

Foreign Direct Investment, Human Capital
Accumulation and Economic Growth:
The Case of Transition Countries

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List of Abbreviations

FDI - Foreign Direct Investment

MNCs - Multinational Corporations

CEB - The Central-Eastern Europe and the Baltic States

CIS - Commonwealth of Independent States

IDP - Investment Development Path

OLI - Ownership, Location and Internalization

NOI - Net Outward Investment

PISA - Programme for International Student Assessment

IMF - The International Monetary Fund

EBRD - The European Bank for Reconstruction and Development

“If ideas are the engine of growth and if an excess of social over private returns is an essential feature of the production of ideas, then we want to go out of our way to introduce external effects into growth theory, not to try to do without them”.

Robert E. Lucas (2002)

Chapter 1

Introduction

As Alfred Marshal noted in 1890, “the most valuable of all capital is that invested in human beings”. Being the most important factor of production and vital to achieving economic growth, human capital measures the quality of the labor supply and can be accumulated through education, additional education and experience. Externalities or the spillovers of superior technology brought with foreign direct investment (FDI) as determinants of the growth rate of human capital are also of the most importance. An increase in human capital through technology spillovers from abroad is captured by instruction, education and training of employees to meet the higher standards. More precisely, multinational corporations (MNCs) in the host economy increase the degree of competition and force existing firms (including the inefficient ones) to make themselves more productive by investing in human capital (see Magnus Blomström, 1991). "MNCs also provide the training of labor and management which may then become available to the economy in general" (Magnus Blomström, 1991). Besides getting spillover benefit from FDI, an existing human capital is also of great necessity for absorbing superior technology brought from abroad. Therefore, there is an interrelationship between human capital formation, FDI and economic growth.

There are three streams of empirical literature (selected) on this topic. FDI inflow and Economic Growth \rightarrow Human Capital: M. Blomström (1991); M. Blomström, R.E. Lipsey and M. Zejan (1992); A. W. Krause (1999); D. Checchi, G. De Simone, R. Faini (2007). Human Capital and Economic Growth \rightarrow FDI inflow: A. W. Krause (1999); M. Blomström and A. Kokko (2003); D. Checchi, G. De Simone, R. Faini (2007). FDI and Human Capital \rightarrow Economic Growth: M. Blomström (1991); M. Blomström, R.E. Lipsey and M. Zejan (1992); E. Borensztein, J. De Gregorio, J-W. Lee (1998); A. W.

Krause (1999); M. Carkovic and R. Levine (2002); N. F. Campos and Y. Kinoshita (2002).

The most of the empirical literature have been done on developed and developing countries and have not considered the distinctive framework of transition countries. By transition countries we mean the Central-Eastern Europe and the Baltic States (CEB), South-Eastern Europe (SEE) and Commonwealth of Independent States (CIS) and Mongolia, which have transited to a market economy after the collapse of the former Soviet Union, opened their economy, and needed the superior technology from developed countries and the high quality human capital meeting the world standards to achieve economic growth. Therefore, the transition countries make an interesting case study for the dynamics of human capital, FDI and economic growth. Most of the countries in our sample, including the Central Asia and the Caucasus countries have been outside of the mainstream of researches. The noteworthy research for transition countries has been done by N. F. Campos and Y. Kinoshita (2002) for 25 transition countries from 1990 to 1998 analyzing the impact of FDI on GDP growth rate.

Whether or not FDI causes human capital and economic growth is a topic of much debate (see Krause, 1999), and there is no clear evidence on the existence of positive productivity externalities in the host country caused by foreign MNCs (see L. Alfaro, A. Chanda, S. K. Ozcan and S. Sayek, 2007). As already mentioned, there is simultaneity between FDI, human capital and economic growth. The previous empirical findings on FDI and economic growth may be considered skeptical because they do not fully control simultaneity bias, the use of lagged dependent variables and country specific factors (see Carkovic. M and Levine. R, 2002). Hence, the estimates can be biased.

The streams of theoretical literature (selected) in Micro and Macro levels:

Macro level

- Human Capital and Economic growth: R.E. Lucas (1988); Mulligan and Sala-i-Martin (1993); Greiner (2008).

Micro level

- FDI, Human Capital and Economic Growth: Liu (2008); L. Alfaro, A. Chanda, S. K. Ozcan and S. Sayek (2007).
- FDI: F. Toubal and J. Kleinert (2005), Y. Xing and G. Wan (2006).

Micro and Macro levels

- Schooling and Economic Growth: M. Bils and P. J. Klenow (2000).

In our theoretical models, we will utilize and extend the above mentioned theoretical papers.

In the dissertation, we have case study for the Central-Eastern Europe and the Baltic States (CEB), the South-Eastern Europe (SEE) and the Commonwealth of Independent States (CIS) and Mongolia covering the period 1990 to 2008.

We integrate the three streams of empirical literature, complement them with our extensions of the above mentioned theoretical literature and apply them to the countries in our sample. We contribute to the theoretical literature on Economics of Education; extending M. Bils and P. J. Klenow (2000) by incorporating additional explanatory factors such as the spillovers from FDI, migration and mortality rates, and analyze the dynamics of schooling. We also contribute to the endogenous growth theory with Lucas style models by incorporating FDI's spillover effect on human capital formation. The purpose is to find the interrelationships between FDI, human capital and economic growth (on the existence of public investment) and study their dynamics and the stability of the model.

In order to contribute to the empirical literature, which complements our theoretical models, we use 29 transition countries and new explanatory variables being specific to them. The assembled data comprise a panel data set for the period 1990 to 2008 with yearly observations. The data set is different from the previously used data structure such that, in our case, it is subject to the equations of our theoretical models. For instance, in comparison to F. Campos and Y. Kinoshita (2002), who analyzed the impact of FDI inflow on economic growth for the transition countries for the period 1990 to 1998 using fixed effects estimations for single equations (obtained from E. Borensztein, J. De Gregorio, J-W. Lee, 1998), we resort to system GMM estimations (with more observation periods and using FDI stock instead of FDI inflow such that FDI stock is believed to capture the spillover effects). Therefore, our data set is increased with additional explanatory variables for human capital, FDI stock and GDP growth rate: repetition and drop-out rates at primary and secondary schools, pupil teacher ratio (as a measure of human capital quality), infant mortality rate, migration, economic reform indicators (enterprise reform, forex and trade liberalization, banking sector reform, infrastructure reform, private sector share/GDP), private credit to domestic sector and etc.

Additionally, to take care of the simultaneity problems, we use various econometrics tools. Especially, we apply dynamic panel data analysis using Arellano and Bover/Blundell and Bond system estimator. This Generalized Method of Moments (GMM) estimator allows us to find the consistent and efficient estimates. We will also follow GMM estimator approach by S. R. Bond, A. Hoeer and J. Temple (2001) that

exploits stationarity restrictions. According to S. R. Bond, A. Hoeer and J. Temple (2001), “there is a problem with using the first-difference GMM panel data estimator cross country growth regressions. Because when time series are persistent, the first differenced GMM estimator can be poorly behaved, since the lagged levels of the series provide only weak instruments for subsequent first differences”.

It is also worthwhile to note that all possible determinants of human capital, FDI and economic growth in our theoretical and empirical analysis are carefully investigated.

The thesis proceeds as follows: Chapter 2 reviews the facts on foreign direct investment, human capital and economic growth in transition countries. The chapter comprises an economic overview and the investment development path of the countries in our sample; Central-Eastern Europe and the Baltic state (CEB), South-Eastern Europe (SEE) and Commonwealth of Independent States (CIS) and Mongolia. Using the Investment Development Path (IDP) hypothesis by John H. Dunning (1981a), we analyze systematic relationship between the countries’ economic development and the outward and inward direct investment position. The analysis is done on individual country and cross-sectional bases. The analysis of the Investment Development Path is the starting point for the subsequent empirical analysis throughout the thesis. Through economic review and the IDP analysis, we group the countries according to their economic development and investment development path, which will be very important for econometric analysis in the dissertation. The chapter is complemented by the analysis of the possible measures of human capital. We investigate the advantages and disadvantages of different measures of human capital, and choose the existing best measure of human capital for the countries in our sample (in our case: secondary and tertiary school enrollment rates, and the average years of education).

Chapter 3 presents three theoretical models.

Model 1: Static model of Schooling and Human Capital Accumulation. We contribute to the existing literature on Mincerian returns to education by extending the schooling model by Mark. B and P. Klenow (2000). We incorporate into the model the spillover effects of superior technology brought with foreign direct investment, and the net migration and the death rates (infant mortality rate) following the approach by Charles I. Jones (2007). From the first model, an equation on the determinants of human capital formation is derived for econometric analysis.

Model 2: An endogenous growth model with foreign direct investment and human capital. Our model is inspired mainly by Lucas (1988), Rebelo (1991), Mulligan and Sala-i-Martin (1993), Greiner (2008), and Liu (2008). Lucas (1988) assumes that hu-

man capital accumulation has only human capital as input. Rebelo (1991) and Mulligan and Sala-i-Martin (1993) consider two sector growth models where human capital is accumulated, in addition to human capital, through physical capital too. Greiner (2008) extends Lucas style models by incorporating public spending (public resources used in the schooling sector) in the human capital accumulation, excluding physical capital. Liu (2008) focuses on externality in the human capital accumulation by adding public information on technologies and management methods brought through foreign direct investment. However, Liu (2008) does not consider public spending or physical capital in human capital production function and does not develop it as a growth model. We contribute to the endogenous growth theory by analyzing the relationship between foreign direct investment and economic growth with a special emphasis on human capital formation through spillover effects. The role of public investment in production sector and human capital formation is also incorporated. The stability and dynamics of the growth model are analyzed.

Model 3: FDI Decision Making. We consider an economy where the technical progress is the result of increasing capital. We closely follow Romer (1990), Grossman and Helpman (1991), Barro and Sala-i-Martin (1995) and Borensztein, Gregoire and Lee (1998), which focused on an increase in the number of varieties of capital goods. Different from this literature, we assume that the total capital in the economy is the sum of domestic capital and foreign capital. Final good sector is slightly different from the previous model, renting the domestic capital from households and buying the foreign capital from foreign producers. Household's utility maximization problem is the same as in the previous model. In this model, we will concentrate on the production of foreign capital goods, which can either be produced in home country or host country. Our purpose is to find the determinants of foreign investment decision making, which will be proxied by the present value of future profits of foreign investors. From the model on FDI decision we derive two equations for estimations; one for the determinants of foreign direct investment and one for the determinants of economic growth.

Chapter 4 deals with the empirical specification of the equations obtained from the theoretical models and data analysis. Econometric methodology is presented in Chapter 5. Estimation results and discussion are presented in Chapter 6. Chapter 7 draws conclusions and presents policy implications.

Chapter 2

Facts on Foreign Direct Investment, Human Capital and Economic Growth in Transition Countries

2.1 Economic Overview and Investment Development Path

Investment Development Path (IDP) hypothesis is investigated for Central-eastern Europe and the Baltic states (CEB), South-eastern Europe (SEE) and Commonwealth of Independent States (CIS) and Mongolia to find systematic relationship between the countries' economic development and the outward and inward direct investment position. The analysis is done on individual country and cross-sectional bases. Through the IDP analysis, we group the countries according to their economic development and investment development path, which will be very important for econometric analysis.

The IDP theory introduced by Dunning (1981) is an extension of Eclectic Paradigm. The IDP theory explains the outward and inward direct investment position of countries with respect to their economic development. According to Eclectic Paradigm, three factors explain foreign direct investment stock of countries; ownership, location and internalization (OLI) advantages.

Ownership advantages: Refer to competitive advantages of domestic firms to engage in foreign direct investment. These advantages include trademarks, patents, production technique, managerial know-how, entrepreneurial skills, scale or preferential access to

raw materials or to markets.

Location advantages: The host country's attractiveness to other countries in terms of economic and political system, infrastructure, physical distance, labor composition, wages, and existence of raw materials.

Internationalization advantages: Indicating the advantages for the firm to exploit the ownership advantages in the international markets; more profitable for the firm to exploit its assets in international market rather than in domestic market.

According to the Investment Development Path Theory, countries pass through five main stages of development classified by OLI advantages (Dunning and Narula,1996). Changes in OLI advantages impact the international investment position of countries with respect to their development and are explained with the countries' net outward investment (NOI: outward FDI minus inward FDI) and gross domestic product levels.

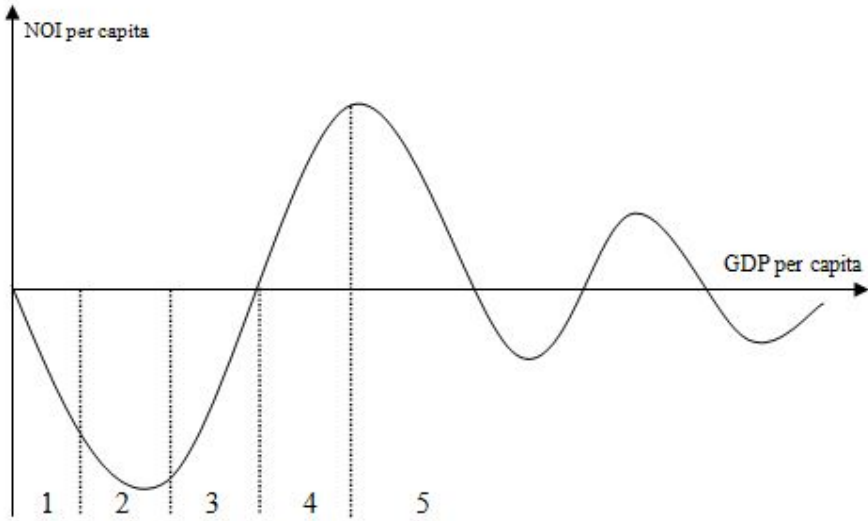


Figure 2.1: The investment development curve with five stages of development NOI

Stage 1: Dunning and Narula (1996) argues that in this stage the location advantages of a country are not sufficient to attract foreign investment. The reasons behind these are improper economic systems and government policies, inadequate labor force and infrastructure to promote FDI. The ownership advantages of domestic firms are also not sufficient. Therefore, outward FDI of the country is likely to be very little. Therefore, the government must intervene "providing basic infrastructure and upgrade

human capital through education or training" (Dunning and Narula, 1996). That is, before a country can attract significant inward FDI, it must develop its location advantages including an increase in GDP per capita. "Consequently, in the first stage, we expect a rapid increase in GDP per capita more than NOI per capita. But, in the second stage the growth rate of NOI per capita can be expected to be higher than GDP per capita" (Buckley and Castro, 1998).

Stage 2: As the country possesses satisfactory location specific advantages (especially, with the help of government policies), inward FDI starts to rise, while outward direct investments still remain low or negligible. In this stage, inward FDI stocks rise faster than GDP.

Stage 3: The ownership advantages of domestic firms grow. Eventually, the rate of outward FDI begins to increase. Gradual decrease in the growth rate of FDI inflows is observed. This results in increasing net outward investment level (NOI) of the country. In this stage, ownership advantages induced by government become less significant, because ownership advantages induced by FDI become more important. Therefore, domestic firms' growing ownership advantages are the main determinants of outward FDI.

Stage 4: Outward FDI stock of the country exceeds or equals the inward FDI stock. Still, outward FDI grows faster than inward FDI. At this stage, domestic firms compete with foreign owned firms in the domestic sector and also enter foreign markets. Since the ownership advantages of the domestic firms become similar to those in other fourth stage countries, trade and foreign investment among these countries will rise.

Stage 5: In the fifth stage of IDP, the NOI level of a country first falls and then fluctuates at the zero level, and at the same time inward and outward FDI continue to rise. Today's situation in advanced industrial countries depends on the short term evolution of exchange rates and economic cycle. "Beyond a certain point in the IDP, the absolute size of GNP is no longer a reliable guide of a country's competitiveness neither indeed is its NOI position" (Dunning and Narula, 1996).

Numerous studies on IDP have been done on developed and developing countries. Dunning (1981) and Dunning and Narula (1996) analyzed the IDP stages of a group of countries using cross section data, regressing GDP on NOI to find J-shaped relation between GDP and NOI. Later on Duran and Ubeda (2001) also analyzed the IDP stages of countries with cross section data. Time series analysis have been done by Buckley and Castro (1998) for Portugal, Bellack (2000) for Austria, Barry, Gord and McDowell (2001) for Ireland, Alvares (2001) for Spain.

Following Dunning (1981), Dunning and Narula (1996) and Buckley and Castro (1998), we adopt the regression equation of quadratical functional form to describe the IDP curve. "Quadratical functional form provides a means of testing whether J-shaped or inverted L-shaped investment development curve gives a good fit of the cross section data" (Tolentino, 1993).

$$NOI_{pc} = \beta_0 + \beta_1 GDP_{pc} + \beta_2 GDP_{pc}^2 + \varepsilon \quad (2.1)$$

Expected signs for coefficients are $\beta_1 < 0$ and $\beta_2 > 0$ in order to get J-shaped relation between GDP and NOI.

In order to analyze the relationship between a country's net outward investment (NOI) and its economic development, we will initially analyze the IDP stages of transition countries individually by using time series data. Then, using aggregate data, we will estimate aggregate IDP using aggregate GDP and the net outward investment position of the region.

Transition countries in our sample are classified in Table (2.1).

Central-eastern Europe and the Baltic states (CEB)	South-eastern Europe (SEE)	Commonwealth of Independent States (CIS) and Mongolia
Czech Republic	Bulgaria	Russia
Estonia	Croatia	Armenia
Hungary	Romania	Azerbaijan
Latvia	Albania	Belarus
Lithuania	Bosnia and Herzegovina	Georgia
Poland	FYR Macedonia	Moldova
Slovak Republic	Montenegro	Ukraine
Slovenia	Serbia	Kazakhstan
		Kyrgyz Republic
		Mongolia
		Tajikistan
		Turkmenistan
		Uzbekistan

Table 2.1: Classification of Transition Countries by Region

Since 1990, remarkable progress has been made in transition countries to a market economy, especially in liberalization, banking reforms and privatization of state-owned

properties. Almost all countries in our sample have adopted a special FDI regime dealing with foreign direct investment, focusing on tax and custom duty breaks, relaxed restrictions on foreign ownership. In the previous literature, some central eastern European countries and Baltic States has been investigated for IDP or other purposes. Duran and Ubeda (2001) grouped economies together using cluster technique¹ and came to the conclusion that Hungary, Slovenia, Latvia, Lithuania, Moldova, Poland, Romania and Russian Federation are in the third stage of development. However, the CIS countries have been outside of the mainstream of researches. Therefore, this makes the selected transition countries an interesting case study to test the IDP hypothesis. Figure (2.2) gives an overview of GDP per capita for the transition countries. The data on GDP per capita have been obtained from the World Bank Education Statistics.

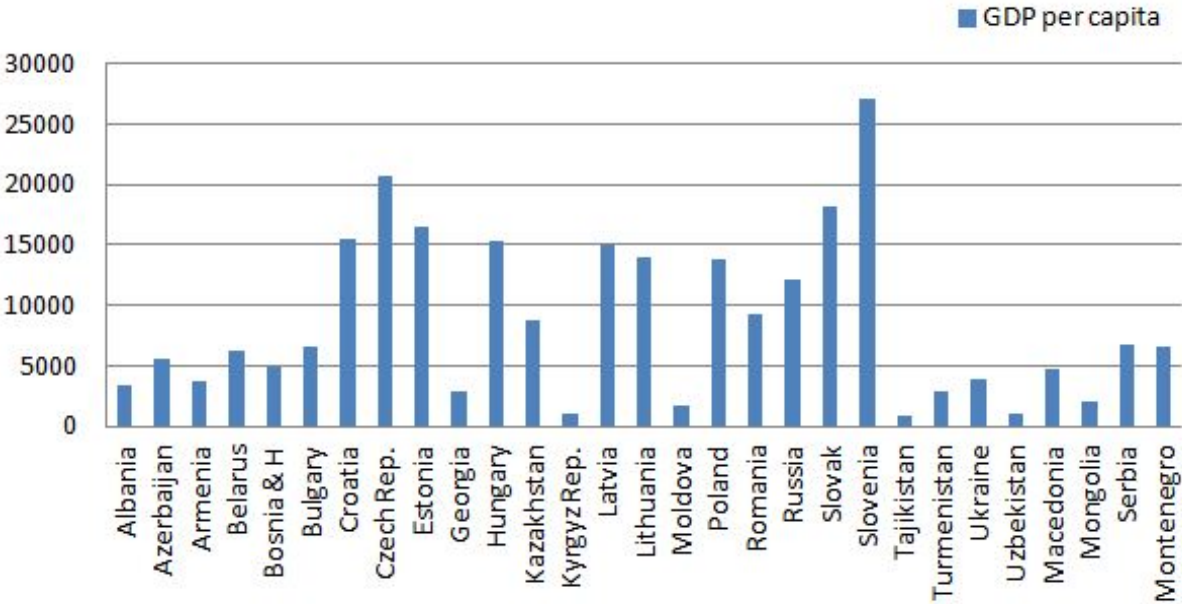


Figure 2.2: GDP per capita for Transition Countries, 2008

As seen from Figure (2.2), according to GDP per capita levels, most of the big Central-eastern and South-eastern Europe countries dominate. In general, average GDP per capita for transition countries is increasing as depicted in Figure (2.3). Due

¹Cluster analysis assigns a set of countries into clusters (or groups) so that the countries in the same cluster are more similar to each other than to those in other clusters.

to the lack of sufficient data, Bosnia, Serbia and Montenegro have been excluded from the graph.

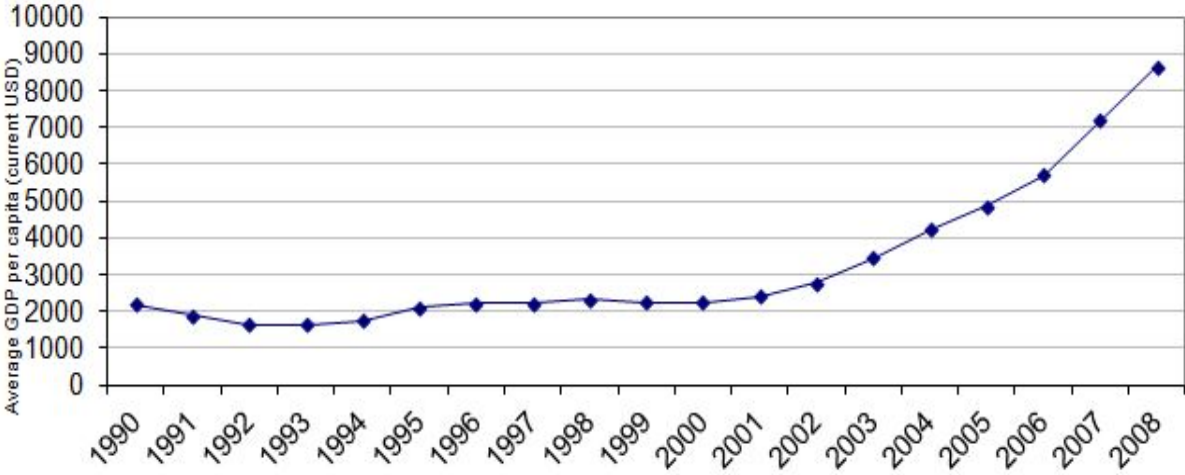


Figure 2.3: Average GDP per capita for transition countries, 1990 - 2008

The inward and outward FDI flows as a percent of GDP in 2008 are depicted in Figure (2.4). The data have been obtained from IMF Balance of Payments and EBRD Transition Report 2008. Bosnia, Serbia, Montenegro and Uzbekistan have been excluded.

According to the data in 2008, all countries except Azerbaijan and Moldova have more inward FDI flows than outward FDI flows. This implies that the transition countries still draw more inward FDI than their outward FDI and might be in the second stage of IDP.

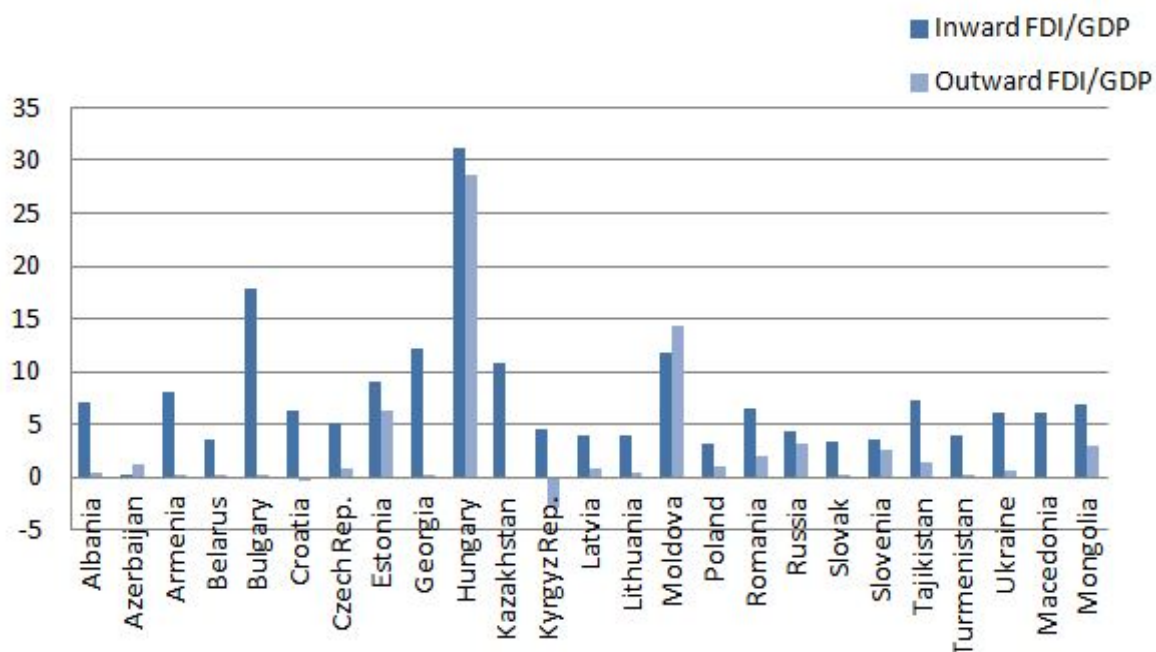


Figure 2.4: Inward and Outward FDI Flows Share in GDP, 2008

To determine the IDP stages of individual countries, we resort to scatter plots provided in Appendix (A.3) and analyze the changes of NOI per capita with respect to GDP per capita level of each country. As we have already noted, in the first and second stage of IDP, inward FDI increases accompanied by an increase in GDP level. In transition to the third stage, outward FDI rises and the growth rate of inward FDI flows decreases. In the third stage, net outward investment is expected to rise.

