogdGDP* at the first lag. The magnitude of coefficients indicates that 1 percent increase in FDI has 0.011 percent positive impact on *LogdGDP* after one year.

In part **B)** of table 10, we can see that the null hypothesis cannot be rejected due to the high *p*-value which is 0.235. Hence, we cannot conclude that GDP Granger-Causes FDI.

The concluding word is that, our data exhibits one-way Granger Causality from FDI to GDP. In more straightforward, first FDI has planted in period one and then, in second period GDP has exhibits an increased growth rate.

#### **5.4 Panel Data Estimation Results**

The tests that we have performed in the previous stages, have given us valuable information about the long-relationship between GDP and FDI in Turkey. At this stage, we would like to measure the magnitude of the coefficients of the explanatory variables. In order to do so, we need to perform the panel OLS estimation regression with fixed or random effects. In

section 4.2.1 and 4.2.5 we have given a brief background of the panel estimation methods. We are now performing the panel estimation regression for our first five models. Before proceeding to the panel estimation regressions, it needs to be determined which effect one should use in the regression model.

The Hausman (1978) specification test is one commonly applied in the literature to determine whether the fixed or random effects specification is suitable for the model. More specifically, the interesting question for the researchers is, whether there is significant correlation between the unobserved individual-specific (in our case sector-specific) random effects and the regressors. In other words, the basic idea of this specification is to test the correlation between explanatory variables and error terms. This is one of the fundamental the Gauss-Markov assumptions. If this assumption is violated, the model is said to be biased and inconsistent. If the correlation is not to be found, then the random effects model can exhibit a better result. In contrast, with a correlation, the random effects model would be inconsistently estimated and the fixed effects model would be the model of choice (Park H. M.2009).

The Null Hypothesis for the Hausman (1978) test is that the error components are not correlated with the explanatory variables. If the null hypothesis is not rejected, there is no misspecification; in contrast, if null is rejected, estimation with random effects will be biased and inconsistent. In other words, the error terms are correlated with one or more explanatory variables. The results of the five models for the Hausman test specification are presented in table 11.

*Table 11: Hausman Test Results*

Test summary:	Chi-Sq. Statistic	P-Value
Test cross-section random effects:		
Model (1)	1.463	0.226
Model (2)	3.997	0.135
Model (3)	1.561	0.668
Model (4)	0.893	0.344
Model (5)	0.392	0.821

Notes: The null hypothesis; the individual effects are NOT correlated with error terms in the model (Hausman 1978).

As a result of the Hausman (1978) tests in table 11, we can conclude that our five model's p-values are more than 10 percent, and the null hypothesis is strongly failed to be rejected;

thus, our models are consistent and do not cause biased results hence, we can proceed the empirical analyses with confidence.

When it comes to the preference of random effect or fixed effect, we follow Mathiyazhagan (2005) and choose the fixed effect model. According to Mathiyazhagan (2005), when individual cross-section and period data are too small, as is the case, one should rather use the FE–LSDV method.

The first five panel estimation models, which have been derived and specified in section 3.2., will be regressed with the fixed-effect model in software EViews. The possible heteroscedasticity issue is corrected with the white-cross section.

The results for the models from 1 to 3 are presented in table 12.

*Table 12: Panel Estimation Results (Model 1-3)*

<u>Dependent Variable <i>log</i> GDP</u>						
<u>Independent Variables</u>	<u>Estimated Coefficients</u>					
	<u>Model 1</u>	<i>P-Value</i>	<u>Model 2</u>	<i>P-Value</i>	<u>Model 3</u>	<i>P-Value</i>
Constant	15.160 (0.027)	0.000***	13.262 (0.285)	0.000***	14.048 (0.185)	0.000***
<i>Log</i> FDI	0.062 (0.005)	0.000***	0.048 (0.005)	0.000***	0.060 (0.008)	0.000***
<i>Log</i> LPR			0.420 (0.061)	0.000***	0.314 (0.039)	0.000***
<i>Log</i> XPR					-0.017 (0.010)	0.0918*
R <sup>2</sup>	0.991		0.993		0.994	
n	100		89		62	
Cross-Section	10		10		7	

Notes: Std. Errors in parenthesis. The *t*-statistics are adjusted for Heteroskedasticity using White. P-Values; \*, \*\*, and \*\*\* indicates 10, 5 and 1 percent significance level respectively.

