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The impact of Foreign Direct Investment from the European Union to Singapore

Master dissertation

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Declaration of authorship

I, Adam Hrazdíra, hereby declare that the dissertation "The impact of Foreign Direct Investment from the European Union to Singapore" was written by myself, and that all presented results are my own, unless stated otherwise. The literature sources are listed in the References section.

Prague, September 30, 2015

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Signature

Abstract

The goal of this dissertation is to investigate the impact of FDI flows from the European countries to Singapore. The analysis focuses on the period between 1995 and 2013. The work begins with the review of the relevant literature. The most important findings about spillover, spinoff effects, and the main FDI determinants are summarized in tables. The empirical part reveals the trends of FDI in Singapore with an emphasis on the influence of FDI from European countries. The work contains two main research questions: Does FDI from European countries have a positive impact on GDP growth in Singapore? Is it possible to identify the main determinants that attract FDI in Singapore? Time series analyses and panel analyses are used in the dissertation. Among the most valuable results belong the confirmation of a positive impact of FDI from Europe on GDP growth and the identification of some of the main positive determinants for attracting FDI in Singapore.

List of abbreviations

ADF – Augmented Dickey-Fuller
APEC – Asia-Pacific Economic Cooperation
ASEAN – The Association of Southeast Asian Nations
DEN – Denmark
EU – The European Union
FDI – Foreign Direct Investment
FRA – France
GDP – Gross domestic product
GER – Germany
GNP – Gross national product
IMF – International Monetary Fund
IRL – Ireland
LUX – Luxembourg
M&A – Mergers and Acquisitions
NED – The Netherlands
NOR – Norway
OECD – Organization for Economic Cooperation and Development
OLS – Ordinary least squares
SUI – Switzerland
TNC – Transnational Corporation
UK – The United Kingdom of Great Britain and Northern Ireland
UNCTAD – United Nations Conference on Trade and Development
USD – The United States dollar

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Introduction

The Republic of Singapore could be described as a city and island country located in Southeast Asia. Despite the fact that Singapore is quite a small country in size, its economic importance is enormous. It has been one of the most modern cities in this region for almost a century. Singapore has become a flourishing country that provides a template for other developing countries on how to thrive by means of trade, investments, tourism and, not least, attracting FDI. Due to colonial history Singapore presents a combination of western-style development and Eastern-style of living which results in a beneficial synergy. Another suitable trait of this country is that it provides one of the world's largest foreign exchange and financial centres and container ports. Singapore takes part in many international organizations. For instance it is a founding member of ASEAN, possesses a membership in East Asia Summit, Commonwealth of Nations and also appears as host of APEC. Singapore embodies one of the so-called Four Asian Tigers, which is a term used for highly developed countries that have experienced rapid industrialization and high growth rates in the last few decades in the territory of Southeast Asia.

Foreign direct investment (FDI) became one of the main vehicles of global economic development in the last decades of the 20th century. The importance of FDI has attracted many authors to develop several theories and explanations of consequences that FDI may bring. However, the literature has provided ambiguous results regarding the influence of FDI on the host countries; the main determinants of FDI are questionable as well. This work will pay particular attention to some of the relevant papers in this field. There are only a few studies analysing FDI in Singapore and none from the European point of view. The purpose of this work is to fill this gap.

The purposes of this research are as follows. First of all the work will introduce the growing importance of European FDI in 21st century Singapore. The second purpose is to analyse the relationship between economic growth in Singapore and FDI flows from Europe to Singapore, giving attention to other aspects as well. Thirdly, this work will examine some of the main determinants of FDI flows from European countries to Singapore.

The work is organized as follows: Section 1 begins with a preview of Singapore's economic history encompassing an analysis of macroeconomics indicators which will be compared to the European one. Section 2 reviews theoretical literature connected to the relationship between FDI and GDP growth and the main FDI determinants. Section 3 provides an overview of trends in FDI flows to Singapore with an emphasis on the impact of European countries. This section also presents methodology and data on the empirical part. Section 4 presents the results of empirical analysis and their robustness. Finally section 5 contains the conclusions.