According to the scatter plots, Albania, Armenia, Belarus, Bosnia, Bulgaria, Croatia, Georgia, Kazakhstan, Ukraine, Uzbekistan, Macedonia, Mongolia, Serbia and Montenegro are in the second stage of IDP. These countries are characterized by increasing inward FDI and low outward FDI. Azerbaijan, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Russia, Slovak Republic and Slovenia are between the second and third stage of IDP.

To determine the IDP stages as a whole in the transition countries, initially we analyze the inflow and outflow levels of FDI in aggregate as depicted in Figure (2.5). Turkmenistan, Mongolia, Bosnia, Serbia, Montenegro and Uzbekistan have been ex-

cluded due to the lack of data.

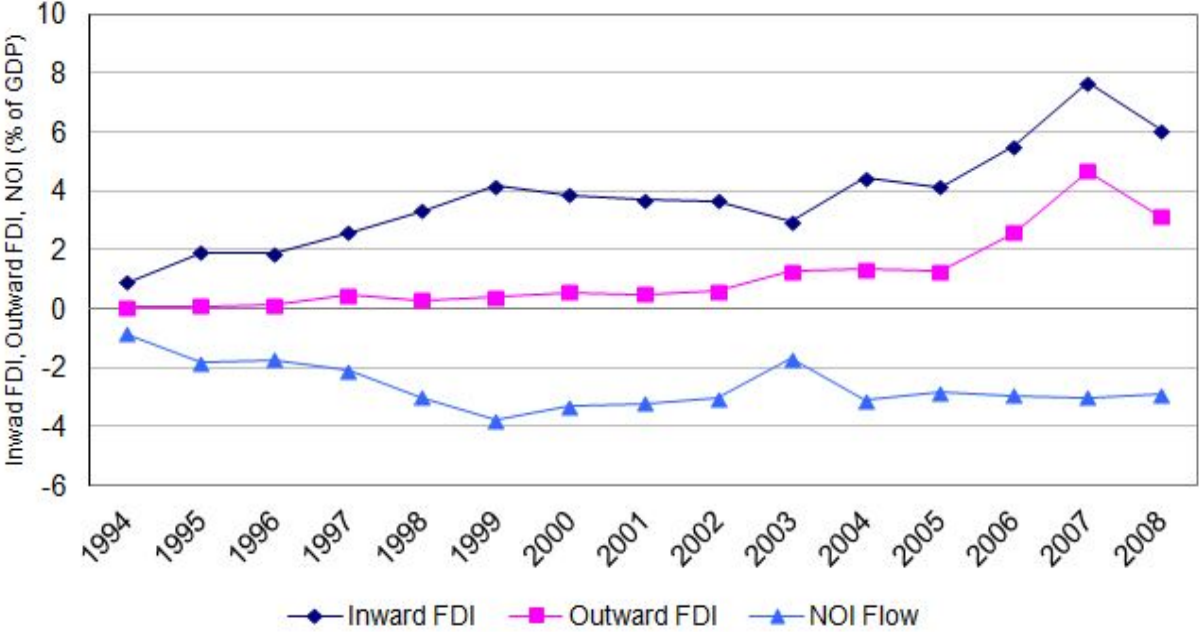


Figure 2.5: Aggregate Outward and Inward FDI Flows and NOI, 1994 - 2008

Although the FDI inflows to the region varies over years, there is an increasing trend. Despite an increasing trend in FDI outflows, it is still below the inward FDI level. As a result, net outward investment decreases. At this point, we should mention that the lack of data after 2008 does not allow us to analyze the impact of European financial crisis, which started in the fall of 2008. However, we can bring a hypothetical explanation to the decline in inward and outward FDI flows during 2007-2008. From 2007 to 2008, inward FDI has decreased more than outward FDI. This has been accompanied by an increase in net outward investment. Because of the lack of data after 2008, it is not so obvious whether this reduction has been impacted by global financial crisis in the fall of 2008 or not. During that time, Central and Eastern Europe was a flash point in the crisis, and the new eastern members of the European Union faced surging inflation and double digits were observed in Bulgaria, Estonia, Latvia, and Lithuania. All transition countries have undergone an increasing inflation rate. Detailed information on inflation rates in transition countries are provided in Appendix (A.4). However, as shown in

Figure (2.6), the decrease in FDI inflows have been observed in Central Europe and the Baltic states, and South-eastern Europe; Bulgaria, Estonia, Latvia, Lithuania, Hungary, Croatia, Poland and Slovakia.

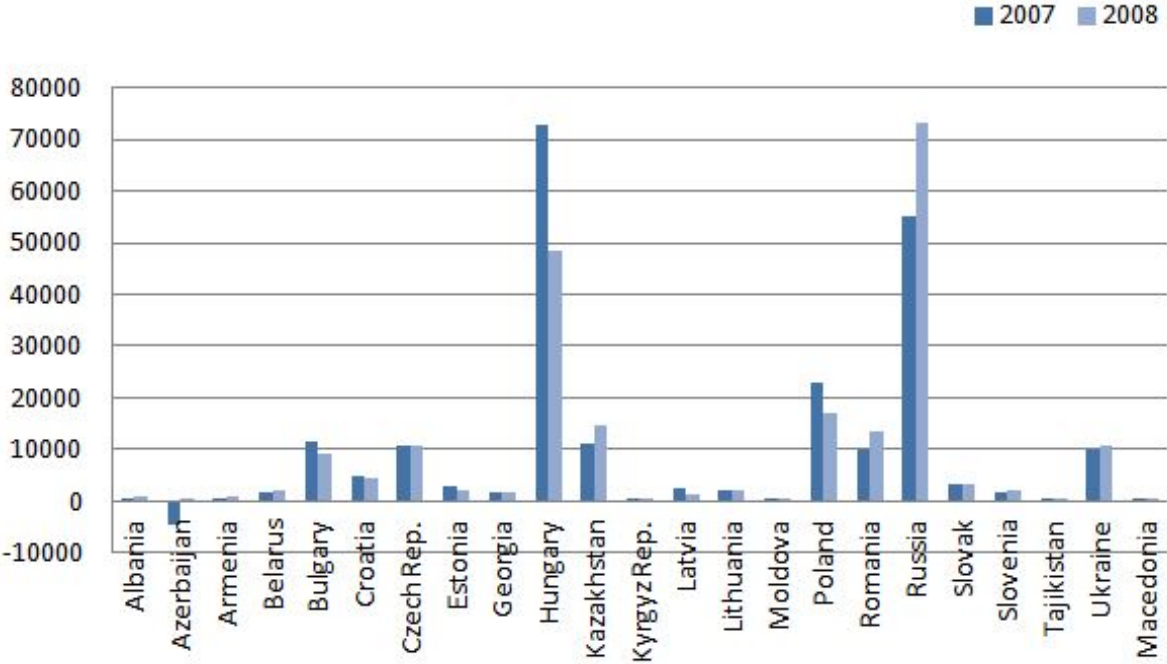


Figure 2.6: FDI inflows by countries, 2007 - 2008 (USD millions)

The reduction in inward FDI flows of Central and Eastern European countries has caused the reduction in aggregate inward FDI flows. Although net outward investment has increased in the period 2007-2008, in our time series it has a decreasing tendency and is still below the inward FDI level. This can indicate that, in aggregate, transition countries are in the second stage of Investment Development Path.

Figure (2.7) shows the NOI position of transition countries (in aggregate). Serbia, Montenegro and Bosnia have been excluded.

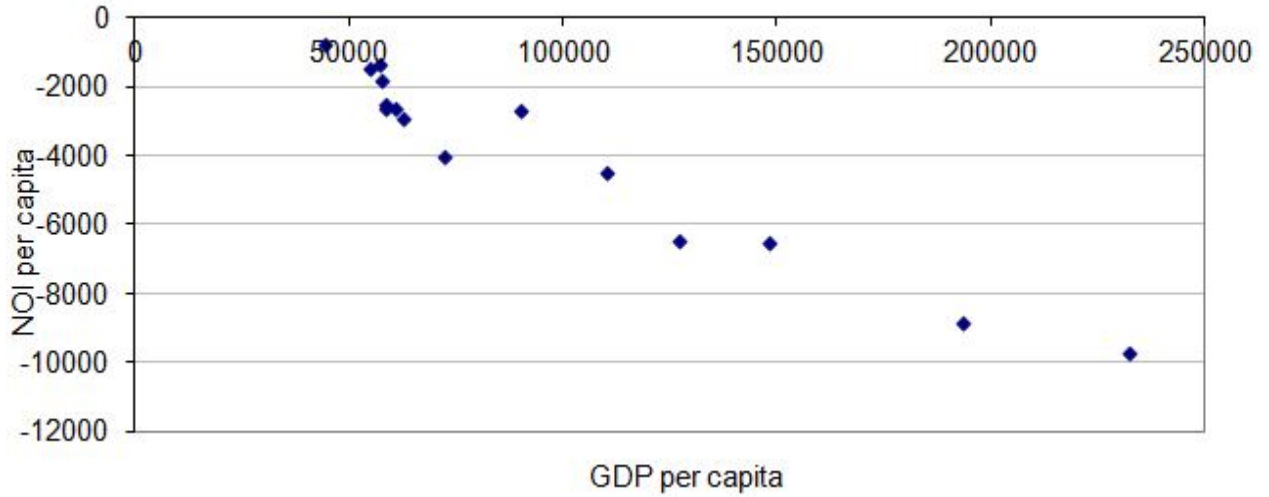


Figure 2.7: IDP of Transition Countries (Aggregate), 1994 - 2008

Based on decreasing NOI level, transition countries appear to be at the end of the second stage of IDP. Because inward FDI grows faster than outward FDI. Using OLS, we estimate IDP position of all 29 transition countries for the period 1990-2008 with 461 observations. The estimation result is given as below:

$$NOI = 28.51385 + (-67.10005)GDP_{pc} + 2.264844GDP_{pc}^2 \quad (2.2)$$

t-values are 2.02, -12.42, 7.31 for constant, GDP_{pc} and GDP_{pc}^2 , respectively. Confirming the expected signs, the coefficients for GDP_{pc} and GDP_{pc}^2 are negative and positive, respectively. The result suggests that the IDP hypothesis to find systematic relationship between economic development and the outward and inward direct investment position is well defined for transition countries. We find that the low level of outward FDI in the transition countries is reflected by insufficient ownership advantages of domestic firms, and that transition countries are in the second stage of IDP, meaning that they still draw more inward FDI than their outward FDI.

2.2 Measure of Human Capital

Human capital is the most important factor of production. Human capital is of extreme importance for achieving growth in GDP. It facilitates structural changes caused by globalisation and technological change over the past years in transition countries. Therefore, in addition to drawing the superior technology from abroad through FDI, one of the most important policies of each government is to promote the growth of human capital. Human capital measures the quality of the labor supply. Human capital can be accumulated through education and experience. Furthermore, externalities like the teacher human capital and the spillovers from superior technology brought with foreign direct investment also determine the growth rate of human capital. In this section, we look for the right measure of human capital for transition countries in our sample and the founded measures will be used in our econometric analysis.

We differentiate four measures of human capital utilizing the analysis method of Bergheim (2005); years of education, attainment rates - guides for future, enrollment rates - future human capital, and quality of human capital.

Years of education: Average years of education of people between 25 and 64 years. It is considered as the best measure of human capital. The average years of education are an aggregation of the average graduation levels attained by individuals. Barro R. J. and J. Lee (2000) have presented data on average years of schooling until 2000 for the countries in our sample. But unfortunately, the observations are not satisfactory for our estimations. Therefore we turn to alternative measures.

Attainment rates –guides for the future: The different attainment rates at secondary and tertiary levels and their development over groups of individuals can provide information about the future path of the average years of education. "If the new entrants into the labor market have spent more time in school than those retiring, then the average human capital or the working age population will rise" (Bergheim, 2005). Attainment rates are not useful for econometric analysis because "a tertiary attainment rate of 40% of the young cohort can signal either a rise in human capital or a decline, depending on the starting level of average human capital of the overall population" (Bergheim, 2005).

Enrollment rates - future human capital: Enrollment rates also provide important information about the future development of human capital. Enrollment rates are calculated by dividing the number of students of a particular age group enrolled in all levels of education by the number of people in the population in that age group.

When compared with the present human capital, enrollment rates can indicate the future human capital.

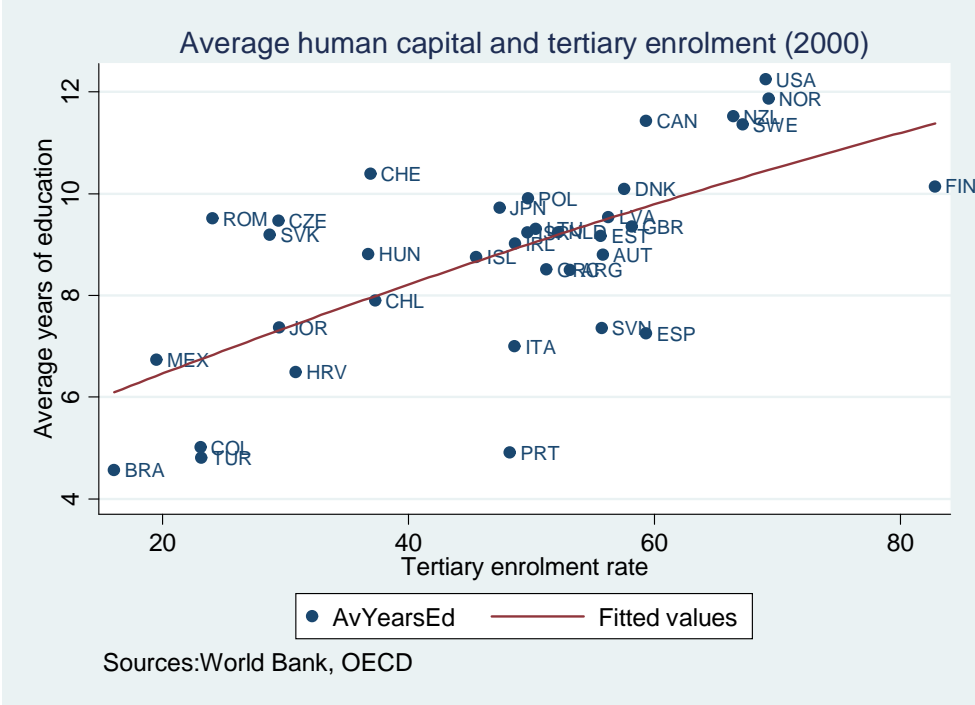


Figure 2.8: Average human capital and tertiary enrollment (2000)

As the chart shows, the tertiary enrollment in Romania, the Czech Republic, Slovakia and Hungary are not high enough to allow a significant rise in average human capital in the coming years. There is a relatively high tertiary enrollment rates in Slovenia, which indicates that the average years of education are set to rise significantly in future. Estonia, Latvia, Lithuania and Poland are characterized with high enrollment rates and high average human capital. Considering the case of Canada, Sweden and Norway, we can say that the possible higher enrollment rates in these countries will be followed by high average human capital.

Quality of human capital

Measure of human capital should indicate the quality of labor input. The average years of education measures the time spent in school but it does not reflect what he has actually learned during that time. Therefore, whether the average years of education can reflect the quality of human capital is skeptical. Although there is an incentive

for the individual to go to schooling to increase his human capital because of the expectation that there is a high probability for skilled people to be employed easily and to get high salary, there can also be the case that some people go to school just to give signal to a future employer about the level of his human capital. Nevertheless, he can get positive influence from the education environment. In our opinion, the average years of education should not be considered as reflecting human capital qualitatively. Despite this, there is another possibility to measure the quality of human capital. In this regard, the OECD’s PISA (Program for International Student Assessment) test and the literacy scores of CIA’s World Factbook are helpful. The disadvantage of this data is that there is the lack of time series in many countries in our sample, and therefore, it is not suitable for estimations. We choose the Science and Mathematics PISA score and investigate its relationship with the average years of education in the following chart.

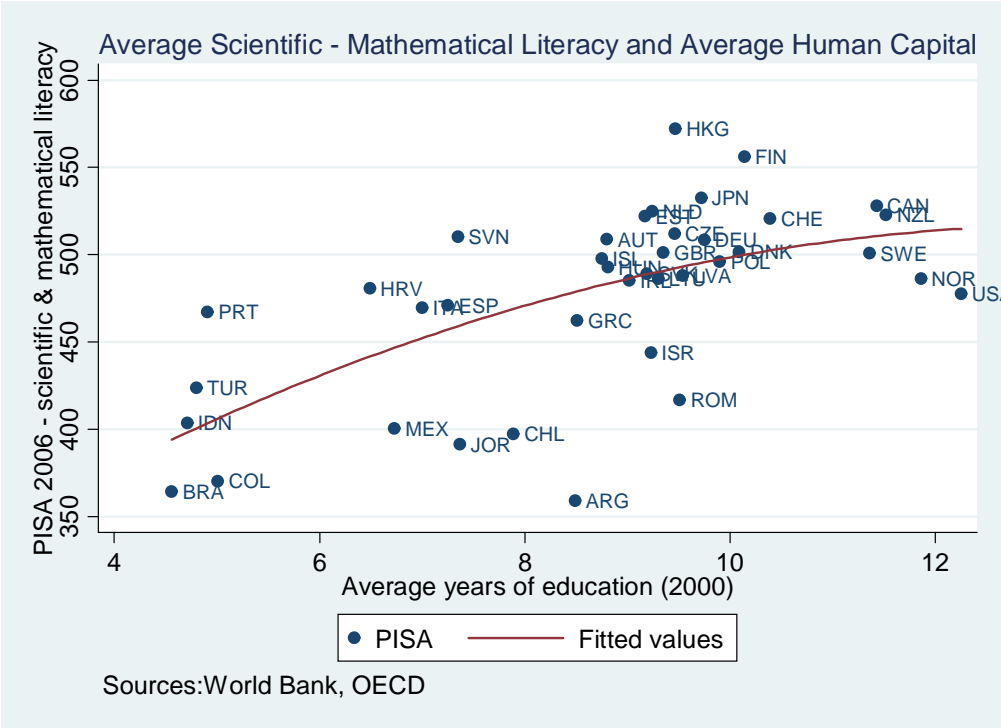


Figure 2.9: Average Scientific - Mathematical Literacy and Average Human Capital

As the chart illustrates, there is a high correlation between the years of education and the PISA literacy score. The summary of two charts for transition countries are

given Table (2.2) in relative comparison.

Level	Enrolment Rates (2000)	Average Years of Education (2000)	Science & Mathematical Literacy, PISA (2006)
High	<ul style="list-style-type: none"> • Estonia • Latvia • Lithuania • Poland • Slovenia 	<ul style="list-style-type: none"> • Estonia • Latvia • Lithuania • Poland • The Czech Rep. • Slovakia • Hungary • Romania 	<ul style="list-style-type: none"> • Estonia • Latvia • Lithuania • Poland • The Czech Rep. • Slovakia • Hungary • Slovenia
Low	<ul style="list-style-type: none"> • The Czech Rep. • Slovakia • Hungary • Slovenia 	<ul style="list-style-type: none"> • Slovenia 	<ul style="list-style-type: none"> • Romania

Table 2.2: Classification of Transition Countries by Human Capital

The results of the chart and the table suggest that Estonia, Latvia, Lithuania and Poland have high enrollment rates, high average years of education and high Science and Mathematical Literacy. As already mentioned, the Czech Republic, Slovakia and Hungary have low enrollment rates, which indicates that the average years of education will not increase in the coming years. However, these countries already possessed high years of education in 2000. Therefore, the average years of education have been accompanied by high science and Mathematics Literacy in 2006. Slovenia had high enrollment rate and low average years of education in 2000, which suggests that average years of education is going to increase in future. Therefore, it has been followed by high literacy rate in 2006. The case of Romania is similar to the Czech Republic, Slovakia and Hungary with respect to enrollment rates and average years of education. However, average Scientific and Mathematical Literacy score is low.

As measures of human capital, the data for the average years of education and PISA literacy score for our countries are not satisfactory. Hence, in our estimations we will use the enrollment rates (secondary and tertiary). Above we showed that enrollment rates can give an indication about the future human capital (average years of education) and in its turn, there is a high positive correlation between the average years of education

and PISA Science and Mathematics literacy score.

$$\text{Enrollment Rates} \rightarrow \text{Average Years of Education} \rightarrow \text{PISA Science and Mathematics literacy score}$$

Therefore, we can also consider enrollment rates as predictor of the quality of education in future. Since the decision to increase human capital impacts enrollment rates, in our estimations for the determinants of capital in transition countries, we will include enrollment rates as a dependent variable. As to the impact of human capital on economic growth and foreign direct investment flows, we can use the lagged variable for enrollment rates as a proxy for future human capital. However, we are not sure if the enrollment rate increases average years of education in one year or five years. Despite this, as an explanatory variable for FDI flows and economic growth, we will resort to our calculations of the percentage of population with secondary and tertiary education.

Before moving to the theoretical models, it is worthwhile to bring some explanations to the relationship of foreign direct investment and average years of education to have initial picture.

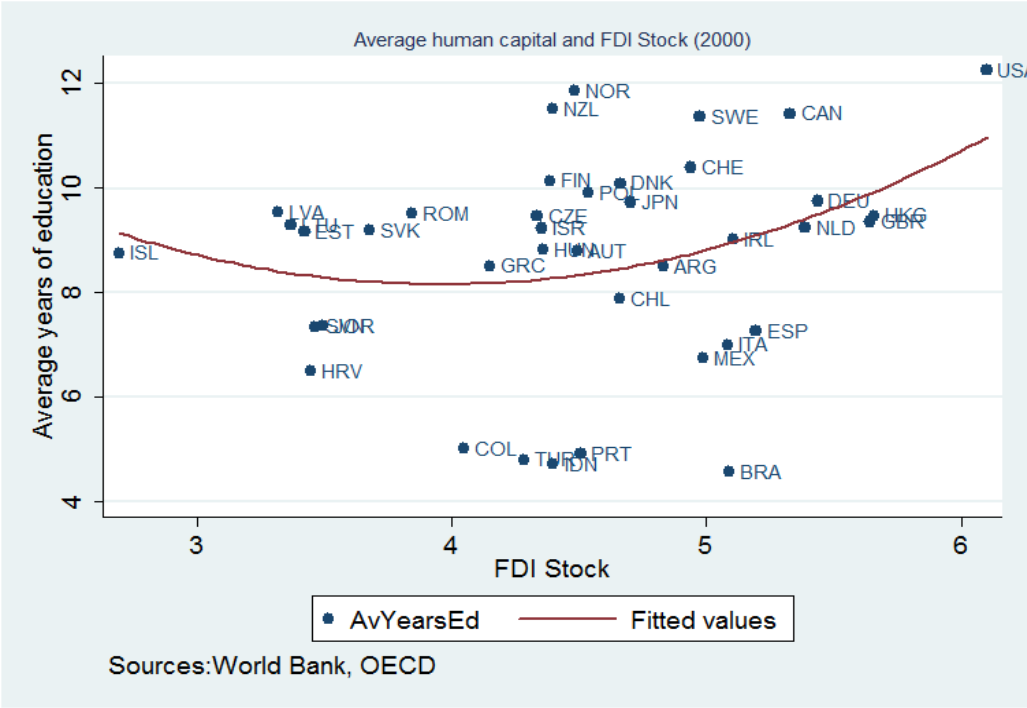


Figure 2.10: Average Human Capital and FDI Stock (2000)

The chart depicts an increasing relationship between the FDI stock and the average years of education. Since data on the average years of education lack for other transition countries in our sample, we include only some of them and complement the chart with developed and developing countries. Hence, in our estimations only FDI stock's impact on the enrollment rates at secondary and tertiary level will be investigated.

In order to see if the government education expenditure increases the quality of education or not, we resort to the following two charts: the first chart depicts the relationship of government education expenditure to the average years of education and the second chart to the quality of education proxied by Science and Mathematical Literacy.

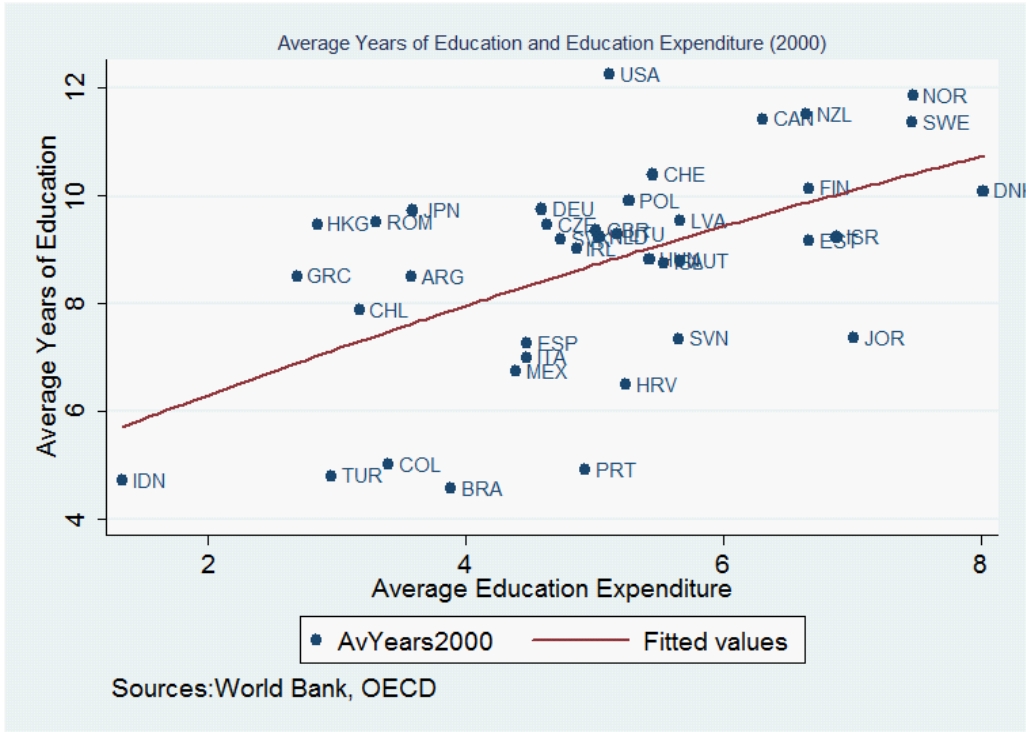


Figure 2.11: Average Years of Education and Education Expenditure (2000)

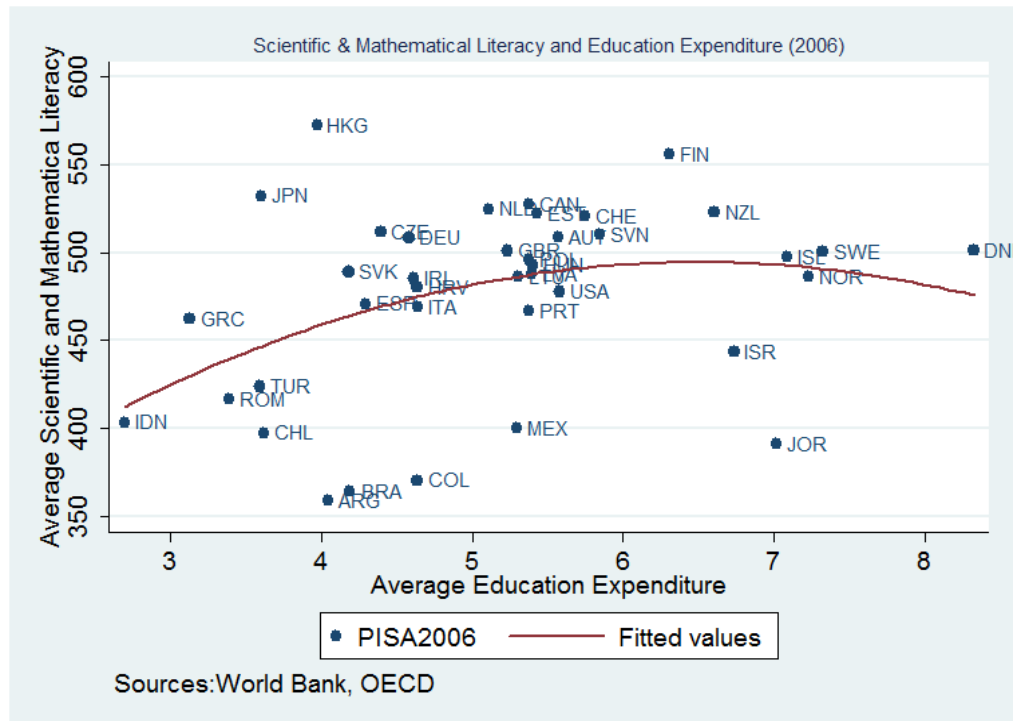


Figure 2.12: Scientific and Mathematical Literacy and Education Expenditure (2006)

According to Figure (2.11), there is a high correlation between the government education expenditure and the average years of education. However, in Figure (2.12) we can see that more spending does not necessarily boost quality. Hence, high spending is not necessarily a sign of a high level human capital. Therefore, countries with high level of human capital should invest more to maintain population's average education level. What increase the quality of education are the students' own incentives and their response to the technological progress considering the high return to education.