In the first benchmark model 1 (10), we have only explicitly used FDI as an explanatory variable, in order to capture the externalities as explained in section 3.2. In model 2 we estimate the independent variables FDI and LPR whereas GDP is modeled as a dependent variable. And finally we estimate the model 3 with dependent variable GDP and explanatory variables are FDI, LPR and XPR.

Considering the first benchmark model 1, the results in table 12, as expected, show that the overall effect of FDI stock on GDP is positive. It demonstrates that a 1 percent increase in FDI stock has a positive impact on GDP, to 0.062 percent, and is statistically significant at the 1 percent level. The results also are consistent with the theoretical background, such as the neo-classical growth model which has been discussed in section 3.1.1. It should again be noted that this 0.062 percent impact on GDP is clean foreign-owned FDI stock.

In this model, the source of growth rate in the economy is probably collected in the residuals. We are not able to measure domestic investment due to lack of data. Therefore, we can only be certain that the FDI flow into Turkey created capital stock accumulation; hence, it contributes to the economic growth via capital widening. It is more likely also, that because of their advanced technological investments this has induced spillover and increased the productivity. However we are not able to capture the magnitude of this factor with the coefficient in this model.

In the second model (11) we add labor productivity to the model. The results show that labor productivity has a highly positive impact on GDP. The coefficient shows that, a 1 % increase in labor productivity increases the GDP by 0.42 % and this is statistically significant at the 1 percent significance level. This is an indication that FDI in Turkey might have increased labor productivity through “learning by doing”. The results give an idea about the importance of labour productivity. This result is not completely surprising. Due to the different levels of the economic state between Turkey and developed countries, the absorption capacity in the Turkish economy is likely high. It is also plausible that those component organizations of the FDI itself might have offered on the job training in order increase their productivity, and thus may have contributed to a better skilled and more productive labor force, which in turn caused the growth rate to increase as has been explained earlier.

In model three (12), we have considered export, which is one of the most important components in the analyses. The result shows that labor productivity still exhibits a high coefficient with slightly lower values. It gives a rise of 0.31 percent to GDP with a 1 % increase.

When it comes to the new variable export, we found that export has no impact on GDP and the result is statistically significant at the 10 percent significance level. It is expected that export would have a positive impact on GDP according to the theoretical background given in section 3.1.3. One should be cautious to interpret the result and not make rigorous conclusion that export has not any effect on economic growth. As Hartwig (2009) argued, considering international trade, specialization induces more intermediate product, labour productivity and physical capital deepening and also technology spillovers (see section 3.1.3). Furthermore, Balasubramanyam et al. (1996) found that FDI has an impact on GDP mainly in export-oriented countries, not import-substituting countries. As has been mentioned in section 5.3., Basu et al. (2003) explained the causal effect of export on GDP growth. In this respect, it is plausible that the negative result in our analysis can be interpreted as no positive reverse effect is confirmed from economic growth to FDI. It is also conceivable that, a negative impact of export on GDP in our study might depend on government policy about the export requirement. Another possible explanation might simply be poor data collection.

In the next step, labour productivity is chosen as the dependent variable. The results of model 4 and 5 are reported in table 13.

Table 13: Panel Estimation Results (Model 4-5)

<u>Dependent Variable <i>log</i> LPR</u>				
<u>Independent Variables</u>	<u>Estimated Coefficients</u>			
	<u>Model 4</u>	<i>P-Value</i>	<u>Model 5</u>	<i>P-Value</i>
Constant	4.504 (0.029)	0.000***	4.5735 (0.313)	0.000***
<i>Log</i> FDI	0.036 (0.004)	0.000***	0.034 (0.012)	0.006***
<i>Log</i> XPR			-0.006 (0.021)	0.767
R <sup>2</sup>	0.664		0.581	
n	89		62	
Cross-Section	10		7	

Notes: Notes: Std. Errors in parenthesis. The *t*-statistics are adjusted for Heteroskedasticity using White. *P*-Values; \*, \*\*, and \*\*\* indicates 10, 5 and 1 percent significance level respectively.