I. Preview of Singapore's history and macroeconomics background

1.1 Short excursion to the economic history

The history of contemporary Singapore began in the mid-sixties. At that time we could claim that Singapore and surrounding regions were, from an economical perspective, very weak. The confusion was caused by post-colonial history, political instability and a very explosive mixture of race, religion and people wealth. Many political demagogues exploited this unstable environment for their own interests, for instance, Sukarno or Lee Kuan Yew. Singapore stepped out of the Malaysian federation in 1965. The GDP per capita was only 500 USD at that time. Nowadays it is more than 80 times more – 40,000 USD, which is a remarkable increase for such a short period of time. The separation brought about a shrink in the national domestic market. Additional harm for the GNP at that period came with the decision of the UK to withdraw its military forces from Singapore. Singapore was forced to change its policy. The new path towards the growth was represented by the export-oriented industrialisation. This approach required many preparations in the field of working conditions (reduction of wages, increase in working hours). These attempts targeted one goal, to kick off industrial investment in export production. The foreign investors were largely welcomed. A higher level of security for Singapore was another strategic aim connected with wide-open doors for foreign investments. Foreign companies reacted positively and began to pour into Singapore. By 1984, the total foreign investment in manufacturing reached over 12 billion dollars. It had a positive effect on decreasing unemployment, which resulted in a shortage of workers and need for importing labour. At the beginning of attracting foreign investments a lot of the focus was mainly labour intensive, providing low-technological standards. Singapore came up with a new strategy to increase the technological sophistication of Singapore's manufacturing base in the beginning of 80's. The move to high-tech, capital intensive industries was appreciated. This strategy was largely successful. Singapore became a business centre and many international companies set their operational headquarters in this location. There was a visible shift backwards from manufacturing investments in Singapore. Nowadays Singapore is a major regional business hub for international companies. The ambition of this advanced economy,

which exploits its strategic location, skilled work force and full integration into the global production system, was accomplished (Dean, 2000).

1.2 Macroeconomics background

Singapore is a developed country with a highly successful free market economy. The main aspects of its remarkable economic achievements are an open and corruption free economic environment and stable market prices. The Global Competitive Index and Business Competitive Index show that Singapore is far ahead of other Asian countries. The legal, regulatory and accounting systems are transparent, sophisticated and on the highest world level of quality. Singapore enjoys a higher level in GDP per capita compare than most other developed countries. The whole economy is pulled by a large volume of trade. In fact the figures of openness support this statement as well. It is not unusual that openness[1] reaches four hundred per cent. Singapore's economic performance is highly dependent on exports of many products such as consumer electronics, pharmaceuticals, financial sector services and information technology products. The whole empirical analysis of relationship between FDI and GDP growth is focused on the time period starting in the year 1995 proceeding until the year 2013. Singapore experienced high GDP growth during the above-mentioned period mainly in 2000 or during the very successful years of 2003-2007. The GDP growth, which exceeded 9 %, was not a surprise at that time. However, Singapore's economy did not avoid declines connected with the Asian financial crisis in 1998. Even though Singapore was less affected by this downturn compared to the others in the region of Southeast Asia. Another decline was detected later in the year 2001, which was explained by the economic slump in the United States connected with the dotcom crash. The electronic industry belongs to the biggest of Singapore's exports and United States accounted for the major trading partner (Arnold, 2001). The last economy slow down came as a result of the global financial crisis, which escalated especially in the year 2009. The economic conditions were affected by a large loss in wealth on the stock market. The other attributes of decline were: depressed domestic demand and lower investment in assets and reduction in consumption. The government reacted promptly with a provision of access to credit facilities at the amount of 2.3 billion dollars for local companies (East Asia Forum, 2009).

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[1]The sum of exports plus imports to the country's domestic product

Singapore's economy rebounded again in 2010 with an enormous 14 % growth. The dependence on demand for export goods has a negative impact on economic conditions. European countries and the United States are still the key export destinations with more than one third of the total volume. All their economic problems can easily affect Singapore. The long struggle with recent the recession in Europe and a decline in demand for import goods has influenced Singapore as well. The government set the goal of establishing new economic growth with a focus on increasing productivity. This strategy should strengthen the effort of establishing Singapore as Southeast Asia's financial and high-tech hub. Singapore maintains an open investment regime. Only a few exceptions are represented by limitation on foreign investor ownership of domestic banks and media (World Bank, 2010).

The economic development in Singapore is associated over many past decades with the use of external capital. Singapore chose the FDI as its main source of external capital. Such an enormous development could not have occurred without this trigger. On the other hand non-Singaporean international corporations began to occupy Singapore's export economy. These firms do not have to necessarily share their technologies and knowledge and, as a result, Singapore's capability to innovate is smaller compared to the other Asian Tigers such as Taiwan or South Korea. Looking back into history Singapore shared the idea that the path towards higher international economy importance and competitiveness includes stable macroeconomics indicators, good infrastructure, motivating policies for entrepreneurs, and a well-educated work force. Singapore treated foreign investors in a different way than other countries. Foreign investors do not have to enter joint ventures. The management do not have to be controlled by local managers. Local and foreign investors obey the same legal framework. Another large benefit for foreign investors can be identified by no restrictions on reinvestment or repatriation of earnings and capital (Asian institute of Management, 2012).