Chapter 3

Theoretical Framework

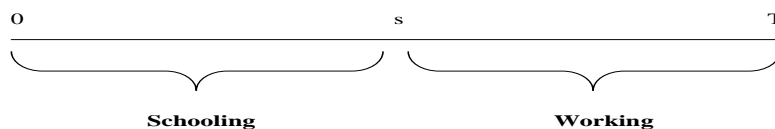
3.1 Model 1: Schooling and Human Capital Accumulation

3.1.1 Introduction and Related Literature

The model is a modified version of the first part of "Does Schooling Cause Growth" by Mark B and P. Klenow (2000), which focuses on the determinants of schooling. We extend it by incorporating the spillover effects from foreign direct investment, the net migration rate and the death rate utilizing "A Simple Mincerian Approach to Endogenizing Schooling" by Charles I. Jones (2007), and analyze the channel to schooling through the presence of foreign direct investment as spillover effects on human capital formation.

3.1.2 Human Capital Formation

Finite lived individuals go to school from age 0 to age s and work from age s to age T .



The aggregate stock of human capital is the sum of the human capital stocks in the economy. Then we have

$$H(t) = \int_s^T h(t)L(t)dt \quad (3.1)$$

where $L(t)$ is the number of workers at time t and $h(t)$ is the level of human capital. Let θ and γ be the percentage gains in human capital in each year at school and work, respectively: $\frac{\dot{h}}{h} = \theta$ on $[0, s]$ and $\frac{\dot{h}}{h} = \gamma$ on $[s, t]$ yield

$$\ln h(s) = \ln h(0) + s\theta \quad (3.2)$$

$$\ln h(t) = \ln h(s) + \gamma(t - s) \quad (3.3)$$

combining these two equations we obtain the level of human capital as¹

$$h(t) = e^{\theta s + \gamma(t-s)} \text{ for all } t > s \quad (3.4)$$

We also assume a positive externality $Q(t)$, which denotes public information on technology and management methods associated with foreign invested firms or in other words, the spillover effects of foreign direct investment: $\dot{Q}/Q = \phi$ on the interval $[0, t] \Leftrightarrow Q(t) = e^{\phi t}$.

$$h(t) = Q(t) e^{\theta s + \gamma(t-s)} = e^{\theta s + \gamma(t-s) + \phi t} \text{ for all } t > s \quad (3.5)$$

Since the individuals, while schooling, obtain satisfactory human capital for working, we can assume that the percentage gain in human capital in each year at school is higher than that at work. That is, $\theta > \gamma$.²

Additionally, following Charles I. Jones (2007), we assume that the workers in the economy are distributed exponentially by age and face a constant death rate δ , and

¹ $h(0)$ is taken as given and assumed to be one. If $h(0) \neq 1$, the results do not change because $h(0)$ is included as constant in $h(t)$ and $h(s)$.

²It seems controversial whether human capital is of exponential form. In our case, assuming constant percentage gains in human capital during the schooling and working period is for simplification purpose.

Other related noteworthy studies on the Mincerian measure of human capital have been done by Lim and Tang (2007) and Cohen and Soto (2002). Lim and Tang (2007) develops a Mincerian measure of human capital distribution and finds a strong evidence of a positive relationship between average education (average years of education) and average human capital (human capital stock developed with Mincer formulation) using data for 99 countries. The authors conclude that an individual's human capital is an exponential function of his own educational level. But the nationwide average human capital is closer to a linear function than an exponential function of average years of education. Cohen and Soto (2002) finds that the years of education is an exponential function of life expectancy.

net migration rate $(E - l)$. The net migration rate is the difference between the number of persons entering, E , and leaving a country, l . An excess of persons entering the country is referred to as net immigration and an excess of persons leaving the country as net emigration. The net migration rate indicates the contribution of migration to the overall level of labor force change. The density is given by $f(a) = (\delta - E + l) e^{-(\delta - E + l)a}$ and replaces L in equation (3.1). Hence, the aggregate human capital takes the form

$$H(t) = \int_s^T (\delta - E + l) e^{\theta s + \gamma(t-s) - (\delta - E + l)t + \phi t} dt \quad (3.6)$$

3.1.3 Productive Sector

A competitive open economy faces a constant world real interest rate. The price of output is normalized to one each period. The production technology is given by

$$Y(t) = K(t)^\alpha [A(t) H(t)]^{1-\alpha} \quad (3.7)$$

The firm maximizes instantaneous profit

$$\max_{K,H} \Pi = K(t)^\alpha [A(t) H(t)]^{1-\alpha} - w(t) H(t) - rK(t)$$

The first order conditions are

$$MPK : \quad \alpha \frac{Y(t)}{K(t)} = r \quad (3.8)$$

$$MPH : \quad (1 - \alpha) \frac{Y(t)}{H(t)} = w(t) \quad (3.9)$$

where $w(t)$ is the *wage rate per unit of human capital*. And $w(t) H(t)$ represents potential earnings. The wage paid to the worker depends not only on the labor supplied or the number of hours worked, but also on his human capital. Such that not all employees that spend the same time get the same wage. That is, their wages differ according to the human capital they possess.

3.1.4 Households

Households are finite-lived and choose a consumption profile and years of schooling to maximize

$$\left(\{c\}_{t=0}^T, s\right) = \arg \max \int_0^T e^{-\rho t} \ln c(t) dt + \int_0^s e^{-\rho t} \xi dt \quad (3.10)$$

Here c is consumption and ξ is flow utility from going to school.

The aggregate budget constraint is

$$\int_s^T e^{-rt} w(t) H(t) dt \geq \int_0^T e^{-rt} c(t) dt + \int_0^s e^{-rt} \mu w(t) H(t) dt \quad (3.11)$$

It states that the discounted value of all income on $[s, T]$ have to be equal to or greater than the present value of consumption on $[0, T]$ and the present value of the tuition fee on $[0, s]$. Where e^{-rt} is the present value factor and $\mu > 0$ is the ratio of tuition to the opportunity cost of student time.

The Lagrange is

$$L = \int_0^T e^{-\rho t} \ln c(t) dt + \int_0^s e^{-\rho t} \xi dt + \lambda \left[\int_s^T e^{-rt} w(t) H(t) dt - \int_0^T e^{-rt} c(t) dt - \int_0^s e^{-rt} \mu w(t) H(t) dt \right]$$

Applying Leibnitz rule for differentiating of an integral, the associated first order conditions for consumption, schooling, and the shadow price, respectively are given by

$$[c(t)] \quad e^{-\rho t} c(t)^{-1} = \lambda e^{-rt} \Rightarrow \lambda = e^{-\rho t} c(t)^{-1} e^{rt} \quad (3.12)$$

Since the individual makes decision while schooling, we convert this equation to time s

$$\lambda = e^{-\rho s} c(s)^{-1} e^{rs} \quad (3.13)$$

[s]

$$e^{-\rho s} \xi + \lambda \left[\int_s^T e^{-rt} w(t) h(t) (\delta - E + l) (\theta - \gamma) e^{-(\delta - E + l)t} dt - (1 + \mu) e^{-rs} w(s) h(s) e^{-(\delta - E + l)s} (\delta - E + l) - \int_0^s e^{-rt} \mu w(t) \frac{\partial H(t)}{\partial s} dt \right] = 0 \quad (3.14)$$

where $\int_0^s e^{-rt} \mu w(t) \frac{\partial H(t)}{\partial s} dt = 0$ because $H(t)$ has been defined for $t > s$ and the alternative costs related to schooling does not change with more schooling.

[λ]

$$\int_s^T e^{-rt} w(t) H(t) dt - \int_0^T e^{-rt} c(t) dt - \int_0^s e^{-rt} \mu w(t) H(t) dt = 0 \quad (3.15)$$

substituting equation (3.13) into equation (3.14) we get

$$\xi c(s) + \int_s^T e^{rs} e^{-rt - (\delta - E + l)t} w(t) h(t) (\theta - \gamma) dt = (1 + \mu) w(s) h(s) e^{-(\delta - E + l)s} (\delta - E + l) \quad (3.16)$$

that is, the sum of the utility from attending schooling plus the present value of future earnings is equal to the sum of tuition and the opportunity cost of student time for the last years spent in school. The difference between human capital gained at school and that gained at work ($\theta - \gamma$) enters as staying in school means forgoing experience.

3.1.5 Comparative Statics

From equation (3.16), we obtain

$$s = \frac{1}{r} \ln \left[\frac{\xi c(s)}{\left[e^{-rs} (1 + \mu) w(s) h(s) e^{-(\delta - E + l)s} (\delta - E + l) - \int_s^T e^{-rt - (\delta - E + l)t} w(t) h(t) (\theta - \gamma) dt \right]} \right] \quad (3.17)$$

where $e^{-rs} w(s) h(s)$ is the present value of the opportunity cost at s (years of schooling). Therefore, it has a negative impact on his schooling enrollment. $e^{-rs} \mu w(s) h(s)$ is the present value of the tuition fee, which also has negative impact on his enrollment. On the other hand, the present discounted value of all income on $[s, T]$ has positive impact on his decision to enroll. Because, if the individual is sure that he will get high salary in future because of the human capital accumulated at schooling time, then he will enroll. Since, the spillovers from foreign investment impacts the discounted value of all income through human capital, then the spillovers have positive impact on schooling decision. Similarly, the utility flow from going to school, $\xi c(s)^\sigma$, has positive impact. The percentage gain in human capital from each year at schooling, θ , has also positive impact. But in contrary, the percentage gain in human capital from each year at work has negative impact on his schooling decision. It could be the case if the individual thinks that it is more efficient to increase human capital at work than at school. However, he knows that the percentage gain from increasing his human capital

at work is not so high, then the individual can enroll at school and prepare himself for future work, which demands high knowledge. At the same time, equation (3.17) shows that death rate has negative impact on schooling, and if $E - l > 0$, then net immigration has positive impact and if $E - l < 0$, then net emigration has negative impact on schooling.

As seen from equation (3.17), there may be an endogeneity problem. The dependent variable is the years of schooling. And the independent variables also depended on the years of schooling. If we accept the opportunity cost and the tuition fee as already given at that time (which could have happened in schooling years), then the problem is relieved except for the present discounted value of all income on $[s, T]$. The future income after school depends greatly on the human capital formed at schooling years. Although, the results above seem to make sense, we try to obtain s from equation (3.17). In the model the real interest rate, r , is world constant. Then from equation (3.8) we get $\frac{\dot{Y}}{Y} = \frac{\dot{K}}{K}$. And from equation (3.9) we have $\frac{\dot{H}}{H} = \frac{\dot{Y}}{Y} - \frac{\dot{w}}{w}$. Substituting these in the derivative of the production function, we get $\frac{\dot{w}}{w} = \frac{\dot{A}}{A} = g_A$. Taking the integral of this equation from time s to time t , we get $w(t) = w(s)e^{g_A(t-s)}$. Additionally, consider $h(t) = h(s)e^{\gamma(t-s)+\phi(t-s)}$ from equation (3.5), and from equation (3.15) at "time" s consider $c(s) = (1 - \mu)w(s)h(s)(\delta - E + l)e^{-(\delta - E + l)s}$. Substituting $w(t)$, $h(t)$, and $c(s)$ into equation (3.17) and simplifying we have:

$$s = T - \frac{1}{r - g_A + \delta - \gamma - (E - l) - \phi} * \ln \left(\frac{\theta - \gamma}{\theta - \gamma - (1 + \mu - \xi(1 - \mu))(r - g_A + \delta - \gamma - (E - l) - \phi)} \right) \quad (3.18)$$

The derivative of equation (3.18) with respect to the rate of return to capital, r , the growth rate of productivity, g , death rate, δ , the spillovers from foreign direct investment, ϕ , and net immigration and emigration (depending on the sign), $E - l$ are the following:

$$\frac{\partial s}{\partial r} < 0, \quad \frac{\partial s}{\partial \delta} < 0, \quad \frac{\partial s}{\partial g} > 0, \quad \frac{\partial s}{\partial (E - l)} > 0 \text{ and } \frac{\partial s}{\partial \phi} > 0 \quad (3.19)$$

The rate of return to capital and the growth rate of productivity enters equation (3.18) together. Schooling reacts negatively to the rate of return of capital (also con-

sidered to be the opportunity cost) and positively to the growth rate of productivity. Bills, Mark and Klenow, Peter J (2000) explains it such that higher growth acts like a lower market interest rate. Hence, by putting more weight on future human capital it stimulates more schooling. As before, the death rate has negative, the net immigration (if $E - l > 0$, then an excess of persons entering the country) has positive, and the net emigration (if $E - l < 0$, and excess of persons leaving the country) has negative impacts on schooling. The spillovers from foreign investment, ϕ , has also positive impact on schooling.

As to the percentage gain in human capital from each year in schooling, θ , it also has positive impact on schooling. The reverse impact is from the percentage gain in human capital from working:

$$\frac{\partial s}{\partial \theta} > 0 \text{ and } \frac{\partial s}{\partial \gamma} < 0 \quad (3.20)$$

The reason for the negative impact of the percentage gain in human capital from working is the same as explained above.

The derivative of equation (3.18) for tuition fee, μ , and the utility flow from going to school, ξ , are the following:

$$\frac{\partial s}{\partial \mu} < 0 \text{ and } \frac{\partial s}{\partial \xi} > 0 \quad (3.21)$$

Equations (3.21) implies that the tuition fee has negative, the utility flow from schooling. The results are summarized in Table 3.1.

Variables	Effect on Schooling
Rate of return on capital	negative
Death	negative
Net emigration	negative
Net immigration	positive
Productivity	positive
Utility from schooling	positive
Spillovers from FDI	positive

Table 3.1: The results of comparative statics analyses, schooling

In order to test the theoretical model's prediction for signs effects of these explana-

tory variables, equation (3.18) will be estimated in a linear form in Chapter 6.

3.2 Model 2: Human Capital Accumulation, Foreign Direct Investment and Economic Growth

3.2.1 Introduction and Related Literature

We present an endogenous growth model utilizing Lucas (1988), Rebelo (1991), Mulligan and Sala-i-Martin (1993), Greiner (2008), and Liu (2008).

Lucas (1988) assumes that human capital accumulation has only human capital as input. Rebelo (1991) and Mulligan and Sala-i-Martin (1993) consider two sector growth models where human capital is accumulated, in addition to human capital, through physical capital too. Greiner (2008) extends Lucas style models by incorporating public spending (public resources used in the schooling sector) in the human capital accumulation, excluding physical capital. Liu (2008) focuses on externality in the human capital accumulation by adding public information on technologies and management methods brought through foreign direct investment. However, Liu (2008) does not consider public spending or physical capital in human capital production function and does not develop it as a growth model.

Our endogenous growth model is inspired by the above mentioned literature. We contribute to endogenous growth theory by analyzing the relationship between foreign direct investment (FDI) and economic growth with a special emphasis on human capital formation through spillover effects. The role of public investment in production sector and human capital formation is also incorporated.

Our economy takes the world interest rate as given. Therefore, we are not going to discuss the effect of the difference or equality of world and domestic interest rates on foreign assets inflow. We accept that foreign assets inflow responds greatly to any differences between interest rates, which in turn depend on exchange rates and the taxation of foreign asset income. Different interest rates might occur in either perfect or imperfect markets, which is also out of the scope of our model. However, we think it could be useful to bring some clarification to this issue. In both markets, the existence of world and domestic interest rate difference is possible explained as following. Under

perfect capital mobility, the difference arises when exchange rate expectations are not static. In this case, interest rate differences are offset by expectations of exchange rate movements (Romer, 2001). Under imperfect capital mobility with floating exchange rate, foreign assets inflow also depends on the interest rate differences. This differential interest rates "hypothesis postulates that capital flows from countries with low rates of return to countries with high rates of return move in a process that leads eventually to the equality of ex ante real rates of return" (Moosa, 2002). Hence different world and domestic interest rates, exchange rates and differentiating market as being perfect and imperfect are out of the scope of the model.

There are a many channels through which FDI affects economic growth. A convenient way is to allow FDI in the production function. FDI can increase the growth by increasing the capital stock. However, if there is perfect substitutability, then this effect will likely be small. If foreign and domestic capitals are complements, then the effect of FDI will be larger because of externalities. If FDI is treated as different input, like the way of expanding the varieties of intermediate good as in Borensztein et al., (1998), then FDI is assumed to raise productivity. Considering these, we develop two open economy endogenous growth models as following:

The first model considers foreign capital as exogenous. We assume that public and human capitals are used proportionally in the production of output and the human capital formation. As in Liu (2008), we include public information in human capital accumulation, and, for simplicity, we assume it to be a linear function of foreign capital. Where public information is characterized by spillover effects of foreign investment on human capital. Aggregate capital is only used in the production sector. In this case, domestic and foreign capitals are assumed to be substitutes and paying the same rate or return (as in open-economy Ramsey Model). The model consists of three-dimensional system of first order differential equations. Our purpose is to investigate the effect of increasing share of foreign capital (in total capital) on economic growth, the reactions of human and productive public capitals, the stability and dynamics of the growth model.

The second model is the extension of the first model and considers foreign capital as endogenous through FDI stock accumulation equation. Additionally, the total capital stock in the production function is disaggregated into domestic and foreign capital stocks, where output's elasticity with respect to foreign capital stock is higher. Through this way we obtain different rates of return on physical capital stocks. Besides, as an incentive to foreign investors, different tax rates are also taken into account. The model

consists of four-dimensional system of first order differential equations. We analyze the relationship between four endogenous variables; consumption, public capital, human capital and foreign capital, and the growth effects, the stability and dynamics of the model.

3.2.2 The Model with Exogenous FDI

We consider an open economy: a final good sector that produces consumption goods and physical capital, a household sector that receive labor income and income from its saving, and the government. Since we consider foreign capital as exogenous, we assume the same income tax, $\tau_k = \tau_{dk} = \tau_{fk}$, and the same rate of return on domestic and foreign capitals, $r = r_{dk} = r_{fk}$. We do this because in the model with exogenous FDI, different real interest and income tax rates on foreign capital do not play any role. However, in the subsequent section with endogenous FDI model, we will consider these rates as incentives to foreign investors. Another reason for assuming equal real interest rates in this model is that we assume that in the long run the real interest rates or marginal productivity on both capital stocks can be equal as long as the quality of domestic capital stock reaches to the quality of foreign capital if we have enough foreign capital stock and spillover effects (we will come to this point in the endogenous FDI model).

However, in this model, we put different labels for income taxes and real interest rates because we will need some of the equations, obtained here, for the model with endogenous FDI.

3.2.3 The Household

In our economy the physical capital is decomposed into domestic and foreign-invested capital. $K = K_d + K_f$ or $(1 - \theta)K + \theta K$. An infinite lived household seeks to maximize overall utility, as given by

$$\max_C \int_0^{\infty} e^{-\rho t} \frac{C^{1-\sigma} - 1}{1 - \sigma} dt \quad (3.22)$$

subject to his/her budget constraint

$$\dot{Q} = (1 - \tau_w)wu_hL + (1 - \tau_{dk})r_{dk}Q - C + T_p + \varrho\Pi \quad (3.23)$$

with $Q = (1 - \theta)K$ denoting the amount of assets, and C , Π , and T_p are the amounts of consumption, profits and transfers, respectively. And τ_w and τ_{dk} are the tax rates on wage income and asset returns. And ϱ is the fraction of profits remained in the economy. Furthermore, u_h is the fraction of human capital or the amount of time used for production and $1 - u_h$ is the amount of time used for human capital accumulation (we will come to this issue later). Π and T_p are taken as given by the household. $T_p > 0$ are lump-sum transfers to the household. If $T_p < 0$, the household has to pay a lump-sum tax.

We formulate the current value Hamiltonian

$$J = \frac{C^{1-\sigma} - 1}{1 - \sigma} + \mu [(1 - \tau_w)wu_hL + (1 - \tau_{dk})r_{dk}Q - C + T_p + \varrho\Pi] \quad (3.24)$$

The associated first order necessary conditions for control (C), state (Q), and co-state (μ) variables, respectively are given by

$$\frac{\partial J}{\partial C} = 0 \quad \Rightarrow \quad C^{-\sigma} = \mu \Rightarrow \frac{\dot{C}}{C} = -\frac{1}{\sigma} \frac{\dot{\mu}}{\mu} \quad (3.25)$$

$$\frac{\partial J}{\partial Q} = -\dot{\mu} + \rho\mu \quad \Rightarrow \quad \dot{\mu} = \rho\mu - \lambda(1 - \tau_{dk})r_{dk} \Rightarrow \frac{\dot{\mu}}{\mu} = \rho - (1 - \tau_{dk})r_{dk} \quad (3.26)$$

$$\frac{\partial J}{\partial \mu} = \dot{Q} \quad \Rightarrow \quad \dot{Q} = (1 - \tau_w)wu_hL + (1 - \tau_{dk})r_{dk}Q - C + T_p + \varrho\Pi \quad (3.27)$$

combining equation (3.25) and (3.26) we obtain

$$\frac{\dot{C}}{C} = -\frac{1}{\sigma} [\rho - (1 - \tau_{dk})r_{dk}] \quad (3.28)$$

Necessary conditions are sufficient if transversality condition given as $\lim_{t \rightarrow \infty} e^{-\rho t} \lambda Q = 0$ holds. Equation (3.28) states that the household will postpone the consumption if the return to assets is greater than the impatience rate ρ . If $\rho > (1 - \tau_{dk})r_{dk}$, the growth rate of consumption will decrease over time because the household has higher impatience than the return to assets. However, in our analysis in the whole paper, we

will stick to maintaining $(1 - \tau_{dk})r_{dk} > \rho$.

3.2.4 The Productive Sector

Utilizing Lucas (1988), Greiner (2006) and Zhiqiang Liu (2006), we assume that output is produced with a constant returns to scale technology and takes the Cobb-Douglas form:

$$Y = AD (K_d + K_f)^{1-\alpha-\gamma} (u_g G)^\alpha (u_h h L)^\gamma \quad (3.29)$$

where A represents exogenous, common technological factors. D is the productivity parameter relating to the superior technology brought through foreign direct investment (Zhiqiang Liu, 2006). G is productive public capital. u_g is the fraction of government spending, which directly affects the production of output. The rest of government spending, $1 - u_g$, is used for education for the purpose of the human capital accumulation and indirectly affects output (we will come back to this issue later). Furthermore, $1 - \alpha - \gamma$, α , and γ represents the elasticities of output with respect to physical capital, public capital and human capital, respectively. If $\alpha = 0$ and D is not included, and h_a (the external effects of human capital) is added, the production function is simplified to that known in Lucas (1988). The firm maximizes instantaneous profit Π :

$$\max_{K,L} \Pi = AD (K_d + K_f)^{1-\alpha-\gamma} (u_g G)^\alpha (u_h h L)^\gamma - w u_h L - r (K_d + K_f) \quad (3.30)$$

the first order conditions are

$$\frac{\partial \Pi}{\partial K} \Rightarrow (1 - \alpha - \gamma) \frac{Y}{K} = r \quad (3.31)$$

$$\frac{\partial \Pi}{\partial L} \Rightarrow \gamma Y (u_h L)^{-1} = w \quad (3.32)$$

From equations (3.30), (3.31), and (3.32) we obtain firm's profit as

$$\Pi = \alpha Y \quad (3.33)$$

3.2.5 Human Capital Formation

The growth of human capital is given by

$$\dot{h} = BP(K_f)^{1-\epsilon-\nu} ((1 - u_h)hL)^\epsilon ((1 - u_g)G)^\nu - \delta_h h \quad (3.34)$$

where B can be considered either shift parameter (Romer, 2001) or a technology parameter (Greiner, 2006) or an efficiency parameter of the production (Zhiqian Liu, 2006). As already mentioned, $(1 - u_h)$ and $(1 - u_g)$ are the fractions of human capital and public capital spent for human capital accumulation. $P(K_f)$ denotes public information on technology and management methods associated with foreign invested firms (Zhiqian Liu, 2006) and K_f is foreign invested capital. Since public information is not an explicit function of the model's parameters, we assume a special case where $P(K_f)$ is linear. Such that $P(K_f) = \Psi K_f = \Psi \theta K$. Where Ψ indicates the reaction of public information to changes in foreign direct investment. And $0 < \epsilon + \nu < 1$ represents the intensity of spillovers. If there are no spillovers, $\epsilon + \nu = 1$. When $\epsilon = 1$ and $\nu = 0$, the equation is simplified to that known in Lucas's model (1988). Considering the linear function and normalizing $L \equiv 1$, the equation for the growth of human capital is given by

$$\dot{h} = B(\Psi \theta K)^{1-\epsilon-\nu} ((1 - u_h)h)^\epsilon ((1 - u_g)G)^\nu - \delta_h h \quad (3.35)$$

3.2.6 The Government

The government is assumed to receive tax income from labor income taxation and taxing the returns on domestic and foreign assets and uses it for public investment and for transfer payments. Thus the government's budget constraint can be written as

$$\dot{G} = (1 - \varphi) (\tau_w w u_h + \tau_{dk} r_{dk} (1 - \theta) K) + \tau_{fk} r_{fk} \theta K \quad (3.36)$$

where φ represents the fraction of tax revenues (excluding the tax income from the return on foreign assets) used for transfers. In turn, $\varphi > 0$ and $\varphi < 0$ represents the fractions for lump-sum transfers and lump-sum tax, respectively. As already mentioned we have assumed $r = r_{dk} = r_{fk}$ and $\tau_k = \tau_{dk} = \tau_{fk}$. We will consider these equalities in the following subsection.