This model will capture the effects of FDI and export on labour productivity. It will also add robustness to models 2 and 3. This model particularly reveals the absorption capacity, and will answer the question if inward FDI stock into Turkey has increased the labour productivity.

Adding logXPR as an additional variable, we expect to capture technology spillovers as has been clarified in section 3.1.3. We expect the model to perform positive coefficients for both logFDI and logXPR.

Considering the model 4, (13) in table 13, we can see that, inward foreign Direct Investment stock in Turkey contributed labour productivity with 0.036 percent increase for each 1 percent investment. The result confirms the theoretical statement that FDI, induces positive economic growth thorough the two channels; one is the capital accumulation and the second is by contributing TFP.

Moreover, in model 5 (14), we have similar results to the model 3, showing that export has a negative coefficient. The result indicates that export does not exhibit a positive impact on labour productivity. This result contradicts the theoretical background, which is explained in section 3.1.

Our results throughout the model 1 to model 5 corroborate positive and statistically significant coefficients for FDI. Hence, we, in light of these results, can draw an important conclusion and state that the effect of FDI on GDP is positive and robust in Turkish economy.

## **5.5 Pooled EGLS Estimation Results**

We have previously discussed the impact of aggregate FDI stock upon GDP. The results have shown the positive effects of FDI stock upon the growth rate. The results are statistically significant and we draw the essential conclusion that the impact of FDI on economic growth is positive and robust.

Nevertheless, due to heterogeneity across the sectors, the result might have been shadowed by important information from individual sectors. For that reason this section will extend the previous models into individual sector levels in order to capture sector-specific effects. For this purposes, we have proceed the EGLS-LSDV estimation technique.

This approach is essential and also unique part of our study which aims to investigate the issues in more specific detail. A brief background of this approach has been explained in section 4.2.5. It should be noted that, this approach is used to generate very high R-squared value. It is due to the considerably large differentiation in production level across the sector which also justifies pooled/panel with fixed-effect specification.

First of all, it is useful to see the overall result with common coefficients of these variables, and then to turn to individual level analyses. For this purposes we have first conducted EGLS estimation and reported common coefficients of the model (8) – (12) in table 14.

*Table 14: Pooled Group EGLS Estimation Results*

Dependent Variable <i>log GDP</i>	Estimated Coefficients					
	<i>Model 8</i>		<i>Model 9</i>		<i>Model 10</i>	
	<i>Constant</i>	<i>LogFDI</i>	<i>Constant</i>	<i>LogLPR</i>	<i>Constant</i>	<i>LogXPR</i>
	15.190 (0.009)	0.056 (0.002)	12.375 (0.221)	0.658 (0.049)	14.695 (0.252)	0.049 (0.014)

  

Dependent Variable <i>log LPR</i>	Estimated Coefficients			
	<i>Model 11</i>		<i>Model 12</i>	
	<i>Constant</i>	<i>LogFDI</i>	<i>Constant</i>	<i>LogXPR</i>
	4.469 (0.036)	0.044 (0.006)	4.162 (0.201)	0.028 (0.011)

Notes: The Std. Errors are in parenthesis, The *t*-statistics are adjusted for Heteroskedasticity using White Cross-Section. Common Coefficients regressors and Fixed-Effect applied.

Table 14 shows pooled group EGLS estimations with common coefficients. As we can observe, in the first portion of the table 14 that, three control variables exhibit positive impacts upon logGDP, and the results are statistically significant. In model 8, 1 percent increases in FDI has 0.056 percent impact on GDP. Similarly in model 9, 1 % increase in LPR, increases 0.658 percent impact on GDP. And finally export has 0.049 percent impact on GDP for one percent increase.