3.2.7 Equilibrium Conditions and The Balanced Growth Path

Definition 1 An equilibrium is a sequence of prices $\{w(t), r(t)\}_{t=0}^{\infty}$, a sequence of household consumption, domestic and foreign assets $\{C(t), K_d(t), K_f(t)\}_{t=0}^{\infty}$, a sequence of government policy $\{G(t), \tau(t), T_p(t)\}_{t=0}^{\infty}$ such that the following conditions are satisfied:

- (i) Given prices, the household decisions $\{C(t), K_d(t)\}_{t=0}^{\infty}$ solve the household problem.
- (ii) The firm maximizes profit.
- (iii) The government's budget constraint is satisfied.

Substituting equation (3.31) into equation (3.28) we derive the growth rate of consumption

$$\frac{\dot{C}}{C} = -\frac{1}{\sigma} \left[\rho - (1 - \tau_k)(1 - \alpha - \gamma)AD \left(u_g \frac{G}{K} \right)^{\alpha} \left(u_h \frac{h}{K} \right)^{\gamma} \right] \quad (3.37)$$

Rearranging equation (3.35) we get the growth rate of human capital

$$\frac{\dot{h}}{h} = B(\Psi\theta)^{1-\epsilon-\nu} \left((1 - u_h) \frac{h}{K} \right)^{\epsilon} \left(\frac{h}{K} \right)^{-1} \left((1 - u_g) \frac{G}{K} \right)^{\nu} \quad (3.38)$$

And resource constraint of the economy is obtained by equations (3.23), (3.29), (3.31), (3.32), (3.33) and considering $Q = (1 - \theta)K$.

$$\begin{aligned} \frac{\dot{K}}{K} = & \frac{1}{1 - \theta} \left[AD \left(u_g \frac{G}{K} \right)^{\alpha} \left(u_h \frac{h}{K} \right)^{\gamma} \{ \gamma (1 - \tau_w + \varphi\tau_w) \right. \\ & \left. + (1 - \alpha - \gamma) (1 - \theta) (1 - \tau_k + \varphi\tau_k) + \varrho\alpha \right] - \frac{C}{K} \end{aligned} \quad (3.39)$$

From the government's budget constraint, equations (3.31) and (3.32) and we get the growth rate of government spending

$$\frac{\dot{G}}{G} = AD(u_g)^{\alpha} \left(u_h \frac{h}{K} \right)^{\gamma} \left(\frac{G}{K} \right)^{\alpha-1} (1 - \varphi) [\tau_w \gamma + \tau_k (1 - \alpha - \gamma) (1 - \theta)] + \tau_k r \theta \left(\frac{G}{K} \right)^{-1} \quad (3.40)$$

where r is given by equation (3.31).

Definition 2 *A balanced growth path follows a path where the economy is in equilibrium and consumption, government spending, physical capital and human capital grow at the same strictly positive constant growth rate, i.e. $\frac{\dot{C}}{C} = \frac{\dot{h}}{h} = \frac{\dot{K}}{K} = \frac{\dot{G}}{G} = \chi$, $\chi > 0$.*

From equations (3.37) - (3.40), at the steady-state, for $\frac{\dot{C}}{C}$, $\frac{\dot{h}}{h}$, $\frac{\dot{K}}{K}$ to be constant, $\frac{C}{K}$, $\frac{G}{K}$ and $\frac{h}{K}$ should be constant. That is $\frac{\dot{C}}{C} = \frac{\dot{K}}{K} = \frac{\dot{h}}{h} = \frac{\dot{G}}{G}$. Since the equations for growth rates depend on the ratio of variables to K , we need to define new variables $\tilde{h} \equiv \frac{h}{K}$, $c \equiv \frac{C}{K}$, and $g \equiv \frac{G}{K}$. Differentiating the new variables with respect to time we get a three dimensional system of first order differential equations of the form:

$$\begin{aligned} \dot{c} = & c[AD(u_g g)^\alpha (u_h \tilde{h})^\gamma \{((\frac{1}{\sigma} - 1)(1 - \tau_k) - \tau_k \varphi)(1 - \alpha - \gamma) \\ & - \frac{1}{1 - \theta} ((1 - \tau_w + \varphi \tau_w) \gamma + \varrho \alpha) \} - \frac{1}{\sigma} \rho + \frac{1}{1 - \theta} c] \end{aligned} \quad (3.41)$$

$$\begin{aligned} \dot{g} = & g[AD(u_g)^\alpha (u_h \tilde{h})^\gamma g^{\alpha-1} (1 - \varphi)(\tau_w \gamma + \tau_k (1 - \alpha - \gamma) (1 - \theta)) \\ & - \frac{1}{1 - \theta} AD(u_g g)^\alpha (u_h \tilde{h})^\gamma \{ \gamma (1 - \tau_w + \varphi \tau_w) \\ & + (1 - \alpha - \gamma) (1 - \theta) (1 - \tau_k + \varphi \tau_k) + \varrho \alpha \} \\ & + \frac{1}{1 - \theta} c + \tau_k (1 - \alpha - \gamma) AD(u_g g)^\alpha (u_h \tilde{h})^\gamma \theta g^{-1}] \end{aligned} \quad (3.42)$$

$$\begin{aligned} \dot{\tilde{h}} = & \tilde{h}[B(\Psi \theta)^{1-\epsilon-\nu} (1 - u_h)^\epsilon \tilde{h}^{\epsilon-1} ((1 - u_g) g)^\nu \\ & - \frac{1}{1 - \theta} \{ AD(u_g g)^\alpha (u_h \tilde{h})^\gamma (\gamma (1 - \tau_w + \varphi \tau_w) \\ & + (1 - \alpha - \gamma) (1 - \theta) (1 - \tau_k + \varphi \tau_k) + \varrho \alpha) - c \}] \end{aligned} \quad (3.43)$$

The steady state levels of consumption, human capital and government spending are found as following. We solve equation (3.41) for $AD(u_g g)^\alpha (u_h \tilde{h})^\gamma$ and substitute it to equations (3.42) and (3.43) to obtain $g(c, \theta..)$ and $\tilde{h}(c, \theta..)$, respectively. Then by

plugging them back into equation (3.41), we can get $c^*(\theta, ..)$ and then get $g^*(\theta..)$ and $\tilde{h}^*(\theta..)$. After finding steady state values, we can analyze the impact of foreign capital share, θ , on these variables and economic growth. However, finding the steady state values is too complex and we expect to get more than one result to $c^*(\theta, ..)$, one of which should be optimal. In order to overcome this complication, we continue with numerical simulations and use the eigenvalue method for continuous-time dynamical systems to analyze the stability of the model economy.

3.2.8 Numerical Analysis: The Effect of Increasing Foreign Investment Share

We fix the following parameter values as benchmark: $\sigma = 1, \varrho = 0.65, \alpha = 0.2, \gamma = 0.5, A = 1, D = 2, \rho = 0.05, u_h = 0.9, u_g = 0.9, \epsilon = 0.5, \nu = 0.2, B = 0.5, \varphi = 0.01, \Psi = 0.5$. And, for simplicity, we assume that the tax rates on wage income and asset returns are equal such that $\tau = \tau_w = \tau_k = 0.12$.

So using the eigenvalue method for continuous-time dynamical system, for different values of $\theta \in (0, 1)$, the solution to the system of differential equations (3.41) - (3.43) for c^*, g^* , and \tilde{h}^* yields the results described in Table (3.2) and the Matlab code is given in Appendix A.

FDI share	c^*	g^*	\tilde{h}^*	\dot{Y}/Y	λ_1	λ_2	λ_3	Stable
$\theta = 0.05$	0.35249	0.53769	0.10458	0.08692	+	-	-	Yes
$\theta = 0.10$	0.37409	0.51716	0.12372	0.09776	+	-	-	Yes
$\theta = 0.15$	0.38694	0.50648	0.13670	0.10467	+	-	-	Yes

Note: λ_i is eigenvalue.

Table 3.2: The impact of the share of foreign assets on growth.

Table (3.2) shows that as the share of foreign capital in the economy increases, the level of human capital increases too. The increase in foreign direct investment and human capital results in increasing growth rate of GDP. On the other hand, the share of public capital in total capital of the economy tends to decrease. It can be

explained such that as the economy is opened to the world (as a result of transition from centralized economy to market economy), foreign investment begins to play much role in the production sector. As to the stability of the balanced growth path, saddle point stability is achieved for all $\theta \in (0, 1)$. In the next section, we extend the model by endogenizing foreign direct investment.

3.2.9 The Model With Endogenous FDI

In this section, we will derive a foreign capital accumulation equation and continue the previous model.

The household's and government's problems are the same as before. However, we will utilize the equations obtained in these sectors and make changes arising from endogenizing foreign capital. We extend the productive sector's problem by considering foreign capital stock as a different input into the production function, and as a result obtain different rates of return on domestic and foreign capitals. In addition to different real interest rates, we consider different tax rates on both capitals.

Foreign Capital Accumulation

From the previous model (with exogenous FDI), we can assume the accumulation of FDI stock in the following form:

$$K_{t+1}^f = \Omega \left((1 - \tau_{fk}) r_{fk} K_t^f + (1 - \varrho) \Pi \right) + newFDIflow_t + (1 - \delta_{ref}) K_t^f \quad (3.44)$$

where Ω is the fraction of existing foreign investors' income that they reinvest in the economy to increase their capital stocks and $(1 - \varrho) \Pi$ is the profit of foreign firms. The decision to reinvest is assumed to be almost the same for new foreign investor and the existing foreign investors in the economy. Therefore, we omit $newFDIflow_t$ from the equation although there are many explanatory variables of new FDI flow, which we will discuss in detail in the second case. Correspondingly, δ_{ref} is the possible repatriation of foreign capital.

The Host Country Production Sector

We rewrite the constant returns to scale Cobb-Douglas production function with foreign capital stock as a different input. We suppose that the elasticity of output with

respect to the foreign capital stock is different from the elasticity of output with respect to the domestic capital stock. We need to find r_{fk} and $(1 - \varrho)\Pi$, the rental rate of foreign capital and the share of total profit going to foreign investors. We find them by maximizing the total profit of the host production sector.

$$\max_{K_d, K_f, L} \Pi = ADK_d^{1-\alpha-\gamma-s} K_f^s (u_g G)^\alpha (u_h h L)^\gamma - w u_h L - r_{dk} K_d - r_{fk} K_f$$

$$\frac{\partial \Pi}{\partial K_d} \Rightarrow (1 - \alpha - \gamma - s) \frac{Y}{K_d} = r_{dk} \quad (3.45)$$

$$\frac{\partial \Pi}{\partial K_f} \Rightarrow s \frac{Y}{K_f} = r_{fk} \quad (3.46)$$

$$\frac{\partial \Pi}{\partial L} \Rightarrow \gamma \frac{Y}{u_h L} = w \quad (3.47)$$

From equations (3.45), (3.46), and (3.47) we obtain the firm's profit the same as in the previous model

$$\Pi = \alpha Y \quad (3.48)$$

For the marginal product of foreign capital stock to be greater than or equal to that of domestic capital stock, the following should hold

$$MPK_f \geq MPK_d \Leftrightarrow \theta \leq \frac{s}{1 - \alpha - \gamma}$$

Hence $r_{fk} \geq r_{dk}$, as long as $\theta \leq s / (1 - \alpha - \gamma)$. We have assumed that the elasticity of output with respect to foreign capital is higher than that to domestic capital. That is $s > 1 - \alpha - \gamma - s$. We do this because in the transition countries, there is a great need for foreign capital because of its high quality. As to the case of developed countries we can assume $s \leq 1 - \alpha - \gamma - s$. That is, the output can depend on both capitals equally or more on domestic capital. For these cases we get the following

$$\text{if } s > 1 - \alpha - \gamma - s \text{ then } \theta \leq \frac{s}{1 - \alpha - \gamma}, \frac{1}{2} < \frac{s}{1 - \alpha - \gamma}$$

$$\text{if } s \leq 1 - \alpha - \gamma - s \text{ then } \theta \leq \frac{s}{1 - \alpha - \gamma} \leq \frac{1}{2}$$

In the previous numerical analysis, we have assumed $\alpha = 0.2$, $\gamma = 0.5$. Assuming $s = 0.2 > 1 - \alpha - \gamma - s = 0.1$, we get $\theta \leq 0.6666$ for transition countries. That is, $MPK_f \geq MPK_d$ for $\theta \leq 0.6666$. It makes sense, because until the share of foreign

capital stock reaches 67% (according to the parameters that we have chosen), there is still an incentive to foreign investors through higher rate of returns on foreign capital stock. If the elasticity of output with respect to domestic capital stock is higher than or equal to that to foreign capital stock, then equilibrium point will be reached at a lower value of θ . That is, if $s = 0.1 < 1 - \alpha - \gamma - s = 0.2$, then $r_{fk} \geq r_{dk}$ as long as $\theta \leq 0.3333$. And if $s = 0.15 = 1 - \alpha - \gamma - s = 0.2$, then $\theta \leq 0.5$. This happens because of the high capacity of domestic capital and the less need for foreign capital.

Equilibrium Conditions and The Balanced Growth Path

Using the different rate of return on domestic capital stock, and different tax rate on this return, the growth rate of consumption given by equation (3.28) is rewritten as

$$\frac{\dot{C}}{C} = -\frac{1}{\sigma} \left[\rho - (1 - \tau_{dk})(1 - \alpha - \gamma - s)AD \left(\frac{K_f}{K_d} \right)^s \left(u_g \frac{G}{K_d} \right)^\alpha \left(u_h \frac{h}{K_d} \right)^\gamma \right] \quad (3.49)$$

Similarly, considering different rate of return on foreign capital stock and different tax rate on this return in equation (3.44), we get the growth rate of foreign capital stock

$$\frac{\dot{K}_f}{K_f} = \Omega AD \left(\frac{K_f}{K_d} \right)^{s-1} \left(u_g \frac{G}{K_d} \right)^\alpha \left(u_h \frac{h}{K_d} \right)^\gamma \left((1 - \tau_{fk})s + (1 - \varrho)\alpha \right) - \delta_{ref} \quad (3.50)$$

The growth rate of human capital is obtained from equation (3.35)

$$\frac{\dot{h}}{h} = B(\Psi)^{1-\epsilon-\nu} (1 - u_h)^\epsilon \left((1 - u_g) \frac{G}{K_d} \right)^v \left(\frac{K_f}{K_d} \right)^{1-v-\epsilon} \left(\frac{h}{K_d} \right)^{\epsilon-1} \quad (3.51)$$

Considering the different real interest and tax rates in equation (3.36), we rewrite the governments budget constraint as

$$\frac{\dot{G}}{G} = (u_g)^\alpha AD \left(\frac{K_f}{K_d} \right)^s \left(\frac{G}{K_d} \right)^{\alpha-1} \left(u_h \frac{h}{K_d} \right)^\gamma \left((1 - \varphi)(\tau_w \gamma + \tau_{dk}(1 - \alpha - \gamma - s)) + \tau_{fk}s \right) \quad (3.52)$$

Using equation (3.23), we obtain the growth rate of capital stock as

$$\begin{aligned} \frac{\dot{K}_d}{K_d} = & AD \left(\frac{K_f}{K_d} \right)^s (u_g \frac{G}{K_d})^\alpha (u_h \frac{h}{K_d})^\gamma ((1 - \tau_w)\gamma + (1 - \tau_{dk})(1 - \alpha - \gamma - s) \\ & + \varphi(\tau_w\gamma + \tau_{dk}(1 - \alpha - \gamma - s)) + \varrho\alpha) - \frac{C}{K_d} \end{aligned} \quad (3.53)$$

As before, we define new variables $\theta_n = \frac{K_f}{K_d}$, $\tilde{h}_n = \frac{h}{K_d}$, $g_n = \frac{G}{K_d}$, $c_n = \frac{C}{K_d}$. Differentiating the new variables with respect to time, we get a four dimensional system of first order differential equations

$$\begin{aligned} \dot{c}_n = & c_n [AD (\theta_n)^s (u_g g_n)^\alpha (u_h \tilde{h}_n)^\gamma [\frac{1}{\sigma} (1 - \tau_{dk})(1 - \alpha - \gamma - s) - ((1 - \tau_w)\gamma \\ & + (1 - \tau_{dk})(1 - \alpha - \gamma - s) + \varphi(\tau_w\gamma + \tau_{dk}(1 - \alpha - \gamma - s)) + \varrho\alpha)] - \frac{1}{\sigma} \rho + c_n] \end{aligned} \quad (3.54)$$

$$\begin{aligned} \dot{g}_n = & g_n [(u_g)^\alpha AD (\theta_n)^s (g_n)^{\alpha-1} (u_h \tilde{h}_n)^\gamma ((1 - \varphi)(\tau_w\gamma + \tau_{dk}(1 - \alpha - \gamma - s)) \\ & + \tau_{fk}s) - AD (\theta_n)^s (u_g g_n)^\alpha (u_h \tilde{h}_n)^\gamma ((1 - \tau_w)\gamma + (1 - \tau_{dk})(1 - \alpha - \gamma - s) \\ & + \varphi(\tau_w\gamma + \tau_{dk}(1 - \alpha - \gamma - s)) + \varrho\alpha) + c_n] \end{aligned} \quad (3.55)$$

$$\begin{aligned} \dot{\tilde{h}}_n = & h_n [B(\Psi)^{1-\epsilon-\nu} (1 - u_h)^\epsilon ((1 - u_g) g_n)^v (\theta_n)^{1-v-\epsilon} (\tilde{h}_n)^{\epsilon-1} \\ & - AD (\theta_n)^s (u_g g_n)^\alpha (u_h \tilde{h}_n)^\gamma ((1 - \tau_w)\gamma + (1 - \tau_{dk})(1 - \alpha - \gamma - s) \\ & + \varphi(\tau_w\gamma + \tau_{dk}(1 - \alpha - \gamma - s)) + \varrho\alpha) + c_n] \end{aligned} \quad (3.56)$$

$$\begin{aligned} \dot{\theta}_n = & \theta_n [\Omega AD (\theta_n)^{s-1} (u_g g_n)^\alpha (u_h \tilde{h}_n)^\gamma ((1 - \tau_{fk})s + (1 - \varrho)\alpha) - \delta_{repf} \\ & - AD (\theta_n)^s (u_g g_n)^\alpha (u_h \tilde{h}_n)^\gamma ((1 - \tau_w)\gamma + (1 - \tau_{dk})(1 - \alpha - \gamma - s) \\ & + \varphi(\tau_w\gamma + \tau_{dk}(1 - \alpha - \gamma - s)) + \varrho\alpha) + c_n] \end{aligned} \quad (3.57)$$

The solution of the system is done by numerical analysis. First, we get the steady state values based on the benchmark parameters. Then spillover parameters and possible determinants of foreign investment inflow are analyzed (all parameters are increased). It is worthwhile to note that we are not going to find optimal parameter values.

We want to know how economic growth and the variables under the analysis react to changes in these parameters. The founded steady states for the ratio of the variables to domestic capital stock is converted to their ratios to total capital stock. The ratios of the variables to total capital stock are founded as following. First, we find the share of foreign capital stock in total capital stock. $\theta_n = \frac{K_f}{K_d} = \frac{\theta K}{(1-\theta)K} \Leftrightarrow \theta = \frac{\theta_n}{1+\theta_n}$. Having founded this, we find $g_n = \frac{G}{K_d} = \frac{G}{K} \frac{1}{1-\theta} \Leftrightarrow g = \frac{G}{K} = g_n (1 - \theta)$. Similarly, $c = \frac{C}{K} = c_n (1 - \theta)$ and $\tilde{h} = \frac{h}{K} = \tilde{h}_n (1 - \theta)$. The results are summarized in Table (3.3).

Parameters		c^*	g^*	\tilde{h}^*	θ^*	\dot{Y}/Y	Stable
Benchmarks		0.58902	0.98174	0.44408	0.39496	0.09168	Yes
Spillovers							
$D = 2.05$	↑	0.59396 ↑	0.97671 ↓	0.43106 ↓	0.39510 ↑	0.09297 ↑	Yes
$B = 0.75$	↑	0.60847 ↑	0.96272 ↓	0.47914 ↑	0.39551 ↑	0.09675 ↑	Yes
$\Psi = 0.55$	↑	0.59475 ↑	0.97592 ↓	0.45429 ↑	0.39513 ↑	0.09318 ↑	Yes
Incentives							
$\rho = 0.70$	↑	0.60428 ↑	1.00212 ↑	0.45140 ↑	0.38497 ↓	0.09061 ↓	Yes
$1 - u_g = 0.20$	↑	0.61262 ↑	0.95891 ↓	0.51027 ↑	0.39562 ↑	0.09784 ↑	Yes
$1 - u_h = 0.25$	↑	0.66947 ↑	0.91415 ↓	0.71683 ↑	0.39700 ↑	0.11266 ↑	Yes
$\tau_{fk} = 0.125$	↑	0.59042 ↑	0.99349 ↑	0.44441 ↑	0.39400 ↓	0.09180 ↑	Yes

Note: The stability is achieved with one positive and three negative eigenvalues.

Table 3.3: Spillover effects and determinants of FDI

As seen from Table (3.3), the spillovers from foreign direct investment have positive impact on economic growth. Except for D (the productivity parameter relating to the superior technology brought through foreign direct investment), the other spillover parameters, B (technology parameter in human capital accumulation equation) and Ψ (the reaction of public information to changes in FDI) increase human capital directly. Since D is the productivity parameter in our production function, it should be accompanied by an increase in the technology parameter B in the equation of human capital formation, which has positive impact on human capital formation. It is also interesting that the spillover parameters have also positive impact on the share of foreign capital stock to total capital stock. It means that the spillovers brought by foreign investment influences the inflow of subsequent foreign investment.

Incentives for foreign investment in our model were characterized by the fraction of the profit that foreign investors get, the fractions of human capital and public capital

spent for the human capital formation. As the fraction of the profit remaining in the economy increases from $\varrho = 0.65$ to $\varrho = 0.70$, the share of foreign capital is decreasing. Since ϱ increases domestic capital stock, the tax revenue from domestic capital increases government investment and an increment in government investment has positive impact on human capital formation through government education investment. Despite an increment in human and public capitals, the decline in foreign capital results in low growth rate. Similarly, the tax τ_{fk} on the return from foreign capital has negative impact on foreign capital stock, and increases government investment, and the government investment increases human capital. Therefore, government investment plays an important role for human capital formation even though foreign investment decreases. Unlike ϱ , which indirectly increased government investment, τ_{fk} increases government investment directly and results in high growth rate. However, the growth rate does not increase forever. It should be noted that the variables and even the growth rate are the concave function with respect to tax rate. The turning point for τ_{fk} is 0.41 for which the growth rate is 0.094869. As $\tau_{fk} = 0.42$ and 0.50, the growth rates become 0.094865 and 0.094596, respectively. Therefore, there should not be too high tax rate on the return from foreign capital. As already mentioned, these values should not be considered as real, because we are not interested in finding the optimal values. They are chosen just for the purpose of analysis. The other incentives, $1 - u_g$ and $1 - u_h$ (the fraction of human and public capitals spent for human capital formation) increases human capital and foreign capitals, but decreases the ratio of public capital to total capital. Although the share of public capital decreases, high human and foreign capitals results in high growth rates.

3.3 Model 3: FDI Decision Making

We consider an economy where the technical progress is the result of increasing capital. We closely follow Romer (1990), Grossman and Helpman (1991), Barro and Sala-i-Martin (1995) and Borensztein, Gregorio and Lee (1998), which focused on an increase in the number of varieties of capital goods. Different from this literature, as already mentioned in the previous model (subsection 3.2.9), we assume that the total capital in the economy is the sum of domestic capital and foreign capital, $K = K_d + K_f$. Final good sector is slightly different from the previous model, renting the domestic capital from households at a rental rate r_{dk} , and buying the foreign capital from foreign

producers at a price, P_f . Household's utility maximization problem is the same as in the previous model. In this section, we will concentrate on the production of foreign capital goods, which can either be produced at home country or host country. Our purpose is to find the determinants of foreign investment decision making, which will be proxied by the present value of future profits of foreign investors.

Foreign investor takes human capital, H , productive public capital, G , and domestic capital, K_d , as given. Foreign investor's decision is what quantity of foreign capital to produce and at what price. Besides these, foreign investor faces a number of factors that can impact on his decision. We will explain these factors step by step and derive the profit function of foreign investors.