In the second portion of table 14, the dependent variable is logLPR and the results again show statistical significance, and furthermore the variables logFDI and logXPR have positive

effects upon logLPR. In the same vein, in model 11 and 12, one percent increase on FDI and export, have impact on labour productivity by 0.044 and 0.028 percent respectively.

The following tables, 15 and 16 will show the results of EGLS sector-wise estimation that has been specified in model 8-12. These results are consistent with the content of the previously discussion that was specified in model 1-5; this is despite the fact that it now releases the assumption of homogeneity among the sectors and permits the variables (logFDI, logLPR and logXPR) for specifying individual sector-specific impacts upon GDP.

The first specifications' results are presented in table 15 and they are statistically significant.

*Table 15 : Pooled EGLS Sector-Wise Estimation Results (Model (8-10))*

<u>Dependent Variable log GDP</u>						
Estimated Coefficients of Control Variables by Sector						
<u>SECTORS</u>	<u>Constant</u>	<u>LogFDI</u>	<u>Constant</u>	<u>LogLPR</u>	<u>Constant</u>	<u>LogXPR</u>
AGR	0.864	0.022 (0.008)	1.233	0.357 (0.049)	1.021	0.026 (0.015)
COMM	0.602	0.087 (0.036)	-3.031	1.280 (0.077)	NA	NA
CON	0.082	0.064 (0.008)	-2.472	0.968 (0.250)	NA	NA
EGW	-1.333	0.097 (0.005)	-2.250	0.724 (0.122)	-1.904	0.108 (0.029)
EHS	-0.034	0.048 (0.026)	-0.120	0.484 (0.127)	-0.045	0.072 (0.016)
FINB	0.854	0.083 (0.010)	13.670	-2.215 (0.620)	1.543	0.045 (0.045)
HRS	-0.763	0.020 (0.003)	2.960	-0.361 (0.135)	NA	NA
MAN	0.988	0.097 (0.009)	-3.392	1.513 (0.084)	0.185	0.094 (0.033)
MIN	-1.790	0.028 (0.006)	0.568	-0.054 (0.209)	-1.066	0.001 (0.015)
WHS	0.530	0.092 (0.016)	-7.177	2.227 (0.159)	0.075	0.096 (0.042)
R <sup>2</sup>		0.996		0.998		0.991
n		100		89		69
Cross-Section		10		10		7

Notes: The Std. Errors are in parenthesis, The *t*-statistics are adjusted for Heteroskedasticity using White Cross-Section. Cross-Section specific coefficients regressors and Fixed-Effect applied.

We first run GDP as a dependent variable and choose the independent variables logFDI (model 8), logLPR (model 9) and logXPR (model 10) for each sector in a cross section specification; then we take the logLPR as a dependent variable and re-produced the model with dependent variables logFDI (model 11) and logXPR (model 12).

As it can be observed from table 15, a positive result for Foreign Direct investment is exhibited in all sectors. The highest impact of FDI appears to be in the manufacturing (MAN) and Electricity, Gas and Water sectors (EGW). They raised the GDP by 0.097 % for every 1 percent of Foreign Direct Investment in these sectors. The following sectors, with 0.092 percent impact upon GDP, are Wholesale and Retail Trade (WHS). It is generally expected that the magnitude of FDI stock in the industrial-sectors such as manufacturing (MAN) would be positive and higher. This is not surprising because FDI in capital intensive sectors, where technology is an important factor, are expected to have a greater positive impact on productivity, and hence contribute to economic growth<sup>19</sup>.

The results reveal also that, Foreign Direct Investment in non-industrial sectors, such as wholesale, trade and service sectors (WHS), shows a greater effect on GDP than industrial-sectors such as Construction (CON). Noy et al. (2007) have found almost identical results in their study of China. They have found that, inward FDI flow on wholesale, trade and service sectors positive and higher in magnitude compared to the industrial-sectors.

The EGLS-regression results for logLPR, which are presented in table 15 on column 5, shows that labor productivity in financing and business (FINB), hotels and restaurants (HRS) and mining (MIN) sectors exhibit negative effects on GDP. In contrast, it is shown to be positive and statistically significant for all other sectors. It shows that, wholesale, trade and service sectors (WHS), manufacturing (MAN) and communication (COMM) have the greatest effect on GDP.

An interesting result might be realized with a comparison between model (3) and model (10). Export has been shown to have negative impact on GDP in model (3), where homogenous assumption is implied in the model. In contrast, export has been shown to have a positive impact upon GDP in all sectors when sector-specific regression has been

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<sup>19</sup> See section 2 and 3 for further discussion

applied in model (10). In this specification, the theoretical background given in section 3.1.3 is now consistent.

We now turn to second specification of EGLS and test the sector-specific impact of FDI and export on labor productivity.

In the previous section 5.4., with model 4 and 5 we had found a clear cut result where logFDI exhibits a positive impact upon labor productivity (logLPR). However, the results are not as clear cut as it has been in panel estimation models 4 and 5. Table 16 presents these results.

*Table 16: Pooled EGLS Sector-Wise Estimation Results (Model 11-12)*

<u>Dependent Variable <i>log LPR</i></u>				
	<u>Estimated Coefficients of Control Variables by Sector</u>			
<u>SECTORS</u>	<u>Constant</u>	<u>LogFDI</u>	<u>Constant</u>	<u>LogXPR</u>
AGR	0.136	0.064 (0.018)	-0.846	0.079 (0.032)
COMM	-0.043	0.067 (0.008)	NA	NA
CON	0.227	0.079 (0.012)	NA	NA
EGW	-0.360	0.125 (0.027)	-1.453	0.138 (0.041)
EHS	-0.001	0.061 (0.015)	0.083	0.049 (0.027)
FINB	0.254	-0.013 (0.009)	0.588	0.002 (0.013)
HRS	0.178	-0.033 (0.007)	NA	NA
MAN	-0.271	0.069 (0.015)	-0.640	0.057 (0.024)
MIN	-0.017	-0.033 (0.021)	2.214	-0.103 (0.009)
WHS	-0.101	0.042 (0.012)	0.064	0.030 (0.022)
R <sup>2</sup>		0.847		0.678
n		89		62
Cross-Section		10		7

Notes: Std. Errors in parenthesis, The *t*-statistics are adjusted for Heteroskedasticity using White Cross-Section. Cross-Section specific coefficients regressors and Fixed-Effect applied.

The main discussion for this section is the same as the previous section, yet again, in this section we will account for the individual members in the panel data. Thus, in these specifications, the regression model will reveal the sector-specific detail of the variables.

As table 16 clearly shows that, LPR gained benefit from FDI in all sectors except for financing and business (FINB), hotels and restaurants (HRS) and mining (MIN) sectors. The highest impact on LPR from FDI comes from the Gas and Water sectors (EGW), with 0.12 percent for a 1 percent increase in FDI. It follows manufacturing (MAN) with 0.069 percent and communication (COMM) with 0.067 percent, again for a 1 percent increase in FDI. Positive impacts are consistent with the spillover effect on LPR; however, as FDI is expected to increase the LPR, this negative impact on these sectors might be due to a judicious wage rate.

And finally, export shows a positive impact on labor productivity in every sector except Mining. It is noted that there are missing data in three sectors; however, it is found that the data is statistically significant.

It should be noted that we had found a negative impact of FDI on LPR in three sectors in table 15. These results are consistent with the consensus that, Foreign Direct Investment in the non-industrial sectors, where advanced technology is not an important factor cannot contribute to Labour productivity as it does in sectors where R&D and advanced technology is brought in by FDI.

Furthermore, the results represented in this section confirm our pervious results, where it is found that there are long-run relationships between all 4 variables; and also Arellano-Bond Dynamic panel-data estimation revealed that this relationship is one sided and comes from FDI to GDP. In other words, when FDI is implemented in Turkey, it gives the Turkish economic growth a positive lift after 1 year with magnitude of 0.011 percent.