Initially, we focus on the setup cost. An increase in foreign capital requires the adaptation of more advanced technology from foreign countries to allow the entrance of foreign capital. This adaptation process is costly and requires a fixed setup cost before the entrance of foreign capital can take place. Following Borensztein, Gregorio and Lee (1998), we can assume that the fixed setup cost depends negatively on the ratio of foreign capital to the ratio of total capital (K_f/K). Such that foreign investors bring "an advanced knowledge" to the host country, making it easier to adopt the technology brought with foreign capital. Therefore, foreign direct investment is considered as the main channel of technological progress. Additionally, the existence of catch up effect in technological progress is also considered. Catch up effect reflects the fact that it will be cheaper to imitate existing products for some time than to produce new capital goods at the frontier of innovation (Borensztein, Gregorio and Lee, 1998). Borensztein, Gregorio and Lee (1998) assumes that the set up cost depends positively on the ratio of capital goods produced domestically (K) to those produced in more advanced countries (K^*). That is, if K/K^* is lower, then imitation possibilities are larger and hence the cost of adopting the new technology will be lower. The setup cost can be postulated in the following form

$$F = F(K_f/K, K/K^*), \text{ where } \frac{\partial F}{\partial (K_f/K)} < 0 \text{ and } \frac{\partial F}{\partial (K/K^*)} > 0 \quad (3.58)$$

Besides the fixed setup cost, each time the foreign capital goods producer engages in production, it incurs one unit of output to use K_f . That is, there is a constant marginal cost of production of K_f equal to 1. Assuming a steady state where the interest rate is constant, net present value (NPV) of future cash flows for foreign capital goods

producer is

$$NPV = \sum_t^n \frac{1}{(1+r)^t} ((1 - \tau_{fk}) P_f K_f - K_f) \quad (3.59)$$

Net present value evaluates the project based on cash flows considering the time value of money by discounting future cash flows at an appropriate discount rate. NPV measures the absolute benefit of the project, and the project is acceptable if NPV is positive. It is worthwhile to note that K_f is independent of time, that is the level of production of each foreign capital goods is the same at each time. Equation (3.59) shows that the cost of production can be covered if the sales price exceeds the marginal cost of production, $P_f > 1/(1 - \tau_{fk})$. Following Levi (1990), we also allow for a country risk, so that the project might stop at year t with a probability p (because of a take over by a host country government). Then the probability for cash flow to arise is $1 - p$, and the probability that cash flow arise for t years is $(1 - p)^t$. Then expected net present value of cash flows is

$$NPV = \sum_t^n \frac{(1-p)^t}{(1+r)^t} ((1 - \tau_{fk}) P_f K_f - K_f) \quad (3.60)$$

and the present value of expected profits is

$$V(\Pi_t^e) = -F(K_f/K, K/K^*) + \sum_t^n \frac{(1-p)^t}{(1+r)^t} ((1 - \tau_{fk}) P_f K_f - K_f) \quad (3.61)$$

as $n \rightarrow \infty$, the profit function is simplified to

$$V(\Pi_t^e) = -F(K_f/K, K/K^*) + \frac{1-p}{r+p} ((1 - \tau_{fk}) P_f K_f - K_f) \quad (3.62)$$

From marginal product of foreign capital in final good sector's profit maximization, the demand for foreign capital follows from the optimality condition equating the price to the marginal productivity of the foreign capital in the production sector of the final good, as being $s \frac{Y}{K_f} = P_f$, which can be expressed as

$$K_f = \left(\frac{ADK_d^{1-\alpha-\gamma-s} (u_g G)^\alpha (u_h h L)^\gamma s}{P_f} \right)^{\frac{1}{1-s}} \quad (3.63)$$

Substituting this into the profit function (3.62) we obtain

$$V(\Pi_t^e) = -F(K_f/K, K/K^*) + \frac{1-p}{r+p} ((1-\tau_{fk})P_f - 1) \left(\frac{ADK_d^{1-\alpha-\gamma-s} (u_g G)^\alpha (u_h h L)^\gamma s}{P_f} \right)^{\frac{1}{1-s}} \quad (3.64)$$

The equation shows that the decision of foreign investor depends on the present value of expected profits and the price of the capital good, P_f . It suggests to have an investment function of the following form

$$FDI_t = FDI \left(V(\Pi_t^e) \right) \quad (3.65)$$

The rational analytical decision making variables for FDI from equation (3.64) are given in Table (3.4).

Explanatory variables	FDI decision
Real interest rate, r	Negative
Country risk, p	Negative
Tax, τ_{fk}	Negative
Domestic capital, K_d	Positive
Productive public capital, G	Positive
Human capital, H	Positive
Existing foreign capital (or lower setup cost)	Positive
Lower catch up (high imitation possibilities and lower setup cost)	Positive
Exchange rates	Ambiguous

Table 3.4: Decision making variables for FDI

The reason for the real interest rate's negative impact can be explained such that the real interest rate can be characterized as the user cost or the rental cost of a capital (e.g machine) that the investor can rent from a rental agency. High tax rate and the country risk (or political instability, corruption) have negative impact on FDI. On the other hand, domestic capital, productive public capital and human capital that characterize the host country's market capacity have positive impact on FDI inflow. The existing foreign capital, which supposedly has already brought "an advanced knowledge" to the host country has positive impact on FDI inflow, because it promotes to the adaptation of new technology and decreases the setup cost.

Profit function is a concave function of the price of foreign capital goods. High

price of foreign capital goods may have positive impact on profits. However, if we assume that the foreign capital goods are produced in a home country and exported to a host country, then this price can be a function of distance costs, that is the price of foreign capital in a host country depends on the price of this capital in a home country multiplied by distance costs (or geographical distance). Therefore, a high price may not be efficient for the seller and buyers. The closer the distance between host and home countries, the lower the price.

It is also worthwhile to explain the effect of exchange rates on foreign investment. Since foreign investment is affected by the level and variability of exchange rates, the effect of exchange rates is ambiguous. If the investor serves local market, then FDI and trade are substitutes (as in our model). In such case, an appreciation of local currency increases foreign investment flows. However, if the foreign investor is export oriented, that is producing in a host country and exporting abroad, then FDI and trade are complements. In such case, through the lower competitiveness, the appreciation of the currency of host country decreases FDI inflows. Although, it appreciation of local currency may indicate a low level of inflation, it also makes the exports from the host country more expensive.

Maximizing the utility from FDI is equal to maximizing utility from $V(\Pi_t^e)$.

The optimal solution to the maximization problem is

$$P_f = \frac{1}{s(1 - \tau_{fk})} > 1 \quad (3.66)$$

Hence the price P_f is constant over time. Substituting this result in equation (3.63), we determine the aggregate quantity of produced foreign capital goods

$$K_f = (ADK_d^{1-\alpha-\gamma-s}(u_g G)^\alpha (u_h h L)^\gamma s^2 (1 - \tau_{fk}))^{\frac{1}{1-s}} \quad (3.67)$$

Since K_f is independent of time, then K_d, G, H, τ_{fk} are taken as given. If we substitute for P_f and K_f in equation (3.64), and assume free entry in the market, and hence, the rate of return r will be such that profit is equal to zero. Then, from zero profit condition, we obtain

$$r = \frac{1-p}{F(K_f/K, K/K^*)} \left((1 - \tau_{fk}) \frac{1}{s} - 1 \right) (ADK_d^{1-\alpha-\gamma-s}(u_g G)^\alpha (u_h h L)^\gamma s^2 (1 - \tau_{fk}))^{\frac{1}{1-s} - p} \quad (3.68)$$

To close the model, we resort to the household's problem (which is the same as in the model with exogenous FDI), where we have obtained $\frac{\dot{C}}{C} = \frac{1}{\sigma} [(1 - \tau_{dk})r_{dk} - \rho]$. In the steady state, the growth rate of consumption is equal to the growth rate of output, that we denote by g . Hence, the growth rate of the economy is given by

$$g = \frac{1}{\sigma} [(1 - \tau_{dk})r - \rho] \quad (3.69)$$

Where r is given by equation (3.68). Equation (3.69) shows that the rate of growth of the economy is determined by household's preference parameters, ρ and σ , the level of technology, country risk (or political risk and corruption), p , domestic capital, productive public capital, and human capital. A greater willingness to save, that is lower ρ and σ , a high level of domestic capital, productive public capital, and human capital will increase the rate of growth of the economy. In addition, a decrease in the setup cost, $F(K_f/K, K/K^*)$, that is an increase in the level of foreign capital raises the rate of return and the rate of growth. In contrast, the country risk, p , decreases the growth rate of economy.

Chapter 4

Empirical Specification and Data Description

4.1 Determinants of Human Capital

The equation that we are going to estimate corresponds to the equation (3.18) at page 36, which we obtained from the model of Schooling and Human Capital and characterizes the determinants of schooling. In the model, schooling refers to the years attended at school. Based on the sign effects of the explanatory variables on schooling, equation (3.18) is expressed in a linear form to be estimated. Since we have missing data on the average years of education for the countries in our sample, we will focus on the enrollment rates at secondary and tertiary levels. We have already mentioned that enrollment rates serve as a proxy for the human capital in future, that is it increases the average years of education in future. Therefore, decision is made on enrollment. Our schooling equation (3.18), can be expressed in a linear form as

$$ER_{it}^j = \alpha_1 UG + \alpha_2 TFP_{it} + \alpha_3 MR + \alpha_4 IMR + \alpha_5 FDIstock_{it} + \alpha_6 ir_{it} + u_{it} \quad (4.1)$$

$$u_{it} = \eta_i + \tau_t + \epsilon_{it} \quad (4.2)$$

where UG is a utility gain from schooling, TFP is total factor productivity, MR is migration rate, IMR is infant mortality rate, $FDIstock_{it}$ is the assumed spillover effect on schooling, and ir_t is a rate of return on capital (which increases an opportunity cost). η_i is a country fixed effect, τ_t is a time fixed effect and ϵ_{it} is an error term.

It is difficult to measure the utility from attending school. Therefore, by following Checchi, De Simone and Faini (2007), we replace the utility from schooling UG with $ER_{i,t-n}$, which is the enrollment rate at time $t - n$. If the dependent variable is the enrollment rate at secondary school, then explanatory variable is the enrollment rate at primary school, which approximately coincides with the students' enrollment at primary school for n years ago. According to the observation of the transition countries, the approximate years can be taken as five years. Previous enrollment rates at primary or secondary level are included because if the students' utility from primary school is high, then enrollment in secondary school is expected to be high. At the same time, if the utility from enrollment at secondary school is high, then the enrollment at tertiary education is expected to rise.

As to the spillover effects of foreign direct investment, we suppose that the spillovers are realized from foreign capital stock rather than foreign capital inflows. And as a proxy for TFP , we take the growth rate of GDP which has the same tendency as TFP . As to the migration, depending on the sign of coefficient α_3 , MR can be either emigration or immigration. If $\alpha_3 < 0$, then there is brain drain. If $\alpha_3 > 0$, then there is brain gain. Explanatory variables along with the relevant control variables are described in Table 4.1.

Variable Name	Definition
RIRate	Real interest rate
MR	Migration rate
IMR	Infant mortality rate
GDPpc	Log GDP per capita
PopDen	Log population density
PrivCredit	Private credit by deposit money banks / GDP
PupilTeacher	Log pupil/teacher primary (tertiary)
EnrPrim	Enrollment rate primary 5 years before
EnrSec	Enrollment rate secondary 5 years before
RepetPrim	Repetition rate primary
GovEdEx	Government education expenditure /GDP
FDIstock	Log Foreign capital stock
TFP	Total Factor Productivity

Table 4.1: Names and Definitions of Explanatory Variables of Schooling

GDP per capita and population density embody the stage of development. We

would also like to consider Gini inequality index. But unfortunately, data for transition countries does not allow this. Therefore, we complement this with credit to the private sector and infant mortality rate. The reason for including infant mortality rate is that the mortality is usually highly correlated with endemic poverty, and also correlated with educational decisions (see Checchi, De Simone and Faini, 2007).

If we exclude real interest rate, total factor productivity, and government education /GDP, then our equation is simplified to the equation given by Checchi, De Simone and Faini (2007). Another difference is that instead of the sum of FDI inflows as a proxy for FDI stock, we take real data on FDI stock. Because FDI stock includes reinvestment and possibly innovation. And spillover effects comes from FDI stock.

4.2 Determinants of Foreign Direct Investment

The equation on the determinants of foreign direct investment is based on equation (3.65). In a linear form, it can be expressed as

$$FDI_{it} = \theta_1 FDIstock_{it} + \theta_2 HC + \varphi_i Z_{it} + u_{it} \quad (4.3)$$

$$u_{it} = \eta_i + \tau_t + \epsilon_{it} \quad (4.4)$$

Since the decision is made on flow variable, we take the explained variables as FDI flows as a percentage of GDP. The implication of equation (4.3) is that FDI flows depend on the existing FDI stock in the economy and the endowment of human capital. Instead of the enrollment rates at school, we adopt the population with secondary and tertiary education as a proxy for human capital. The control variables affecting investment decision choices are given in Z matrix. These explanatory variables are adopted from equation (3.65) and complemented with the variables that the existing empirical literature consider as major determinants of FDI.

Names, definitions and source of explanatory variables are described in in Table 4.2.

Variable Name	Definition
RIRate	Real interest rate
Politics	Country risk, Politics
DCapital	Gross fixed capital formation
PopSec or PopTert	Population with secondary or tertiary education
FDIstock	Log Foreign capital stock
ExRate	Effective exchange rate
Open	Openness, Trade/GDP
Infl	Inflation
GDPg	GDP growth
Initial GDP	Initial income
ProdPC	Productive public capital
Pop	Log Population
Reform	Economic reform index

Table 4.2: Names and Definitions of Explanatory Variables of FDI

The literature suggests that the main location factor for FDI are host country market size, costs, and the riskiness of investment. Market size is typically measured by the gross domestic product of the host country and characterize the potential economies of large scale production. The riskiness of investment in terms of economic and political environment can affect the expected profits from investing such that high macroeconomic and political stability of the host country can attract more FDI (Bevan and Estrin, 2000). With respect to the economic and political risk, we consider macroeconomic stability, e.g. growth, inflation, exchange rate, and political stability, e.g. democracy, corruption. We consider the politics index on political freedom, an indicator of democracy. The data on the politics index is taken from The Polity IV Project supported by the Political Instability Task Force, Societal-Systems Research, and Center for Systemic Peace. The indicator for democracy is the ranking based on the Polity score for the level of democracy, ranging from -10 (strongly autocratic) to 10+ (strongly democratic).

It is also worthwhile to bring some explanation to the relationship between exchange rate and foreign direct investment. "The effect of exchange rates on FDI is ambiguous because the latter is affected by both the level and variability of exchange rates" (Moosa, 2002). The effect of the level of exchange rate depends on the destination of produced goods. If the investment decision is made on serving the market, then FDI and trade will be substitute. In such case, the appreciation of currency of the host country will attract FDI. On the other hand, if FDI's purpose is re-exports, then trade and FDI are complements. In such case, appreciation of the host country's currency will reduce FDI inflow because of lower competitiveness. Depending on the objective of FDI, the effect of exchange rate changes. "If the investor aims at serving the local market, then exchange rate variability encourages FDI. If, however, the objective is to re-export, then this benefit vanishes" (Moosa, 2002). Based on this explanation, and resorting to Singh and Jun (1996), we can also argue that FDI and openness of the economy can be positively correlated, where openness is measured by the trade as a percentage of gross domestic product. According to Campos and Kinoshita (2008), the relationship between FDI and trade liberalization is less straightforward. "If trade flows are complements to FDI flows, then the countries with more trade liberalization regimes are expected to attract more FDI and if FDI is intended for tariff jumping purposes, then more restrictive trade regimes may attract more FDI" (Campos and Kinoshita, 2008).

Based on the case of transition countries, where financial markets were liberalized, trade barriers were lowered and state owned enterprises were privatized, we can argue that these initial measures can motivate FDI incentives. Campos and Kinoshita (2008) emphasizes that the successful realization of economic reforms by the host country is a positive signal to foreign investors because it indicates low investment risk, therefore the progress in reforms can be an incentive to foreign investment flows. We have four indicators for reform taken from the European Bank for Reconstruction and Development (EBRD) Transition Reports 2006-2008 covering data for the period 1990-2008. EBRD scores for these indicators range from 1 to 4+.

1. Banking reform and interest rate liberalization. The lowest score 1 indicates little progress beyond establishment of a two-tier system. The highest value 4+ indicates the standards and performance norms of advanced industrial economies: full convergence of banking laws and regulations with BIS (Bank of International Settlements) standards: provision of full set of competitive banking services.
2. Trade and foreign exchange system. The lowest score 1 indicates widespread im-

port and/or export controls or very limited legitimate access to foreign exchange. The highest score 4+ indicates the standards and performance norms of advanced industrial economies: removal of most tariff barriers; membership in WTO.

3. Governance and enterprise restructuring. The lowest score 1 indicates soft budget constraints (lax credit and subsidy policies weakening financial discipline at the enterprise level): few other reforms to promote corporate governance. The highest score 4+ indicates the standards and performance typical of advanced industrial economies: effective corporate control exercised through domestic financial institutions and markets, fostering market-driven restructuring.
4. The share of private sector to the public sector.

We do not include all of the reform indicators. Because the indicators are highly correlated. Therefore, we use principal component analysis (PCA) to combine them in one new variable. PCA examines whether the correlation between the four indicators can be explained in terms of unobservable factors. PCA combines an original large set of variables into a smaller set of uncorrelated variables, which still contains most of the information in the original set of variables. Moreover, it takes care of multicollinearity problems. The selection of necessary factors are based on the hypothesis of taking the threshold cumulative variance 75% and Kaiser criterion, retaining factors with eigenvalues greater than one. That is, if a factor does not extract at least as much as the equivalent variable, then we drop it. However, eigenvalue rule will be replaced by meaning (extracting factors as long as they are interpretable obeying cumulative variance 75%) in some factor loadings. And the scores on the obtained factor for all observation period, represented by the regression line, will be used in regressions to represent the essence of combined variables. The detailed explanation of Principal Component Analysis is given in the next chapter under Econometric Methodology.

4.3 Determinants of Economic Growth

To empirically test the effect of FDI and Human Capital on economic growth, we resort to equation (3.69), where the dependent variable is considered to be the growth rate of real GDP per capita. It can be expressed in the following basic formulation:

$$GDPg_{it} = \beta_1 FDIstock_{it} + \beta_2 HC_{it} + \beta_3 Y_0 + \chi_{it} + u_{it} \quad (4.5)$$

$$u_{it} = \eta_i + \tau_t + \epsilon_{it} \quad (4.6)$$

where FDI is a foreign direct investment stock, HC is a stock of human capital, Y_0 is an initial GDP per capita, and χ are the set of other variables that affect economic growth. The variable FDI is measured as a percentage of GDP, and reflects the share of foreign capital in total capital in equation (3.69), K_f/K . The initial GDP per capita variable captures the catch-up effect K/K^* . Human capital, HC , is proxied by the population with secondary and tertiary education.

Our equation also benefits from Borensztein, de Gregorio and Lee (1998) and Mankiw, Romer, Weil (1992). Borensztein, de Gregorio and Lee (1998) considered an equation of the form

$$y = f(Y_o, HC, FDI, FDI * HC, Infl, GovCons, \text{and dummies}) \quad (4.7)$$

where $GovCons$ is government consumption and the proxy for human capital stock variable is the initial year level of average years of the male secondary schooling constructed by Barro and Lee (1993), and FDI is foreign direct investment flow variable (because of insufficient data to construct a stock measure of FDI).

FDI augmented version of the growth equation developed by Mankiw, Romer, Weil (1992) takes the following form

$$y = f(Y_o, INV, POP, HC, FDI) \quad (4.8)$$

where INV is gross domestic investment and POP is population. The equation allows to see the relationship between foreign and domestic investments.¹

As mentioned, Borensztein, de Gregorio and Lee (1998) considered FDI flows as explanatory variables. However, we will replace it with FDI stock variable. And also, in addition to government consumption variable we also include productive public capital. Our equation's another significant difference is that we allow the economic reform indicators which are typical for transition countries and are assumed to boost economic growth. We also assume that for economic reforms to have positive impact, political stability and democracy should play an important role. Therefore, we also need to

¹Romer (1993) estimated a standard cross-country growth equation in a form: $Growth (I/Y, Y_{1960}, Sec)$, where I stands for the national income accounts measure of total investment, and the variable Sec stands for the secondary school enrollment rate in 1960. However, in our sample, the missing data do not allow us to add initial enrollment rates to our regression equations.

control for a variable reflecting political situation and democracy.

Names and definitions of explanatory variables are described in in Table (4.3).

Variable Name	Definition
Initial GDP	initial real GDP per capita
Politics	Country risk, Politics
DCapital	Gross fixed capital formation
PopSec or PopTert	Population with secondary or tertiary education
FDIstockGDP	Foreign capital stock /GDP
FDI*PopSec or PopTert	Synergy of FDI and Human capital
Open	Openness, Trade/GDP
Infl	Inflation
M2/GDP	Financial development
GovCons	Government consumption
ProdPC	Productive public capital
Reform	Economic reform index

Table 4.3: Names and Definitions of Explanatory Variables of Economic Growth

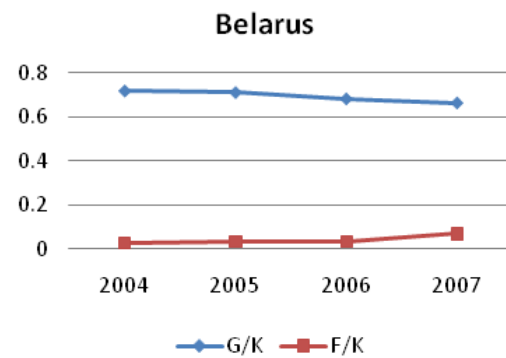
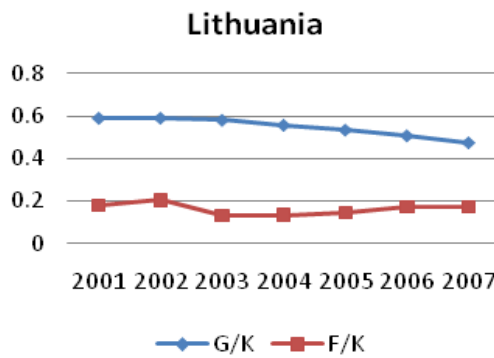
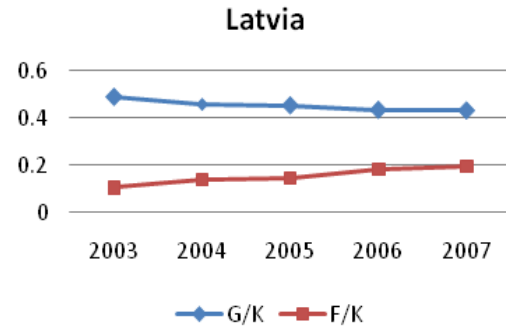
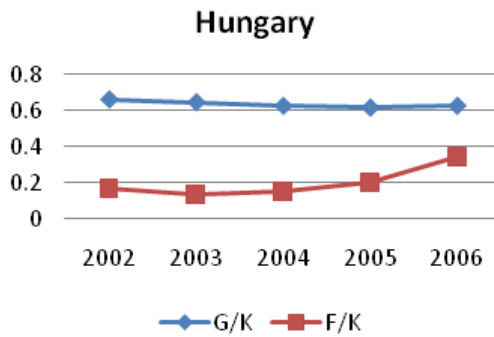
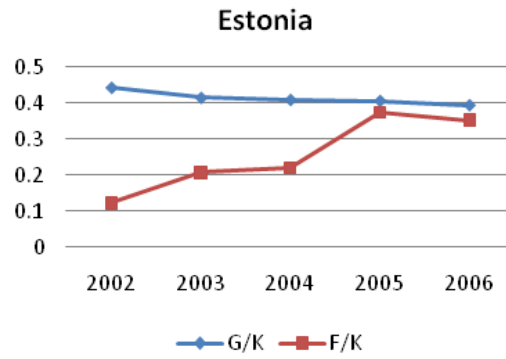
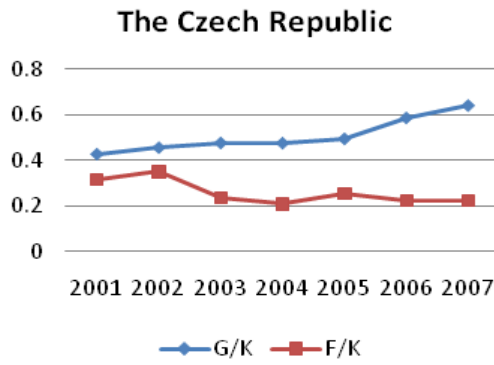
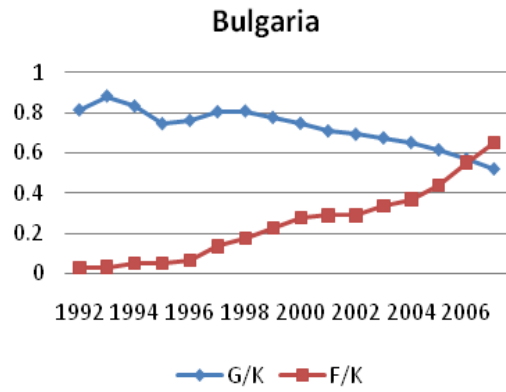
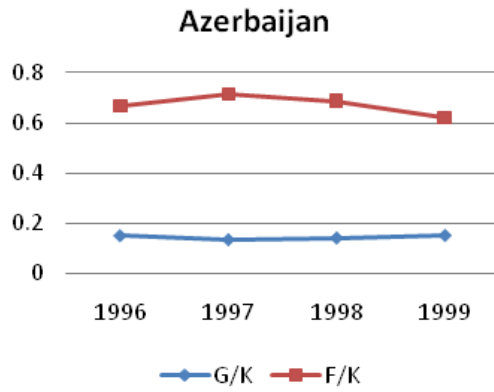
Our empirical model predicts that the effects of initial income, inflation, government consumption and politics are negative, while those of human capital, FDI, M2/GDP, productive public capital, gross fixed capital, openness of the country, economic reforms are positive.