Finally we can conclude that FDI stock has a positive and robust effect on GDP growth at steady state even sector-specific analyses imposed. The coefficients of FDI are positive throughout the empirical models for panel OLS, as well as sector-specific EGLS applied.

## 6 Conclusions and Implications

In this study, the impact of foreign Direct Investment on Gross Domestic Product at the sector-specific level has been estimated with a panel data approach. To the best of our knowledge, this individual, country-specific study, specifically at the sectoral level, has not been conducted before for Turkey. In this respect, this study provides a unique contribution to the empirical research. In particular, most of the study in the empirical literature has drawn upon strong and rigorous assumptions on homogeneity among the country groups and neglected the fact that country-specific factors are in fact undoubtedly heterogeneous. Weinhold et.al (2001) have argued that “incorrectly imposing such a strong assumption on the data can lead to biased estimates and faulty policy implications”. Thus, country-specific studies need to pay more attention to heterogeneous data. Additionally, the Granger-Causality by Arellano-Bond Dynamic panel-data estimation has widened the scope of this study. We have found one-way link between GDP and FDI and this is from FDI to GDP.

We have ten years of data available, from year 2000 to 2009. Although there was no additional good quality data available, choosing a longer time span would cause a structural break issue in any case. It is arguable whether this length is long enough to be long-run. However, there are similar studies with the identical length and size of observation (e.g. Mathiyazhagan, M.K. 2005).

Principally GDP is chosen as the dependent variable in ten sectors and it is controlled with three explanatory variables over these ten sectors. The control variables are important components of GDP according to the literature on economic growth theory. Thus, labor productivity and exports have been chosen in addition to the inward foreign direct investment stock for Turkey.

The results indicate a positive relationship between the variables and it is confirmed that when the stock of inward FDI increased in Turkey, GDP followed in the same direction. In other words, FDI caused GDP to grow. The coefficients of FDI exhibit positive and statistically significant throughout the empirical study which can convince the conclusions about positive impact of FDI upon GDP. The results also are consistent with basic neo-classical theory, where augmented capital accumulation induces “technological progress”

and productivity; hence a raise in economic growth. However, this improvement can only be observed in the residuals. In this study however, we were not able to isolate domestic investment due to lack of available data, thus we could not measure the magnitude of coefficients. Therefore we hesitate interpreting the residual as a “technological progress” rigorously.

The results also confirm the convergence theory, where less developed countries grow faster than developed countries. When the other variables, such as labor productivity and export, are controlled, the results have shown that the magnitude of coefficients for labor productivity is positive, while export exhibits negative coefficients.

When we switch the dependent variable to labor productivity and control the FDI and export variables, it is confirmed that FDI influences labor productivity. These results are consistent with the theory of the spill-over effect of FDI upon labor productivity. It is also related to the absorption capacity, where in different states of economies, spill-over can raise labor productivity in the developing country.

One of the main objectives of the study is to investigate and see the effect of FDI between the individual sectors. In order to investigate this, it is required that the EGLS-LSDV estimation technique be utilized. With this empirical method, it is possible to obtain individual coefficients of the sectors as well as the constants. The result shows that FDI still has a positive impact on GDP overall. When labor productivity is controlled, the results show that not all sectors are enjoying the benefit of FDI. As a result of this estimation, logLPR does not contribute to the GDP, in sectors such as financing and business (FINB), hotels and restaurants (HRS) and mining (MIN) to the same extent as the other sectors. This is not a surprising result because industrial-sectors, where advanced technology is widely used, enjoy the benefit of technology spillover. It is consistent with the endogenous growth models, which suggest that different levels of R&D activities are essential for productivity and technological growth hence, positive effect on output in an economy.