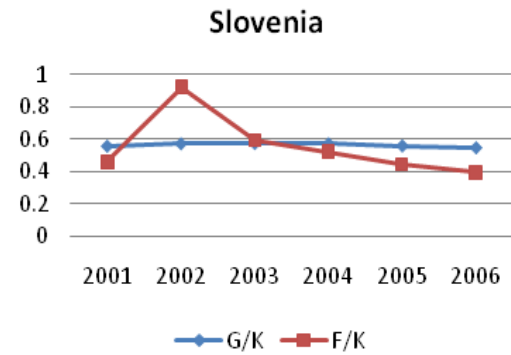
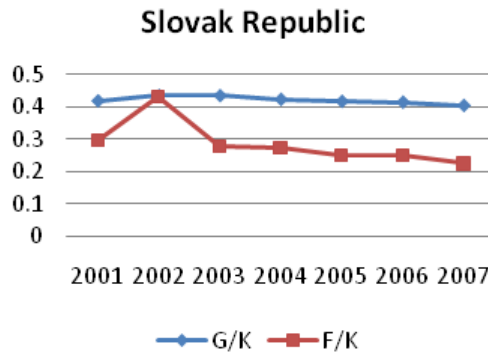
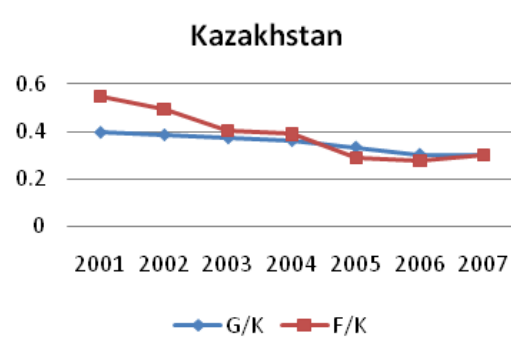
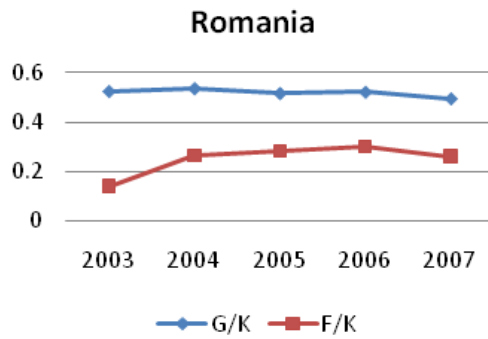
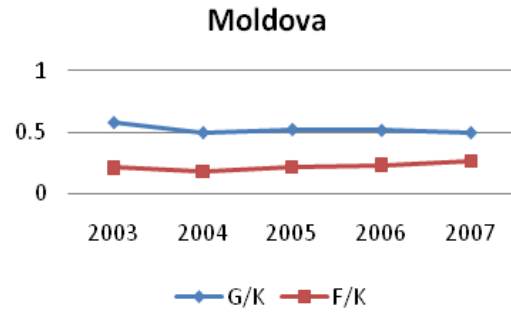
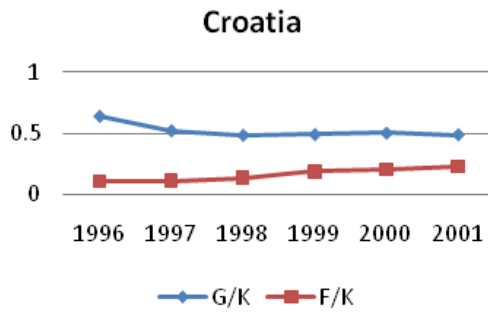
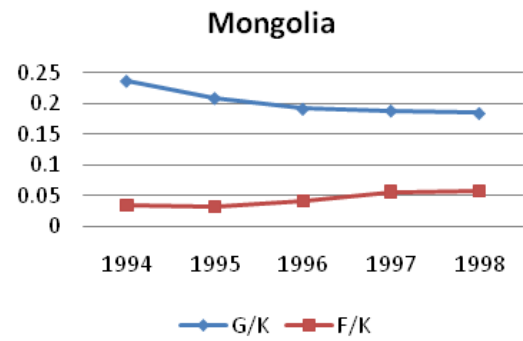
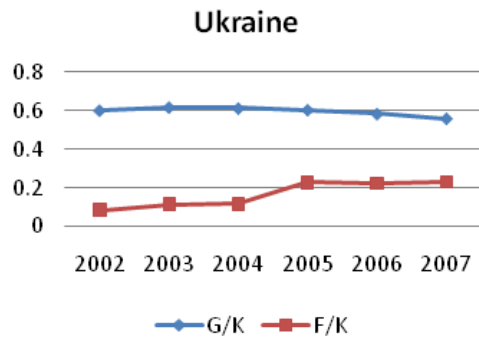
The empirical analysis is done on 26 transition countries; Turkmenistan, Bosnia and Herzegovina, and Turkmenistan are excluded because of insufficient data. The sources of data are the International Monetary Fund (IMF), the World Bank, the European Bank for Reconstruction and Development (EBRD), and the Central Banks of these countries, and refers to the period 1990-2008. Detailed description and sources of data are given in Appendix (A.5). Since the years for which data are available differ per country, the estimates are done for an unbalanced panel. Initially, we will analyze the relationship between foreign direct investment and government expenditure, and then we will turn to the analysis of the impact of foreign direct investment on economic

growth with an emphasis on human capital formation.

The Relationship Between FDI and Productive Public Capital.

In the empirical analysis, we are going to discuss mainly the tendencies of public and foreign capital stocks. As the model predicted, there is a negative correlation between the ratios of these two variables to total capital stock. In order to verify this, we turn to the data of the transition countries. The public, foreign and total capital stocks are created through the Perpetual Inventory Method (PIM) from the flows of government investment, foreign direct investment and gross fixed capital formation. Since the government investment is not explicitly given, we calculate it as the sum of the government expenditure on public order and safety, economic affairs and education. The PIM is based on $X_{t+1} = I_t + (1 - \delta)X_t$, where X_{t+1} is the stock in year $t+1$, I_t is the investment in year t and δ is the depreciation rate. The initial stock, X_0 , is calculated as $X_0 = I_0 / (x + \delta)$, where I_0 is the investment level at t_0 , and x is the average geometric growth rate of the investment and is expressed as $x = \left[(I_{final} / I_{initial})^{1/a} - 1 \right] * 100$, where a is the length of time between the initial and final years of the investment. We assume the depreciation rate $\delta = 0.05$.





Chapter 5

Econometric Methodology

5.1 Dynamic Panel Data Analysis

We turn to panel data analysis because it allows to investigate the relationship between foreign direct investment, human capital and economic growth on time series basis. Additionally, in comparison to cross-country estimations (with instrumental variables), we can take care of unobserved country specific effects which can bias the estimates.

Our econometrics methodology is based on the Generalized Method of Moments (GMM) estimators developed for dynamic panel data analysis by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). We also closely follow Carkovic and Levine (2002), which has summarized and used the same methodology for estimations for developing countries. The methodology is as following:

Let us consider the model

$$y_{it} = \beta' x_{it} + u_{it}, \quad t = 1, \dots, T, \quad i = 1, \dots, N \quad (5.1)$$

$$u_{it} = \eta_i + \tau_t + \epsilon_{it} \quad (5.2)$$

So that the variable x_{it} is assumed to be exogenous given the unobservable country specific effect η_i and time effect τ_t . Where x_{it} is a set of explanatory variables. The equation is extended by adding one lag of the dependent variable.

$$y_{it} = \alpha y_{i(t-1)} + \beta' x_{it} + u_{it}, \quad t = 1, \dots, T, \quad i = 1, \dots, N \quad (5.3)$$

In order to eliminate individual effects η_i , we take the first differences

$$y_{it} - y_{i(t-1)} = \alpha (y_{i(t-1)} - y_{i(t-2)}) + \beta' (x_{it} - x_{i(t-1)}) + \tau_t - \tau_{t-1} + (\epsilon_{it} - \epsilon_{i(t-1)}) \quad (5.4)$$

To overcome the problems connected with the endogeneity of the independent variables, and the correlation of errors $\epsilon_{it} - \epsilon_{i(t-1)}$ with $y_{i(t-1)} - y_{i(t-2)}$, we need to add instrumental variables and consider the assumptions that the error term is not serially correlated and the independent variables are weakly exogenous. Hence, the moment restrictions for the first differenced GMM approach is the following

$$E [y_{t-j}(\epsilon_{it} - \epsilon_{it-1})] = 0 \text{ and } E [(x_{it} - x_{i(t-1)}) (\epsilon_{it} - \epsilon_{it-1})] = 0 \text{ for } j \geq 2, t = 3, \dots, T \quad (5.5)$$

In finite sample properties, the first differenced GMM approach is weak in terms of bias and imprecision. The weakness of the instruments, in the first order differenced regression equations, happens because the lagged levels is weakly correlated with the subsequent first differences. Considering this, a new approach by Arellano and Bover (1995), and Blundell and Bond (1997) is presented. The new approach consists of a system of regression in differences and regression in levels. The instruments for regression in differences is the same as explained above. But the instruments for regression in levels are the lagged first differences of the dependent variable. Additionally, we assume that there is no correlation of the independent variables and their differences with country specific effect η_i , and consider new moment restriction for the regression in levels.

$$E [(y_{i(t-j)} - y_{i(t-j-1)})(\eta_i + \epsilon_{it})] = 0 \text{ for } j = 1 \quad (5.6)$$

For estimations, we use Stata 10 statistical software that implements Arellano and Bover/Blundell and Bover system estimator, which uses the moment conditions of Arellano and Bond estimator (where the lags of the dependent variable and first differences of the exogenous variables are instruments) for the first differenced equation and moment conditions (where the lagged first differences of the dependent variable are instruments) for level equation.

5.2 Principal Component Analysis

Principal Component Analysis (PCA) is used to reduce an original large set of variables into a smaller set of uncorrelated variables called principal components, which still contains most of the information in the original set of variables. PCA reduces the dimensionality of the original data set.¹ For example: We have four indicators for economic reforms and they are highly correlated. By applying PCA, we get only one common factor called REFORM that we will use in the regression equation.

The simple explanation of obtaining such a common factor by PCA in the case of two variables is the following. The characteristic equation is given by

$$RV = \lambda V \tag{5.7}$$

Where R is the matrix to be solved, V is the eigenvector to be found, and λ is an eigenvalue. The solution is based on a determinantal equation of the form

$$Det(R - I\lambda) = 0$$

\Rightarrow

$$Det \begin{pmatrix} 1 - \lambda & r_{12} \\ r_{12} & 1 - \lambda \end{pmatrix} = 0$$

By solving the quadratic equation, we get the eigenvalues: $\lambda_1 = 1 + r_{12}$, $\lambda_2 = 1 - r_{12}$.

If there is a perfect correlation between two variables, then one of the eigenvalues will be 2 and the other zero. If the correlation is zero, both eigenvalues will be 1. The sum of the eigenvalues $\lambda_1 + \lambda_2 = 1 + r_{12} + 1 - r_{12} = 2$ is equivalent to the number of variables and the product of the eigenvalues $\lambda_1\lambda_2 = (1 - r_{12}^2)$ is equivalent to the determinant of the correlation matrix.

As the sum of eigenvalues is equal to the number of variables, by dividing the first eigenvalue by the number of variables, n, we can also calculate the proportion of variance explained by a given component

$$(\text{proportion explained by a given component}) = (\text{corresponding eigenvalues}) / n$$

¹The references for Principal Component Analysis that we focus in the description here are: “Principal Component Analysis” by George H. Dunteman (1989) and “Introduction to Factor Analysis: What It Is and How to Do It” by Jae-On Kim and Charles W. Mueller (1978).

We impose an arbitrary additional constraint that the lengths of eigenvectors be 1. The eigenvectors are found as the following

$$\begin{pmatrix} (1 - \lambda_k) x_1 + r_{12}x_2 = 0 \\ r_{12}x_1 + (1 - \lambda_k) x_2 = 0 \end{pmatrix}$$

For each value of eigenvalue, we get the matrix of eigenvectors.

The principal component loadings are produced by multiplying eigenvectors by the square roots of the respective eigenvalues, which correctly reflect the relative amount of variances by the corresponding data.

$$\begin{pmatrix} x_{11} & x_{12} \\ x_{21} & x_{22} \end{pmatrix} \begin{pmatrix} \sqrt{\lambda_1} & 0 \\ 0 & \sqrt{\lambda_2} \end{pmatrix} = \begin{pmatrix} x_{11}\sqrt{\lambda_1} & x_{12}\sqrt{\lambda_2} \\ x_{21}\sqrt{\lambda_1} & x_{22}\sqrt{\lambda_2} \end{pmatrix} \quad (5.8)$$

We get two common factors. The selection of necessary factor is based on the hypothesis of taking the threshold cumulative variance 75% and Kaiser criterion, retaining factors with eigenvalues greater than one. That is, if a factor does not extract at least as much as the equivalent variable, then we drop it. And the scores on the obtained factor for all observation period, represented by the regression line will be used in regressions to represent that essence of combined variables. The principal component loadings are obtained by using statistics program SPSS 15.

Chapter 6

Estimation Results

6.1 Results: Determinants of Human Capital

Before going to the estimates, we present a correlation matrix of the constructed variables to check whether we can include these variables simultaneously in one regression without running into multicollinearity problems. At the same time, it allows us to check the correlation between the main determinants of human capital derived from the theoretical models. Correlation matrix is given in Table (6.1)

	EnrSec	EnrTert	IMR	MR	FDIstock	EnrPrim	GDPpc	GovEdEx	PrivCredit	PupilTeacher	RepetPrim	TFP	RIRate
EnrSec	10.000												
EnrTert	0.5162*	10.000											
IMR	-0.3695*	-0.5518*	10.000										
MR	0.1310*	0.3273*	-0.4833*	10.000									
FDIstock	0.4757*	0.5249*	-0.5296*	0.2772*	10.000								
EnrPrim	0.1723*	0.1841*	-0.2286*	0.0639	0.3673*	10.000							
GDPpc	0.4209*	0.4999*	-0.8760*	0.4148*	0.6816*	0.2655*	10.000						
GovEdEx	0.0654	0.1040*	-0.1224*	0.2784*	-0.2090*	0.0047	0.0044	10.000					
PrivCredit	0.4696*	0.4204*	-0.5653*	0.4136*	0.6312*	0.0701	0.6105*	0.1408*	10.000				
PupilTeacher	-0.3766*	-0.3916*	0.5331*	-0.1381*	-0.5551*	-0.2101*	-0.6282*	0.0733	-0.3762*	10.000			
RepetPrim	-0.1490*	-0.0238	-0.2683*	0.0422	0.0269	0.1237*	0.2872*	0.0674	0.0101	-0.2518*	10.000		
TFP	0.1449*	0.1401*	-0.0989*	-0.0320	0.4741*	0.1658*	0.1450*	-0.0941	0.2562*	-0.1585*	-0.1416*	10.000	
RIRate	-0.4319*	-0.4067*	0.4313*	-0.0961*	-0.6306*	-0.3426*	-0.5070*	0.0825	-0.5838*	0.3491*	0.0020	-0.2620*	10.000

Table 6.1: Correlation Matrix of Explanatory Variables of Schooling

The stars in the correlation matrix indicates the significance at 10 percent. The correlation matrix points to several interesting issues, which support the results of theoretical models such that as expected RIRate (rate of return on capital) and IMR (infant mortality rate) have negative correlation with EnrPrim (enrollment rate primary), EnrSec (enrollment rate secondary) and EnrTert (enrollment rate tertiary). The spillovers from Foreign Direct Investment proxied by FDI stock has significant and positive correlation with the enrollment rates at each level. The same significant and positive correlation also applies to the growth rate of GDP and the GDP per capita. As to the migration rate, we see that it has negative but insignificant correlation with EnrPrim (enrollment rate primary), but positive and significant correlation with EnrSec (enrollment rate secondary) and EnrTert (enrollment rate tertiary). As we have already mentioned, the positive correlation of migration with enrollment rates indicates net immigration.

Our estimations on the determinants of school enrollment rates and foreign direct investment will utilize Chechi, De Simone and Faini (2007), which to our best knowledge is the only research done on the analysis of human capital in developing countries, analyzing 112 developing countries (including only Bulgaria, Romania, Hungary and Poland from our sample). In difference, we consider transition countries of the Former Soviet Union and Easter European countries and extend the estimated equations. Our results will be compared and conclusions will be derived.

As a decision variable on schooling, our gross enrollment rates by educational level (secondary, tertiary) cover the period of 1990 -2008. Considering missing information on regressors, in its largest version 213 observations cover 26 countries and minimum 93 observations cover 21 countries in the case of secondary school enrollment. Similarly, in the case of tertiary enrollment, in its largest version 223 observations cover 26 countries and 87 observations cover 21 countries. Missing data urges us to run our estimations with unbalanced panel data. The estimations of equation 4.1 in chapter 4 are reported in Tables (6.2) and (6.3) correspondingly for secondary school and tertiary enrollment rates as explanatory variables as proxies for human capital.

The first two columns of both tables reports simple OLS correlations, while columns 3 to 6 reports fixed effects estimator, and columns 7 to 8 use SYS-GMM dynamic panel data analysis, system estimator offered by Arellano and Bover / Blundell and Bover.

First we look at secondary enrollment in Table (6.2)

	1	2	3	4	5	6	7	8
	OLS	OLS	FE	FE	FE	FE	SYS-GMM	SYS-GMM
Secondary Sch. Enr - lag							.6375875 (11.66)***	.6909828 (7.31)***
Real interest rate	-.0322191 (-2.71)***	-.0336028 (-3.03)***	-.013951 (-1.31)				-.021619 (-2.46)**	
Infant Mortality Rate	-.0237218 (-2.16)**	-.0316153 (-3.08)***	-.0047651 (-0.34)	.0105492 (0.42)	.0392742 (1.23)	.0105737 (0.40)	-.0051646 (-0.67)	-.0367597 (-1.44)
Migration rate	-.0002611 (-0.26)	-.001548 (-1.69)*	.001332 (1.72)*		-.0010424 (-0.68)	.0013154 (0.85)	-.0001071 (-0.18)	-.0004382 (-0.22)
Total Factor Productivity		.0000944 (0.48)	.0002591 (1.91)*				.0001668 (2.11)**	
Foreign capital stock	.0150382 (3.51)***	.0077838 (1.75)*	.0084756 (2.02)**	.0288702 (2.24)**	.0189054 (1.44)	.0282767 (1.86)*	.0026575 (0.98)	.0180626 (1.40)
Enrollment rate primary 5 years before		-.0538704 (-0.68)	.0551611 (0.92)	-.0546038 (-0.66)	.0016938 (0.02)	-.0381448 (-0.40)	-.0422238 (-0.92)	-.0240854 (-0.38)
GDP per capita				.0142354 (0.45)	.0747693 (2.12)**	.0106718 (0.31)		-.0352249 (-1.19)
Population density						.1647746 (0.47)		.0127844 (0.92)
Government education expenditure /GDP		.0044564 (2.34)**		.0028664 (0.92)		.0028447 (0.87)		-.0040967 (-1.37)
Private credit by deposit money banks / GDP				-.006654 (-0.34)	-.0045894 (-0.19)	-.0058092 (-0.27)		.0101793 (0.56)
Log pupil/teacher primary				-.1403523 (-1.95)*	.054981 (0.58)	-.1518284 (-1.95)*		-.0420351 (-0.73)
Repetition rate primary						-.0048164 (-0.41)		.0142223 (1.89)*
Constant	1.877645 (35.89)	2.049051 (13.32)	1.788683 (14.37)	1.891619 (9.24)	1.404276 (5.31)	1.59587 (2.06)	5.01 (0.000)	.662557 (3.21)
Observations	218	133	178	99	121	97	166	93
R ²	0.3058	0.4280	0.2647	0.4694	0.3001	0.3029		
Number of countries	26	26	22	22			22	21
Sargan test							0.0000	0.8247

1. Sargan test of overidentifying restrictions. H0: overidentifying restrictions are valid. P values are presented.

t statistics in brackets - * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6.2: Gross enrollment rate - Secondary Education (1990-2008) - Unbalanced Panel

Initially, we discuss the independent variables derived from our theoretical models, which are rate of return on capital, mortality rate, migration, total factor productivity, utility from schooling (proxied by enrollment rate at primary and pupil/teacher primary), and spillovers from foreign direct investment. As expected from the theoretical model, the real interest rate (lending rate), which is thought to be the opportunity cost of a student, has negative and significant impact on secondary school enrollment. The negative effect of infant mortality rate is supported by columns 1 to 3 and 7 to 8, but only OLS estimations reports significant effect. Migration rate depending on the sign

of the coefficient can be either net emigration (negative) or net immigration (positive). In our estimations, the results are ambiguous and we cannot derive explicit result. We have to note that our migration rate does not differentiate migration with secondary or tertiary education level. In our estimations, negative effect although insignificant dominates. We will come back to the discussion of migration in the subsequent estimations.

We obtain strongest positive impact from total factor productivity and foreign direct investment stock. It indicates that the technology and knowledge brought by FDI and embodied in total factor productivity indeed stimulates enrollment at school. There might not be direct effect on pupils' decision to enroll at secondary school, which depends on their parents, but the development environment of the country caused by technological growth stimulates parental impact on secondary school enrollment. This result contradicts to the findings by Chechi, De Simone and Faini (2007) that FDI has negative correlation with secondary school enrollment. Actually, different results can be obtained for different countries in sample, as the measure of FDI stock does not allow distinction between types of investment and motives (market seeking, efficiency or resource seeking).

It seems that the utility obtained from schooling, enrollment rate at primary and the quality of education, pupil/teacher primary, have negative impact on secondary school enrollment but not significant. In our empirical analysis we had discussed that although the government education expenditure does not increase the quality of education, it can impact school enrollment. We only obtain its positive and significant impact in column 2, OLS estimation.

As a proxy for the stage of development, GDP per capita has significantly positive influence in column 5, fixed effects estimation. This suggests that secondary education attainment is related to the stage of development of a country, reflecting resources to families to invest in their children's education.

Although we could expect positive impact from the private credit by deposit money banks, our estimations do not support this. As to the population density, which not only is considered as the stage of development but also it can capture the availability of resources, such that high population density decreases the cost of schooling services. The positive sign in our estimations, although non-significant, advocates for the availability of school resources.

And now we consider the tertiary enrollment rate as explained variable.

	1	2	3	4	5	6	7	8
	OLS	OLS	FE	FE	FE	FE	SYS-GMM	SYS-GMM
Tertiary Enr -lag							.8270072 (25.76)***	.8416597 (16.88)***
Real interest rate	-.1104059 (-2.22)**	-.1108498 (-1.83)*	-.2458979 (-6.05)***				.0130374 (0.79)	
Infant Mortality Rate	-.1384726 (-3.03)***	-.1142868 (-1.84)*	-.1703176 (-3.23)***	-.1822256 (-2.16)**	-.2987225 (-3.89)***	-.2673804 (-3.58)***	-.0390303 (-2.31)**	-.010564 (-0.26)
Migration rate	.0102767 (2.57)***	.0079332 (1.64)	.0115948 (4.54)***		.0030313 (0.83)	-.0027752 (-0.62)	.0011428 (0.93)	.0015244 (0.60)
Total Factor Productivity		.0004375 (0.40)	-.0008205 (-1.66)*				-.0002683 (-1.74)*	
Foreign capital stock	.052135 (2.90)***	-.0055421 (-0.22)	.1028364 (6.42)***	.2459472 (5.60)***	.2156025 (7.09)***	.1530889 (3.13)***	.0485581 (5.68)***	.0372441 (1.68)*
Enrollment rate secondary 5 years before		1.316501 (2.94)***	-.1712433 (-0.73)	-.3923212 (-1.15)	-.2153186 (-1.03)	-.6347823 (-1.92)*	-.1003233 (-0.97)	-.071892 (-0.54)
GDP per capita				.1258005 (1.13)	.1383613 (1.69)*	.2088568 (1.92)*		.0264164 (0.75)
Population density						-.1402553 (-1.53)		-.0377382 (-2.15)*
Government education expenditure /GDP		.02422 (2.28)**		-.0071655 (-0.67)		-.0047047 (-0.47)		.0150564 (3.24)***
Private credit by deposit money banks / GDP				.0026958 (0.04)	-.0533648 (-0.88)	.064456 (0.92)		-.0041261 (-0.16)
Log pupil/teacher primary				.8491638 (3.55)***	.7722997 (3.37)***	.9207883 (3.55)***		.0228945 (0.23)
Repetition rate primary						.0240311 (1.20)		.0012026 (0.10)
Constant	1.39493 (6.35)	-.7446612 (-0.82)	1.457813 (2.98)	-1.246 (-1.36)	-1.058337 (-1.49)	2.275572 (1.10)	.0579478 (0.27)	-.0458025 (-0.12)
Observations	223	128	176	95	117	87	164	90
R ²	0.3718	0.4475	0.3248	0.1759	0.2387	0.0434		
Number of countries	26	26	22	21	24	21	22	21
Sargan test							0.0013	0.3806

1. Sargan test of overidentifying restrictions. H0: overidentifying restrictions are valid. P values are presented.
2. t statistics in brackets - * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6.3: Gross enrollment rate - Tertiary Education (1990-2008) - Unbalanced Panel

The same as in the previous case with secondary school enrollment rate, the real interest rate and infant mortality rate have negative and significant effect on tertiary enrollment rate. The positive effects of government education expenditure and GDP per capita are also obtained on tertiary education. Enrollment rate secondary 5 years before has positive and significant impact in column 2 with OLS estimation, but it turns to negativity when we add additional control variables and run fixed effects estimation. The ambiguous impact is again obtained from private credit by deposit money banks. In difference from secondary school enrollment, tertiary enrollment gets positive and

significant impact from the enrollment rate secondary 5 years before and pupil/teacher ratio. It indicates that the quality of education and the utility obtained at secondary school stimulates the enrollment at tertiary level. But in the case of tertiary education, population density does not have positive impact on tertiary enrollment. This result is intuitive, because the universities are located in big cities rather than regions in developing countries. Our results on population density contradicts those obtained by Chechi, De Simone and Faini (2007) such that in the analysis of 112 developing countries (including only Bulgaria, Romania, Hungary and Poland from our sample), the population density exerts negative impact on both secondary and tertiary enrollment rates.

The counter intuitive result is obtained on total factor productivity, which seems to have negative impact on tertiary enrollment in fixed effects and system dynamic panel data analysis. The negativity disappears when we add government education expenditure as a control variable and run OLS estimation, but the positive effect is not significant.

As the main determinant of the enrollment rate under our focus, foreign direct investment stock has positive and significant contribution to tertiary enrollment in all estimations except column 2 with OLS, but insignificant.

Our overall conclusion is that there is strong evidence that foreign direct investment stock exerts a significant and positive impact on both secondary and tertiary enrollment rates. Therefore, the presence of foreign firms in the domestic market gives incentives to acquire education in order to increase the returns to education attainment. Such that "Inward FDI creates job opportunities for skilled workers; therefore providing an incentive to enroll at tertiary level" (Checchi, De Simone and Faini, 2007).

Other strong evidences we found are that the education attainment of a country is highly associated with the stage of development proxied by GDP per capita and the quality of education proxied by pupil/teach ratio at primary school (reflecting the availability of resources). As a complement to pupil/teach ratio, increasing population density increases the enrollment at secondary school (decreasing the cost of schooling services and also increasing school resources), while it has negative impact at tertiary level.

6.2 Results: Determinants of Foreign Direct Investment

The equation (4.3) on the determinants of foreign direct investment is estimated. Our results for the unbalanced panel data are reported in Table (6.4) and (6.5). Again, we begin with simple OLS estimates followed by country fixed effect and dynamic panel data system GMM estimations.

Before discussing the results, it is worthwhile to bring some explanation to the economic reform index obtained by Principal Component Analysis (PCA). As mentioned, we combine four economic reform indicators provided by European Bank and Reconstruction (EBRD): Banking reform and interest rate liberalization, trade and foreign exchange system, governance and enterprise restructuring and the share of private sector to the public sector. Considering high correlation between these variables, one economic reform index is obtained as following.

	Reform
Banking reform and interest rate liberalization	0.5078
Trade and foreign exchange system	0.5016
Governance and enterprise restructuring	0.4888
The share of private sector to the public sector	0.5016
Cumulative: 0.8762	

We choose only the first factor loading with cumulative variance 0.8762, which means that the obtained new variable explains 87.62 percent of the original data. The factor scores obtained from PCA analysis is used in our estimations as an explanatory for the determinants of FDI.

Human capital = secondary education attainment

	1	2	3	4	5	6	7	8
	OLS	OLS	FE	FE	FE	FE	SYS-GMM	SYS-GMM
FDI inflows lagged 1							.5983159 (8.24)***	-.1557765 (-1.55)
Population with secondary education	14.72697 (0.72)	58.46718 (2.02)**	14.99277 (0.19)	-3.60378 (-0.03)	-48.47068 (-0.44)	-159.6392 (-0.77)	137.8037 (2.07)**	-123.5871 (-1.90)*
Log GDP per capita	.0815086 (0.08)	-2.634672 (-1.63)	4.675373 (1.58)	-.5784068 (-0.11)	-17.03749 (-2.52)**	-19.00784 (-2.01)**	-2.667744 (-0.70)	-28.00495 (-5.71)
Log stock of inward FDI		2.791408 (2.82)***		1.792837 (0.87)	.1242942 (0.06)	6.036843 (0.91)	4.105307 (2.20)**	18.80215 (5.29)***
Trade (% of GDP)					14.25258 (1.25)	-2.215579 (-0.14)		-17.10462 (-1.65)
Inflation					.0016106 (0.03)	-.059677 (-0.41)		.1325432 (1.37)
Log Population						-163.7067 (-1.21)		-20.43263 (-3.56)***
Domestic Investment						.3445295 (1.65)		.1960442 (1.36)
Real interest rate						4.259335 (0.60)		.8868392 (0.19)
Politics, country risk					-.4031771 (-1.38)	-.1445384 (-0.56)		-.2912976 (-1.72)*
GDP growth						-.0767858 (-0.25)		.240572 (1.18)
Productive public capital						.0509469 (0.14)		-.4412864 (-1.94)*
Reform					10.21919 (3.36)***			4.768007 (2.31)
Exchange rate					-.0053358 (-0.63)	.0223961 (0.47)		.0248896 (0.001)
Constant	3.558733 (0.69)	-19.62071 (-2.01)	-11.69443 (-0.70)	-9.460272 (-0.38)	32.85771 (0.91)	3.509256 (0.90)	-45.10254 (-2.89)	96.45111 (2.31)
Observations	164	164	164	131	131	71	130	70
R ²	0.0037	0.0865	0.0209	0.0141	0.1512	0.3167		
Number of countries	26	26	24	23	23	16		
Sargan test							0.0000	0.4512

1. Sargan test of overidentifying restrictions. H0: overidentifying restrictions are valid. P values are presented.
2. t statistics in brackets - * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6.4: Gross enrollment rate - Average Inflows of FDI (1990-2008) - Unbalanced Panel

As a main focus of this section's research to find the contribution of human capital to the entry of foreign capital flows, we find that the percentage of population with secondary and tertiary education as proxies for human capital statistically significantly impacts FDI flows (excluding the equation 8 of Table (6.4)). Therefore, the role of existing human capital in drawing foreign investment is essential.

The stock of FDI has positive and significant impact on the inflow of FDI in both Tables with the percentage of population with secondary and tertiary education as

human capital, which indicates that previous investment in the economy increases the absorption capacity for future FDI inflows. Such that if the domestic market has already been impacted by the superior technology from abroad and its spillovers onto the human capital have been realized, then there is high probability that future FDI inflows will be beneficial both to home and host countries. Therefore, the amount of present foreign capital stock contributes to the entry of future FDI inflow to the market.

In both estimations, we do not find any evidence for the impact of openness (proxied by Trade/GDP), economic stability (proxied by inflation) and economic growth of a country on FDI inflow. Stage of development and market size proxied by GDP per capita and population (assuming that FDI is attracted by larger countries in terms of population) seem to have negative impact on FDI inflow; in column 5 to 6 of Table (6.4) and column 6 to 8 in Table (6.5), GDP per capita has negative and significant impact and population has negative impact in column 7 to 8 of both tables. It indicates that the stage of development of the countries in our sample impedes the inflow of foreign investment.

Political stability seems to impact FDI inflows negatively, column 8 of Table (6.4) (with secondary education attainment). Although insignificant, the negative impact of political stability is reported in the estimations in Table (6.5) (with tertiary education attainment).

Domestic investment exerts positive impact on FDI inflow in all estimations (significant only in Table (6.5) in the presence of tertiary education as a proxy for human capital).

There is no clear evidence on the role of productive public capital. Column 8 of Table (6.4) and Table (6.5) reports negative impact (significant only in Column 8 of Table (6.4)), while other estimations report positive influence but non-significant.

Regressions suggest that reform index has a significant positive impact on foreign capital. It is not clear via which channel reforms impact on FDI inflow; impacting the financial efficiency, GDP per capita or political stability of the host countries such that estimations did not support financial efficiency and we got negative response from GDP per capita and political stability. At the same time, estimations do not provide us with necessary information on Trade /GDP. Therefore, we come to the conclusion that reform indicators alone increases FDI inflow. However, we expect that successful implementation should stimulate an increase in the openness, stage of development and political stability of a country in order to draw the attention of foreign firms.

The expected negative sign of real interest rate is provided by estimations in Table

(6.5) but non-significant, while Table (6.4) reports positive sign. On the other hand, exchange rate has positive and significant impact on FDI inflow. As mentioned, the appreciation of national currency can increase FDI inflow if it is directed to the market service instead of re-export. It seems that FDI inflow to countries in our sample is market oriented.

Human capital = tertiary education attainment

	1	2	3	4	5	6	7	8
	OLS	OLS	FE	FE	FE	FE	SYS-GMM	SYS-GMM
FDI inflows lagged 1							.5260405 (6.96)***	-.1284656 (-1.25)
Population with tertiary education	106.991 (2.10)**	101.9249 (1.49)	207.3675 (1.96)*	181.3676 (1.55)	66.43295 (0.55)	-289.493 (-1.68)	213.5835 (2.13)**	-107.3231 (-1.09)
Log GDP per capita	.5921153 (0.59)	-2.277199 (-1.24)	2.064305 (0.73)	-2.16704 (-0.45)	-15.66232 (-2.50)	-15.85011 (-1.76)*	-6.733595 (-2.14)**	-24.38173 (-5.51)***
Log stock of inward FDI		2.028216 (1.93)*		1.839483 (0.90)	.2546012 (0.12)	3.588335 (0.56)	4.445606 (2.48)**	15.62012 (4.84)***
Trade (% of GDP)					13.99191 (1.23)	.081111 (0.01)		-16.62487 (-1.54)
Inflation					.0035028 (0.07)	.035793 (0.23)		.1661457 (1.65)
Log Population						-125.794 (-0.95)		-13.28052 (-2.72)***
Domestic Investment						.5418204 (2.28)**		.3000521 (1.77)*
Real interest rate						-1.520353 (-0.21)		-3.26652 (-0.71)
Politics, country risk					-3857167 (-1.33)	-.045802 (-0.18)		-.1761476 (-1.12)
GDP growth						-.24316 (-0.81)		.1241113 (0.59)
Productive public capital (% of GDP)						.3147644 (0.84)		-.2789501 (-1.28)
Exchange rate					-.0048839 (-0.58)	.0480555 (1.08)		.02536 (3.17)***
Reform					9.563195 (3.00)***	3.153782 (0.89)		4.076262 (1.96)**
Constant	-5.036952 (-0.80)	-14.72811 (-1.60)	-18.0593 (-1.87)	-19.72867 (-1.38)	16.74991 (0.54)	894.8031 (0.97)	-35.2203 (-2.76)	
Observations	164	131	164	131	131	71	130	70
R ²	0.0272	0.0733	0.0473		0.1522	0.3509		
Number of countries	26	26	24	23	23	16	23	16
Sargan test							0.0000	0.4407

1. Sargan test of overidentifying restrictions. H0: overidentifying restrictions are valid. P values are presented.
2. t statistics in brackets - * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6.5: Gross enrollment rate - Average Inflows of FDI (1990-2008) - Unbalanced Panel

An overall conclusion of this part is that existing human capital stock and foreign capital stock are incentives for future investment inflows. Strong evidence is also found

on economic reforms' contribution to FDI inflows. However, political stability and stage of development (GDP per capita) a country impedes FDI inflow. It might indicate that economic reforms have not been fully absorbed in the economy and still political instability (low democracy or corruption) and low development level are obstacles. We also find out that the FDI inflows in the economy are more market oriented than resource seeking. This is supported by the positive influence of exchange rate on FDI inflows. If the FDI is market oriented, then it will increase employment level and cause technological spillovers and therefore necessitating skilled workers stimulates people to increase their education in order to increase the return to education, which is higher in foreign owned companies. In this regard, we find that on the presence of foreign capital stock in the economy, human capital proxied by the percentage of population with secondary and tertiary education significantly impacts foreign capital flows.

6.3 Results: Determinants of Economic Growth

The objective of this section is to discuss the main determinants of economic growth in transition countries. Our main focus is on the influence of foreign direct investment and human capital on the growth rate of real GDP per capita. Our estimations are based on the standard specifications representing equations (4.5) to (4.8) proposed by Borensztein, de Gregorio and Lee (1998) and Mankiw Romer, Weil (1992) and complemented with additional explanatory variables specific to transition economies. As before, depending on the specification of human capital (the percentage of population with secondary and tertiary education), we report the results in different tables, that is in two cases. Table (6.6) (OLS and fixed effects estimations) and Table (6.7) (SYS-GMM) report results with the percentage of population with secondary education, and Tables (6.8) (OLS and fixed effects estimations) and (6.9) (SYS-GMM) report results with the percentage of population with tertiary education.

Let us now turn to the discussion of the set of results. On the presence of the percentage of population with secondary education as a human capital (Table (6.6) and Table (6.7)), it seems that the prediction of the neoclassical model holds for transition countries such that the coefficient of initial income is negative, although it is statistically significant only in SYS-GMM. It suggests that there is a strong tendency for convergence.

Human capital = secondary education attainment

	1	2	3	4	5	6	7	8
	OLS	OLS	OLS	FE	FE	FE	FE	FE
Initial real GDP per capita	-.6058913 (-0.51)	-1.046571 (-0.90)	-.5149789 (-0.44)					
Human capital: Population with secondary education	-11.05392 (-0.71)	-63.8077 (-2.83)***	-6.302688 (-0.40)	-174.251 (-4.86)***	-151.5373 (-3.44)***	-149.3776 (-3.89)***	-165.972 (-4.49)***	-21.61438 (-0.49)
FDI stock (% of GDP)	.0280754 (2.28)**	-.1396589 (-2.55)**	.0093002 (0.59)	-.0151747 (-0.96)	.0432429 (0.64)	-.0339565 (-1.46)	-.0147539 (-0.93)	-.0186638 (-0.82)
FDI*Human capital		1.403112 (3.14)***			-.5012478 (-0.89)			
Government consumption Domestic investment	-.2101058 (-5.50)***	-.1960496 (-5.22)***	-.2037075 (-5.35)***	-.1645363 (-3.02)***	-.1631131 (-2.99)***	-.1837839 (-3.25)***	-.1633248 (-3.00)***	-.1144875 (-2.41)***
Openness: Trade (% of GDP)			.1976812 (3.68)***			.1168937 (1.80)*		24.28214 (5.01)***
Inflation							-.0095818 (-0.93)	-.0095784 (-1.04)
M2 (% of GDP)								-.0095555 (-0.21)
Reform								2.135895 (1.87)*
Country risk: Politics								-.0885887 (-0.57)
Population growth								.0699787 (0.10)
Constant	16.38591 (3.30)	23.6292 (4.41)	10.90436 (2.13)	33.5311 (6.58)	30.82387 (5.19)	29.00844 (5.16)	32.60249 (6.28)	-34.50618 (-3.19)
Observations	178	178	171	178	178	171	178	153
R ²	0.2435	0.2846	0.2951	0.1715	0.1759	0.1714	0.1763	0.3968
Number of countries	26	26	26	25	25	25	25	25

1. t statistics in brackets - * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6.6: Real per capita GDP growth rate (1990-2008) - Unbalanced Panel

Other variables that are found to contribute to economic growth are reform, openness (Trade/GDP) and productive public capital. For these factors, we obtain statistically positive coefficient.

We cannot derive evidence for the political stability, and population growth, which have different signs but non-significant. As a proxy for financial efficiency, inflation has negative non-significant impact. As a proxy for financial size, M2/GDP has negative non-significant coefficient. As to the government consumption, it has statistically significant negative impact in all estimations.

Human capital = secondary education attainment

	1	2	3	4	5	6	7
	SYS-GMM	SYS-GMM	SYS-GMM	SYS-GMM	SYS-GMM	SYS-GMM	SYS-GMM
GDP growth rate lagged 1	.5450334 (9.94)***	.5435523 (9.89)***	.0385033 (0.49)	.5435356 (9.64)***	.5404959 (9.74)***	.244222 (3.80)***	.2077704 (3.10)***
Initial real GDP per capita	-5.701213 (-1.23)	-5.442233 (-1.17)	-5.518468 (-1.51)	-2.837669 (-0.64)	-5.47846 (-1.18)	-7.529764 (-1.98)**	-7.282074 (-2.15)*
Human capital: Population with secondary education	-19.90905 (-0.58)	-5.214813 (-0.12)	-87.55802 (-2.65)***	-3.343661 (-0.09)	-17.01969 (-0.49)	17.80712 (0.40)	-2.988246 (-0.05)
FDI stock (% of GDP)	.0043703 (0.30)	.0411301 (0.62)	-.0022172 (-0.03)	.0030005 (0.14)	.0041957 (0.29)	-.0142714 (-0.65)	-.1122815 (-0.89)
FDI*Human capital		-.3140315 (-0.57)	.0249421 (0.04)				.7250453 (0.72)
Government consumption	-.1518347 (-3.08)	-.1515632 (-3.05)***	-.3566167 (-5.58)***	-.163136 (-3.14)***	-.1517946 (-3.08)***	-.1586216 (-3.53)***	-.1834127 (-3.71)***
Domestic investment				.0216337 (0.34)			.038321 (0.52)
Productive public capital			.3030833 (2.77)***				
Openness: Trade (% of GDP)						15.87673 (4.10)***	16.99902 (4.28)***
Inflation					-.005042 (-0.51)	-.0106956 (-1.19)	-.0111232 (-1.19)
M2 (% of GDP)						-.0382607 (-0.90)	-.035599 (-0.74)
Reform						1.82405 (2.29)**	1.522208 (1.78)
Country risk: Politics						-.0228264 (-0.17)	.0352 (0.26)
Population growth						-.0071821 (-0.01)	.2177807 (0.35)
Constant	29.70275 (1.72)	27.1268 (1.50)	45.13701 (3.47)	18.26723 (1.09)	28.71773 (1.65)	2.81728 (0.16)	2.778582 (0.16)
Observations	178	178	97	171	178	153	151
Number of countries	25	25	16	25	25	25	25
Sargan test	0.0327	0.0327	0.5805	0.0382	0.0341	0.0610	0.1098

1. Sargan test of overidentifying restrictions. H0: overidentifying restrictions are valid. P values are presented.

2. t statistics in brackets - * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6.7: Real per capita GDP growth rate (1990-2008) - Unbalanced Panel

Counter-intuitive results are obtained for human capital (population with secondary education), foreign direct investment stock. As seen in Table (6.6) and Table (6.7), both variables have statistically significant negative impact on economic growth. In our opinion, it results from the inclusion of population with secondary education as a proxy for human capital. To analyze the reason for negativity in detail, first we review Borenstzein et al (1998). According to their research on developing countries for the period of 1970-1989, the coefficient on foreign direct investment alone is not statistically significant. Because the adoption of new technology requires educated labor force. Therefore, the authors consider an interaction between FDI and schooling (the male secondary schooling constructed by Barro and Lee (1993)). The positive sign

of the interaction term suggests that FDI is able to have impact on economic growth for the countries in which the human capital stock has reached a minimum threshold level. This can be applied to our case for transition countries too. With population with secondary education, the effect of FDI on economic growth is negative. However, the interaction term exerts positive coefficient (Table (6.6) - column 2, Table (6.7) – column 3 and 8). This implies that the effect of FDI is necessarily conditional on a minimum threshold level of human capital. Our results on FDI and human capital contradict those from Nauro F. Campos and Yuko Kinoshita (2002) on transition countries of our sample for the period 1990-1998. The proxy for human capital in Nauro F. Campos and Yuko Kinoshita (2002) is taken as secondary school enrollment ratio, but the type of FDI (whether inflow or stock) is not mentioned. Their result is that secondary school enrollment has negative impact on economic growth, but FDI alone and without an interaction term has positive impact on economic growth. According to Nauro F. Campos and Yuko Kinoshita (2002), the reason for human capital's negative impact is explained by decreasing public financial support as transition progresses and therefore decreasing average years of education. In difference from Nauro F. Campos and Yuko Kinoshita (2002), our result with FDI stock and human capital (the percentage of population with secondary education) support Borenstzein et al (1998). In subsequent analysis, we will see if the results with tertiary education hold the same or not.

Although the data on gross domestic investment also includes FDI, we get its positive impact on economic growth (see Table (6.6) - column 3 and 6). Hence, the investment as a whole plays an important role.

The results with tertiary education as a proxy for human capital are reported in Table (6.8) and Table (6.9).

Different from the first case, the coefficient of initial income is positive in OLS estimations, but it improves and gets statistically negative impact in SYS-GMM estimations in Table (6.9). It reinforces our conclusion that there is a strong tendency for convergence.

Human capital = tertiary education attainment

	1	2	3	4	5	6	7	8
	OLS	OLS	OLS	FE	FE	FE	FE	FE
Initial real GDP per capita	2.415636 (1.87)*	1.882422 (1.44)	1.75513 (1.36)					
Human capital:	130.9709	57.03491	99.95162	221.3384	294.5375	204.9621	211.2255	91.22715
Population with tertiary education	(3.61)***	(1.11)	(2.71)***	(4.66)***	(4.72)***	(3.51)***	(4.40)***	(1.74)**
FDI stock (% of GDP)	.029493 (2.48)**	-.1120281 (-1.56)	.0096087 (0.62)	.0199624 (1.31)	.154684 (2.02)**	.0156182 (0.62)	.0183978 (1.21)	-.0030397 (-0.13)
FDI*Human capital		1.754952 (2.00)**			-1.724312 (-1.79)**			
Government consumption	-1.691744 (-4.76)***	-1.565005 (-4.37)***	-1.1767771 (-4.95)***	-1.1567589 (-2.87)***	-1.1533056 (-2.82)***	-1.1696816 (-2.99)***	-1.1560469 (-2.86)***	-1.1156217 (-2.51)**
Domestic investment			.1758069 (3.30)***			.0108387 (0.14)		
Openness: Trade (% of GDP)								23.86729 (4.98)***
Inflation							-.0137558 (-1.36)	-.0104189 (-1.15)
M2 (% of GDP)								-.0249058 (-0.53)
Reform								1.6674 (1.48)
Country risk: Politics								-.0680977 (-0.44)
Population growth								.2257234 (0.32)
Constant	-7.148214 (-1.10)	.1396695 (0.02)	-5.971188 (-0.93)	-6.769551 (-1.55)	-12.67784 (-2.33)	-5.134091 (-1.08)	-5.754147 (-1.30)	-43.25565 (-4.52)
Observations	178	178	171	178	178	171	178	153
R ²	0.2945	0.3105	0.3419	0.1620	0.2149	0.1563	0.1723	0.4105
Number of countries	26	26	26	25	25	25	25	25

1. t statistics in brackets - * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6.8: Real per capita GDP growth rate (1990-2008) - Unbalanced Panel

Other variables positively contributing to economic growth are reform, openness (Trade/GDP) and productive public capital (Table (6.8) and Table (6.9)).

The results in the first case also hold in the second case for political stability, and population growth, which have different sign effects but non-significant. As a proxy for financial efficiency, inflation has negative non-significant impact. As a proxy for financial size, M2/GDP has negative non-significant coefficient. As to the government consumption, it has statistically significant negative impact in all estimations.

Human capital = tertiary education attainment

	1	2	3	4	5	6	7
	SYS-GMM	SYS-GMM	SYS-GMM	SYS-GMM	SYS-GMM	SYS-GMM	SYS-GMM
GDP growth rate lagged 1	.5121948 (8.92)***	.513499 (8.92)	.1030113 (1.30)	.5080942 (9.10)***	.510001 (9.16)***	.2275898 (3.52)***	.207653 (3.13)***
Initial real GDP per capita	-3.078189 (-0.74)	-2.944427 (-0.70)	-4.268277 (-1.12)	-8316728 (-0.20)	-3.112491 (-0.74)	-5.249825 (-1.38)	-5.638225 (-1.55)
Human capital: Population with tertiary education	92.69001 (2.06)**	87.94157 (1.39)	-62.45051 (-0.73)	116.4911 (2.20)**	89.60263 (1.97)**	90.205 (1.86)*	76.12291 (0.83)
FDI stock (% of GDP)	.0131563 (0.98)	-.000284 (-0.00)	.0251634 (0.20)	.0275853 (1.22)	.0126546 (0.94)	.0056645 (0.25)	-.0153831 (-0.11)
FDI*Human capital		.1626039 (0.18)	-.135894 (-0.08)				.2921009 (0.18)
Government consumption	-.141833 (-3.10)***	-.1439685 (-3.14)***	-.276809 (-4.20)***	-.1476723 (-3.08)***	-.1421347 (-3.10)***	-.1545046 (-3.56)***	-.1598878 (-3.49)***
Domestic investment				-.0631973 (-0.90)			-.0049628 (-0.06)
Productive public capital			.341496 (3.04)***				
Openness: Trade (% of GDP)						16.47196 (4.22)***	17.03121 (4.24)***
Inflation					-.0030933 (-0.32)	-.010975 (-1.24)	-.0119081 (-1.30)
M2 (% of GDP)						-.0584618 (-1.42)	-.0479408 (-0.91)
Reform						1.092984 (1.31)	.8689277 (1.00)
Country risk: Politics						-.0111898 (-0.08)	.0122858 (0.09)
Population growth						-.1421432 (-0.24)	-.0566473 (-0.09)
Constant	10.63311 (0.74)	10.65696 (0.72)	31.36838 (2.14)	2.643687 (0.19)	11.07575 (0.77)	-10.44465 (-0.63)	-8.977028 (-0.47)
Observations	178	178	97	171	178	153	151
Number of countries	25	25	16	25	25	25	25
Sargan test	0.0210	0.0229	0.4708	0.0246	0.0225	0.0497	0.0709

1. Sargan test of overidentifying restrictions. H0: overidentifying restrictions are valid. P values are presented.

t statistics in brackets - * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6.9: Real per capita GDP growth rate (1990-2008) - Unbalanced Panel

Intuitive results are obtained for human capital (population with tertiary education), foreign direct investment stock. In this case, population with tertiary education has statistically significant positive impact on economic growth. FDI also exerts a positive effect on economic growth (except equation (2) and (8) - Table (6.8) and equation (2) and (7)- Table (6.9)). We obtain the contribution of FDI to economic growth when we add interaction term between FDI and human capital. Interaction exhibits negative coefficient in equation (5) – Table (6.8). This might result from the high correlation between human capital and FDI such that both variables have significant positive impact on GDP growth rate. Hence, with and without interaction term, FDI on the existence

of human capital (with educated labor force) and human capital contributes positively to economic growth.

Overall our results support a positive impact of FDI on economic growth. FDI contributes to economic growth on the existence of educated labor force or skilled labor because it allows technology to be absorbed easily. However, in the regressions with population with secondary education, FDI and human capital cannot contribute to economic growth by themselves. Only their complementary relationship can influence positively. Because the adoption of new technology requires educated labor force. The positive sign of the interaction term suggests that FDI is able to have impact on economic growth for the countries in which the human capital stock has reached a minimum threshold level. The role of productive public capital, gross domestic investment and openness of the countries are crucial for the growth of economy. But the growth is impeded by inflation and political stability (although we could not find strong results).

Chapter 7

Conclusion

Our dissertation focused on three directions: The determinants of human capital, foreign direct investment and economic growth in the transition countries. These three directions got their bases from the empirical analysis of the investment development path and the right measure of human capital.

The Investment Development Path hypothesis developed by Dunning (1981) suggests that our countries are in the second stage of development and investment development path, meaning that they still draw more inward FDI than their outward FDI, suggesting that the ownership advantages of domestic firms are still at a low level.

As already mentioned, according to IDP theory, in the first stage of development, the location advantages of a country are not sufficient to attract foreign investment. The reasons behind these are improper economic systems and government policies, inadequate labor force and infrastructure to promote FDI. The ownership advantages of domestic firms are also not sufficient. Therefore, outward FDI of the country is likely to be very little. In this case, government's intervention is necessary to provide basic infrastructure and upgrade human capital through education or training. That is, before a country can attract significant inward FDI, it must develop its location advantages including an increase in GDP per capita. In this stage, determinants of foreign direct investment in the economy are formed: the stage of development of the local market, availability of necessary human capital for absorption of new technology and so on. As long as there is a suitable environment in the host country and the location advantages of the country improve, especially with the help of government policies, FDI inflow begins to rise and the stage of development enters the second stage. In this stage, outward direct investment still remains at a negligible level and inward

FDI stocks rise faster than GDP. As a conclusion, we can say that the determinants of foreign direct investment are determined in the first stage, while the determinants of human capital and economic growth are formed in both cases. As the economy develops and the ownership advantages of local firms improve, then outward investment will also increase and there will be higher economic development than before. So our econometric analysis was based on the first and second stages of investment development path with three directions: determinants of FDI inflow, human capital formation and economic growth.

In chapter 2 we also discussed the measures of human capital and came to the conclusion that although the average years of education is considered as the best measure for human capital, we can choose the enrollment rates at secondary and tertiary education level. Analysis showed that enrollment rates are the future human capital and increase the average years of education in future. Therefore, since the decision is also made on enrollment, we chose this variable as the right measure of human capital as an explained variable. Additionally, we concluded that the percentage of population with secondary and tertiary education level should be chosen as the determinants of foreign direct investment and economic growth because this variable can embody the spillover effect from older generation too.

From chapter 3, where we presented three economic models, we derived three main equations on the determinants of human capital, foreign direct investment and economic growth. The estimation results of these three directions are as follows.

Conclusion from the determinants of schooling:

Our overall conclusion is that there is strong evidence that foreign direct investment stock exerts a significant and positive impact on both secondary and tertiary enrollment rates. Therefore, the presence of foreign firms in the domestic market gives incentives to acquire education. Inward FDI creates job opportunities for skilled workers; therefore providing an incentive to enroll at tertiary level to increase the returns to education attainment.

Other strong evidences we found are that the education attainment of a country is highly associated with the stage of development proxied by GDP per capita and the quality of education proxied by pupil/teach ratio at primary school (reflecting the availability of resources). As a complement to pupil/teach ratio, increasing population density increases the enrollment at secondary school (decreasing the cost of schooling services and also increasing school resources), while it has negative impact at tertiary level.