As a result of the findings, some implications can be discussed. Considering that FDI has an overall positive impact on GDP, it is plausible that the government needs to keep pursuing a FDI-led growth policy. We do hesitate though to form strong statement about the effect of

FDI on GDP, in Turkey. This statement should not be construed to mean that FDI created a miracle in Turkish economy, rather it is well known prospect in the literature that FDI can act as an important catalyst for developing economies, especially at the converging stage. Furthermore, our findings -concerning the sector specific analyses- suggest that FDI seems to possess important contributions to labor and industrially oriented sectors where advanced, technologically intensive capital is required. Although this is an important aspect of progress at the earlier stages of catching-up progression, governments should take great concern to consider the *“crowding out effect”*, and design the policy which is needed to encourage domestic investors as well. Thus, it is vital for the policy makers to concern themselves with which type of foreign capital flow, as well as how much should be received into the country and which sector should be mainly encouraged to open up to the Multinational Enterprises.

In the nutshell, even though Europe has been struggling in a deep economic recession throughout the late 2007 to 2010 and further, Turkey has performed well with annual percentage growth rate of GDP at an average of around 2.5 percent during the same period. It indicates that it has paid off liberalizing the country’s economy and exposing it to the global economy. Generally, it is found in this study that Turkey appeared to enjoy the benefit of FDI over the last decades, and furthermore, FDI brought a considerable boost to the Turkish economy in terms of productivity growth. On the other hand, it should be argued that there is another side to the coin, which policy makers should take into consideration with great caution in regard to the policy which neglects domestic investment. Domestic investment is very important constituent of FDI, hence policy makers should not stick on merely into FDI policy and serve the resources on golden plate, while discriminating against the domestic investors. Rather, they should consider creating better conditions for domestic investment in addition to the conditions for FDI.

And finally, there is a believable reason to repeat this study when better data collection is available in the future. A larger and accurate data collection would make it possible to improve this study and investigate the subject more accurately, hence, it would help to draw more trustworthy conclusions. A Future study can also employ more control variables such as education, political stability and openness to increase the robustness.

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## Appendix A

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Sectors specifications according to *ISIC Rev.2* (International Standard Industrial Classification) standards<sup>20</sup>.

- 1. AGR -Agriculture, Hunting, Forestry and Fishing**
  - - Agriculture and Hunting
  - - Forestry and logging
  - - Fishing
- 2. MIN -Mining and Quarrying**
  - - Coal Mining
  - - Crude Petroleum and Natural Gas Production
  - - Metal Ore Mining
  - - Other Mining
- 3. MAN -Manufacturing**
  - - Manufacture of Food, Beverages and Tobacco
  - - Textile, Wearing Apparel and Leather Industries
  - - Manufacture of Wood and Wood Products, Including Furniture
  - - Manufacture of Paper and Paper Products, Printing and Publishing
  - - Manufacture of Chemicals and Chemical, Petroleum, Coal,
  - - Manufacture of Non-Metallic Mineral Products, except Products of Petroleum
  - - Basic Metal Industries
  - - Manufacture of Fabricated Metal Products, Machinery and Equipment
- 4. EGW -Electricity, Gas and Water**
  - - Electricity, Gas and Steam
  - - Water Works and Supply
- 5. CON -Construction**
  - - Construction
- 6. WHS -Wholesale and Retail Trade and Restaurants and Hotels**
  - - Wholesale Trade
  - - Retail Trade
  - **HRS -Restaurants and Hotels**
- 7. COMM -Transport, Storage and Communication**
  - - Transport and Storage
  - - Communication
- 8. FINB -Financing, Insurance, Real Estate and Business Services**
  - - Financial Institutions
  - - Insurance
  - - Real estate and Business Services
- 9. EHS -Community, Social and Personal Services**
  - - Public Administration and Defence (Discarded)
  - - Sanitary and Similar Services
  - - Social and Related Community Services
  - - Recreational and Cultural Services
  - - Personal and Household Services
  - - International and Other Extra-Territorial Bodies
- 10. -Activities not Adequately Defined (Discarded)**
  - Activities not adequately defined

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<sup>20</sup> Source: UN <http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=8&Lg=1>