Conclusion from the determinants of FDI:

An overall conclusion of this part is that existing human capital stock and foreign capital stock are incentives for future investment inflows. Strong evidence is also found on economic reforms' contribution to FDI inflows. However, political stability and stage of development (GDP per capita) in the transition countries impede FDI inflow. It might indicate that economic reforms have not been fully absorbed in the economy and still political instability (low democracy or corruption) and low development level are obstacles. We also find out that the FDI inflows in the transition countries are more market oriented than resource seeking. This is supported by the positive influence of exchange rate on FDI inflows. If the FDI is market oriented, then it will increase employment level and cause technological spillovers and therefore necessitate skilled workers and stimulate people to increase their education in order to increase the return to education, which is higher in foreign owned companies. In this regard, we find that on the presence of foreign capital stock in the economy, human capital proxied by the percentage of population with secondary and tertiary education significantly impacts foreign capital flows.

Conclusion from the determinants of economic growth:

Overall our results support a positive impact of FDI on economic growth. FDI contributes to economic growth on the existence of educated labor force or skilled labor because it allows technology to be absorbed easily. However, in the regressions with population with secondary education, FDI and human capital cannot contribute to economic growth by themselves. Only their complementary relationship can influence positively. Because the adoption of new technology requires educated labor force. The positive sign of the interaction term suggests that FDI is able to have impact on economic growth for the countries in which the human capital stock has reached a minimum threshold level. The role of productive public capital, gross domestic investment and openness of the countries are crucial for the growth of economy. But the growth is impeded by inflation and political stability (although we could not find strong results).

Finally, we would like to note that despite the level of economic development, investment in the economy has always been one of the actual problems. But it is the most important for the countries transiting to a market economy. It is explained such that achieving economic growth and maintaining its stable level depend on the balanced development of all sectors of economy, the drawing of domestic and foreign investments and their use in the right direction. Investment is also a financial source. Because of this source, not only production but also serious structural changes occur. Foreign

capital can bring scientific and technical achievements and superior management skills to the economy. Thus, drawing foreign investment in the production sector is more efficient.

In general, foreign direct investment is very important for eradicating modern economic difficulties. To achieve this, attractive investment climate, economic and legislative bases should be taken into the consideration. Because, before investing in the economy, every foreign firm investigates the present political, economic, cultural and legislative environment. If these are considered satisfactory, the investment is realized. One of the most important tasks in front of the transition countries is to create transparent environment for foreign investors.

In these regards, our research will promote a better understanding of the FDI situation in the transition countries and assist policymakers in formulating development oriented FDI policies.

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Appendix A

Numerical Analysis, Tables and Scatter Plots

A.1 The Eigenvalue Method for Continuous-Time Dynamical Systems

We simplify the system of equations by including parameter values. Then to analyze the stability of the balanced growth path, we calculate the Jacobian matrix. The stability analysis for three dimensional system of first order differential equations is as following:

- A system has a stable origin if and only if its characteristic roots have negative real parts.
- A saddle point occurs if and only if the determinant of the Jacobian is positive. In this case, one positive and two negative eigenvalues suggest that the balanced growth path is saddle point stable (or conditional stable).
- A negative trace of the Jacobian is a sufficient condition for instability.

A.2 Matlab Code for The Stability of the Balanced Growth Path

```
syms cn gn hn fn
```

```
% D = Productivity parameter relating to the superior
```

```

technology brought through FDI.
% B = Efficiency parameter of production or technology parameter.
% tauw = Tax rate on wage income
% taudk = Tax rate on the return on domestic capital.
% taudk = Tax rate on the return on foreign capital.
% ug = The fraction of public capital spent for production
% uh = The fraction of human capital spent for production.
% phi = Lump-sum transfers if phi>0.
% rho = The fraction of profit remaining in the economy.
% psi = The reaction of public information to changes in FDI.
% repf = The repatriation of foreign capital stock.

%% Fixed parameters:

D = 2
B = 0.5
tauw = 0.12
taud = 0.12
tauf = 0.12
ug = 0.9
uh= 0.9
phi = 0.05
rho = 0.65
psi = 0.5
omega = 0.25
repf = 0.06

%% Four Dimensional System of First Order Differential Equations.

z= D*((theta)^(0.2))*((ug*g)^(0.2))*((uh*h)^(0.5))*((1-tauw)*0.5+
(1-taud)*0.1+phi*(tauw*0.5+taud*0.1)+rho*0.2)-c
f1=(1-taud)*0.1*D*((f)^(0.2))*((ug*g)^(0.2))*((uh*h)^(0.5))-0.05-z;
f2=((ug)^(0.2))*D*((f)^(0.2))*((g)^(-0.8))*((uh*h)^(0.5))*
((1-phi)*(tauw*0.5+taud*0.1)+tauf*0.2)-z;
f3=B*((psi)^(0.3))*((1-uh)^(0.5))*(((1-ug)*((g)/(f))))^(0.2))*

```

```

(((h)/(f))(-0.5))-z;
f4=omega*D*((f)(-0.8))*((ug*g)(0.2))*((uh*h)(0.5))*((1-tauf)*
0.2+(1-rho)*0.2)-repf-z;

%% Find the equilibrium state(s)

[csteady,gsteady,hsteady,fsteady] = solve(f1,f2,f3,f4);
N=length(csteady);
fprintf('The equilibrium points are\n')
disp([csteady gsteady hsteady fsteady])

%% Compute the Jacobian matrix

DF = [diff(f1,c), diff(f1,g), diff(f1,h), diff(f1,f);
      diff(f2,c), diff(f2,g), diff(f2,h), diff(f2,f);
      diff(f3,c), diff(f3,g), diff(f3,h), diff(f2,f);
      diff(f4,c), diff(f4,g), diff(f4,h), diff(f4,f)];

%% For each equilibrium point, compute its eigenvalues:

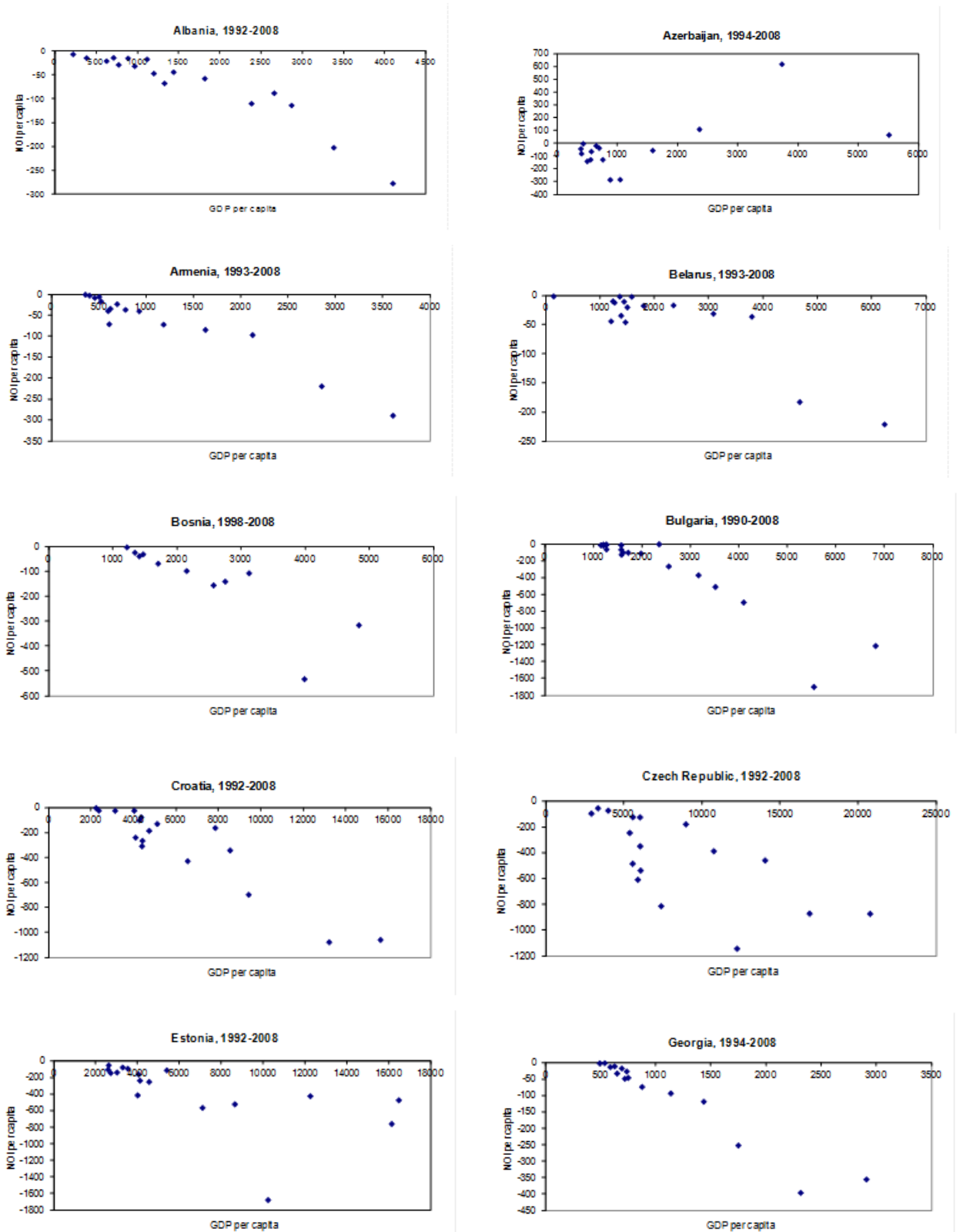
A=subs(DF,[c,g,h,f],[csteady,gsteady,hsteady,fsteady])
eig(A)
det(A)

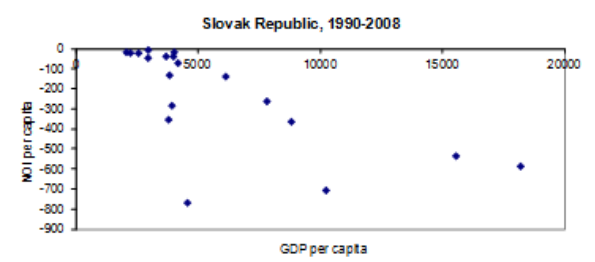
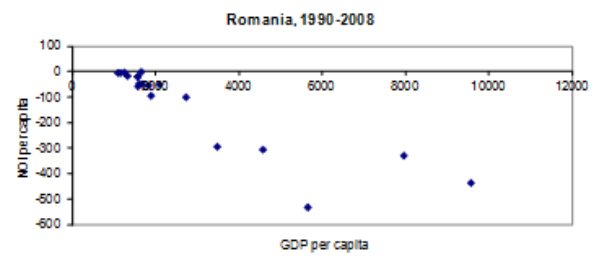
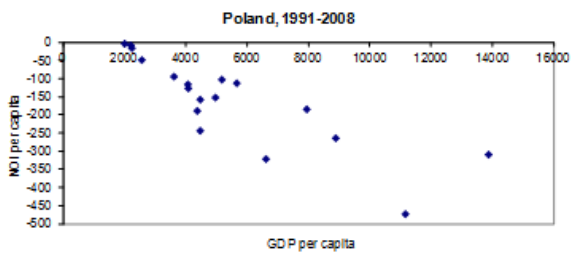
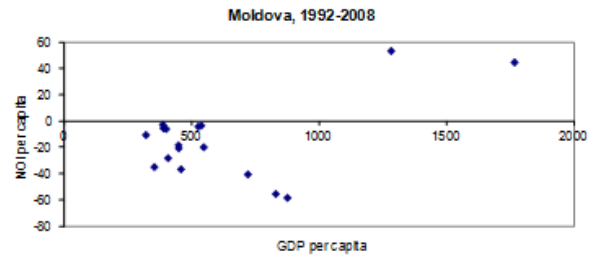
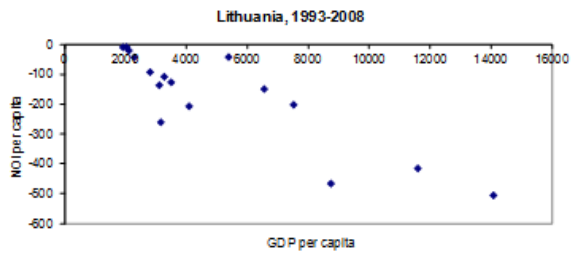
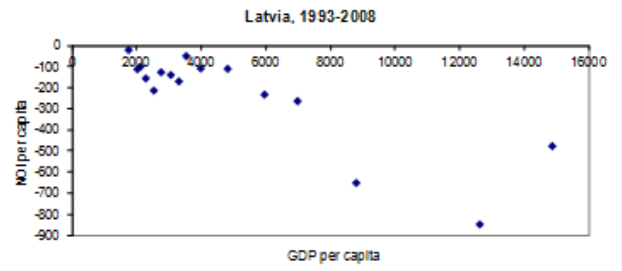
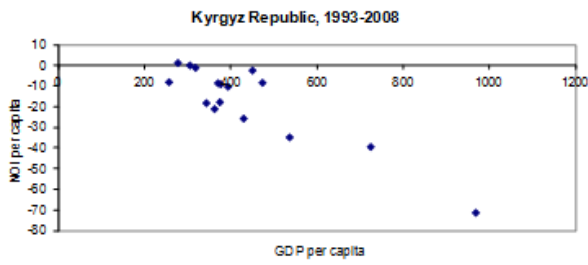
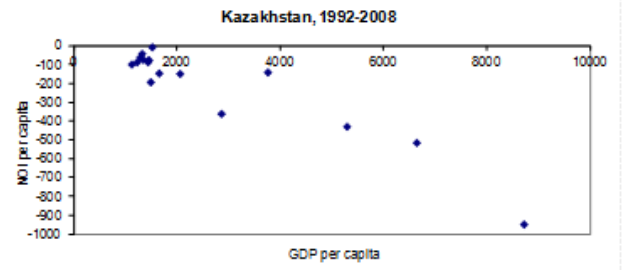
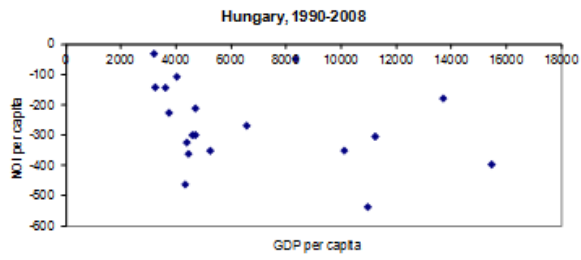
%% For the obtained steady states, compute the growth rate:

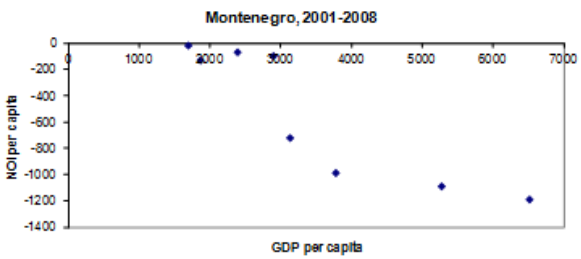
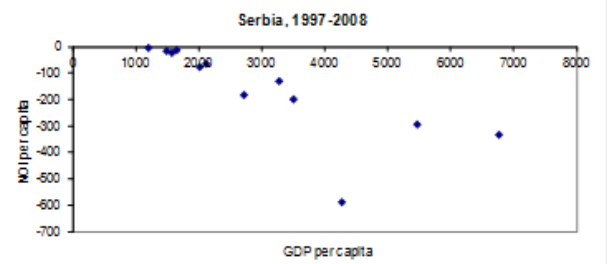
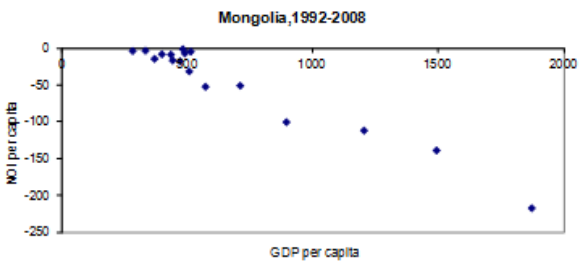
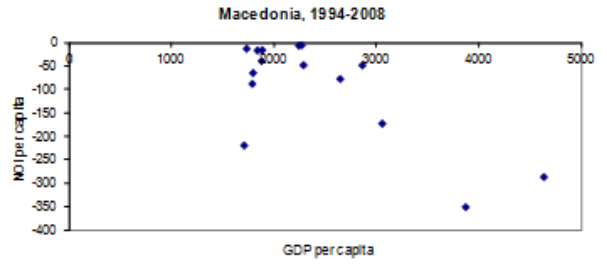
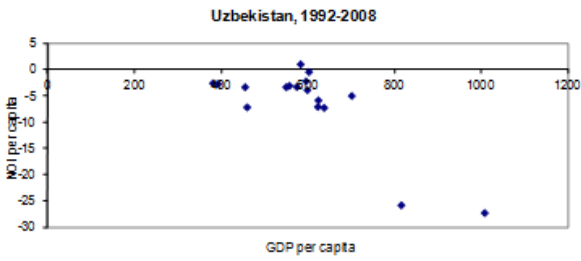
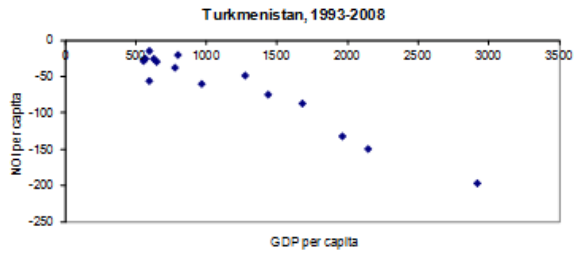
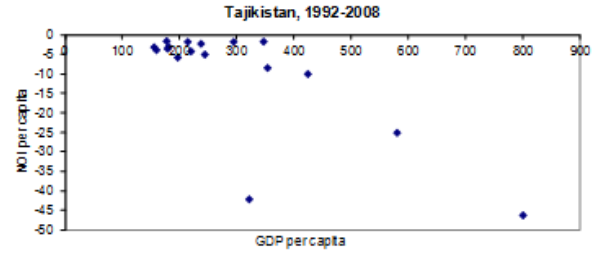
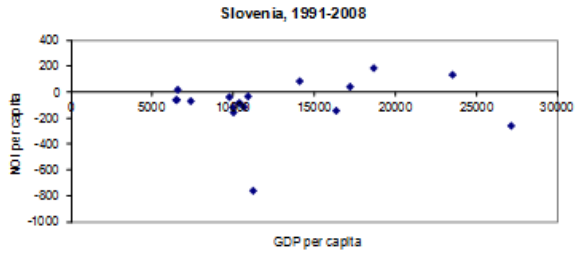
growth_rate=(1-taud)*0.1*D*((fsteady)(0.2))*((ug*gsteady)(0.2))*
((uh*hsteady)(0.5))-0.05

```

A.3 IDP Stages of Individual Transition Countries







A.4 Inflation

(change in annual average retail/consumer price level, in per cent)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Central Europe and the Baltic states												
Croatia	3,6	5,7	4,0	4,6	3,8	1,7	1,8	2,1	3,3	3,2	2,9	6,1
Czech Republic	8,4	10,6	2,1	4,0	4,7	1,8	0,2	2,8	1,9	2,6	3,0	6,3
Estonia	11,2	8,1	3,3	4,0	5,8	3,6	1,3	3,0	4,1	4,4	6,6	10,4
Hungary	18,3	14,3	10,0	9,8	9,2	5,3	4,7	6,8	3,6	3,9	8,0	6,1
Latvia	17,6	8,4	4,7	2,6	2,5	1,9	2,9	6,2	6,7	6,5	10,1	15,4
Lithuania	8,9	5,1	0,8	1,0	1,5	0,3	-1,1	1,2	2,7	3,8	5,7	11,0
Poland	14,9	11,8	7,3	10,1	5,5	1,9	0,8	3,5	2,2	1,2	2,4	4,3
Slovak Republic	6,1	6,7	10,6	12,0	7,3	3,0	8,5	7,5	2,5	4,5	2,8	4,6
Slovenia	8,4	8,0	6,2	8,9	8,4	7,5	5,6	3,6	2,5	2,5	3,6	5,7
<i>Mean</i> ¹	10,8	8,7	5,4	6,3	5,4	3,0	2,7	4,1	3,3	3,6	5,0	7,8
South-eastern Europe												
Albania	33,2	20,6	0,4	0,1	3,1	5,2	2,4	2,9	2,4	2,4	2,9	3,4
Bosnia and Herzegovina	na	-0,3	3,4	5,0	3,2	0,4	0,6	0,4	3,8	6,1	4,9	6,5
Bulgaria	1.082,0	22,2	0,7	9,9	7,4	5,9	2,3	6,1	5,0	7,3	8,4	12,3
FYR Macedonia	2,6	-0,1	-0,7	5,8	5,5	1,8	1,2	-0,4	0,5	3,2	2,3	8,3
Montenegro	23,4	32,4	67,6	97,1	22,6	16,0	6,7	2,4	2,3	3,0	4,2	7,4
Romania	154,8	59,1	45,8	45,7	34,5	22,5	15,4	12,0	9,5	6,9	4,8	7,9
Serbia	18,3	30,0	41,1	70,0	91,8	19,5	11,7	10,1	16,5	12,7	6,7	11,7
<i>Mean</i> ¹	219,0	23,4	22,6	33,4	24,0	10,2	5,7	4,8	5,7	5,9	4,9	8,2
Eastern Europe and the Caucasus												
Armenia	14,0	8,7	0,7	-0,8	3,1	1,1	4,7	7,0	0,6	2,9	4,4	9,0
Azerbaijan	3,5	-0,8	-8,5	1,8	1,5	2,8	2,2	6,7	9,6	8,3	16,7	20,8
Belarus	63,9	72,9	293,7	168,6	61,1	42,5	28,4	18,1	10,3	7,0	8,4	14,9
Georgia	7,1	3,6	19,2	4,1	4,6	5,7	4,9	5,7	8,4	9,2	9,3	10,0
Moldova	11,8	7,7	39,3	31,1	9,6	5,2	11,6	12,5	12,0	12,8	12,4	12,8
Ukraine	15,9	10,6	22,7	28,2	12,0	0,8	5,2	9,0	13,5	9,1	12,8	25,2
<i>Mean</i> ¹	19,4	17,1	61,2	38,8	15,3	9,7	9,5	9,8	9,1	8,2	10,7	15,4
Russia	14,7	27,6	86,1	20,8	21,6	15,7	13,7	10,9	12,7	9,7	9,0	13,0
Central Asia												
Kazakhstan	17,4	7,1	8,3	13,2	8,4	5,9	6,4	6,9	7,6	8,6	10,8	17,3
Kyrgyz Republic	23,4	10,5	35,9	18,7	6,9	2,0	3,1	4,1	4,3	5,6	10,2	24,5
Mongolia	36,6	9,4	7,6	11,6	8,0	0,3	5,1	8,3	12,7	5,1	9,0	27,6
Tajikistan	88,0	43,2	27,5	32,9	38,6	12,2	16,4	7,2	7,3	10,0	13,2	20,5
Turkmenistan	83,7	16,8	24,2	8,3	11,6	8,8	5,6	5,9	10,7	10,5	8,6	12,0
Uzbekistan	70,9	29,0	29,1	25,0	27,3	27,3	11,6	6,6	10,0	14,2	12,3	13,3
<i>Mean</i> ¹	53,3	19,3	22,1	18,3	16,8	9,4	8,0	6,5	8,8	9,0	10,7	19,2
All transition countries												
<i>Mean</i> ¹	66,5	16,9	27,3	22,6	14,9	7,9	6,3	6,2	6,5	6,4	7,5	12,0

Source. EBRD Transition Report

A.5 Data Description and Sources

Variables	Definition	Sources
EnrPrim	Enrollment rate primary 5 years before	Education Statistics, World Bank, 1990-2007
EnrSec	Enrollment rate secondary 5 years before	Education Statistics, World Bank, 1990-2007
EnrTert	Enrollment rate tertiary	Education Statistics, World Bank, 1990-2007
GDPpc	GDP per capita	World Development Indicators, World Bank, 1990-2007
FDIstockGDP	FDI stock as a percent of GDP	International Financial Statistics, IMF, 1990-2008
FDIstock	Log of GDI stock	International Financial Statistics, IMF, 1990-2008
FDIinflow	FDI inflow /GDP	International Financial Statistics, IMF, 1990-2008
PEducExp	Public education expenditure/GDP	Education Statistics, World Bank, 1990-2007
PupilTeachPrim	Pupil teacher ratio primary	Education Statistics, World Bank, 1990-2007
PupilTeachSec	Pupil teacher ratio secondary	Education Statistics, World Bank, 1990-2007
RepetPrim	Repetition rate primary	Education Statistics, World Bank, 1990-2007
RepetSec	Repetition rate secondary	Education Statistics, World Bank, 1990-2007
Politics	Polity score: Degree of democracy dummy variable with score range (-10 to 10 +)	The Political Instability Task Force, 1990-2008 http://www.systemicpeace.org/polity/polity4.htm
PrivCredit	Private credit by deposit money bank /GDP	EBRD Transition Report, 1990-2008
PopDen	Log Population density	World Development Indicators, World Bank, 1990-2008
MR	Net migration rate	The World Factbook, CIA, 1990-2008
IMR	Infant mortality rate	The World Factbook, CIA, 1990-2008
RIRate	Real interest rate	EBRD Transition Report, 1990-2008
Open	Openness; Share of trade in GDP	EBRD Transition Report, 1990-2008
Inflation	The rate of inflation	EBRD Transition Report, 1990-2007
Pop	Log of Population	World Development Indicators, World Bank, 1990-2008
ExRate	Exchange Rate	EBRD Transition Report, 1990-2007
GDPg	Real GDP growth rate	EBRD Transition Report, 1990-2007
GDP	GDP in current pr \$	World Development Indicators, World Bank, 1990-2007

Variables	Definition	Sources
ProdPubC	Productive public capital/GDP	Government Finance Statistics, IMF, 1990-2007
GovCons	Government consumption /GDP	EBRD Transition Report, 1990-2008
DInvest	Gross domestic investment /GDP	EBRD Transition Report, 1990-2008
M2GDP	Broad money (M2, end-year) /GDP	EBRD Transition Report, 1990-2008
FDI*PopSec	Synergy of FDI stock and Secondary School Enrollment	IMF and World Bank
FDI*PopTert	Synergy of FDI stock and Tertiary Enrollment	IMF and World Bank
PopSec	Population secondary /Population	Education Statistics, World Bank, 1990-2008
PopTert	Population tertiary /Population	Education Statistics, World Bank, 1990-2008
BSREF	Banking reform and interest rate liberalization	EBRD Transition Report, 1990-2008
ENTREF	Governance and enterprise restructuring	EBRD Transition Report, 1990-2008
TFEX	Trade and foreign exchange rate	EBRD Transition Report, 1990-2008
PRSEC	The share of private sector to the public sector	EBRD Transition Report, 1990-2008
PopGrowth	Population growth	World Development Indicators, World Bank, 1990-2007