The first analysis of this work is devoted to the comparison of the main macroeconomics indicators in Singapore and European Union, which are displayed in the table 1. This analysis is significant because both economies are strongly connected through large volumes of trades and, furthermore, the Stock Exchanges are still very sensible and vulnerable on fluctuations even on the other side of the world. The

condition of Singapore's economy seems to be much better in comparison to the European one. The average of real GDP growth was five times higher during the last decade. The highest difference between these two subjects occurred in the unemployment rate. The European countries have suffered with the raising trend of unemployment mainly in southern countries, especially among the younger generation. The overall youth unemployment rate in EU exceeded 23 % during crisis years (Eurostat, 2015). What is so distinctive in Singapore? Not only is most of the younger generation in Singapore perfectly educated, but also the governmental organizations stepped up their effort in trying to match the redundant workers with jobs available in the economy. This strategy targets even the mid-career Singaporean, equipping them with new skills that make them more attractive on the labour market. Another approach is to provide subsidies for companies covering training costs for new employees (Ministry of Manpower Singapore, 2015).

Almost no difference is visible in the average inflation during the last decade. Singapore struggled with the possibility of deflation and its negative consequences in the first half of the observed period. Inflation has been much higher recently. Possible causes of higher inflation: a hike in Singapore's population in recent years and fast economic growth, especially after the year 2009. Singapore's inflation policy is a variation of inflation targeting, except the fact that policy maker's management involves a periodic adjustment of the exchange rate, not the short-term interest rates. The exchange rate as a tool for transmission of monetary policy is more important than interest rates. This is a consequence of much higher openness ratio in Singapore (McCallum, 2007). On the other hand Europe was threatened by deflation pressure in the second half of the observed period. Despite the fact that the 2% target is almost accomplished as the average inflation rate in the EU shows.

Table 1 Comparison of three main macroeconomics indicators of Singapore and EU countries

Indicator/Time	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average
Real GDP growth in Singapore	4,58	9,16	7,37	8,62	9,02	1,75	-0,79	14,78	5,16	1,32	3	**5,82**
Real GDP growth in EU (27)	1,5	2,5	2	3,4	3,1	0,5	-4,4	2,1	1,7	-0,5	0,1	**1,09**
Unemployment in Singapore	4,1	3,5	3,1	2,7	2,1	2,2	3	2,2	2	2	1,9	**2,62**
Unemployment in EU (27)	9,2	9,3	9	8,2	7,2	7	9	9,6	9,7	10,5	10,9	**9,05**
Inflation in Singapore	0,51	1,66	0,47	0,96	2,1	6,54	0,58	2,83	5,24	4,58	2,36	**2,53**
Inflation in EU (27)	2,1	2,3	2,3	2,3	2,4	3,7	1	2,1	3,1	2,6	1,5	**2,31**

Source: author's own work in consideration to Department of Statistics Singapore and Eurostat

II. Review of the literature connected to FDI

The core term of this work is Foreign Direct Investment. How does the legislation in Singapore define this term? "FDI refers to an investment where a foreign direct investor owns 10 per cent or more of the ordinary shares or voting power in Singaporean enterprise" (Department of Statistics Singapore, 2013, p. 15). This process contains not only direct equity investment, but also net lending between the foreign investor and new entity abroad. The biggest difference from the portfolio investment is seen in long-term lasting interest and controlling the entity (Department of Statistics Singapore, 2013). The two following subsections will examine the literature connected with the relationship between FDI and Growth and the second will focus on main determinants that affect FDI flows.

2.1 FDI and Growth

What was the motivation for so many attempts that came up with theories and possible effects of FDI on the hosting economy? First of all, there was a huge increase in FDI flows all over the world, which started in 1980s. This new trend was accompanied with higher competition among countries that tried to provide incentives for new investors on the basis of liberalization of financial and factor markets. The other reason is considering the impact of foreign ownership on attributes such as employment, technological progress or trade balance. Positive effects may arise and played a really significant role in the transition period in many countries. On the other hand FDI inflow can also result in some negative consequences. Costs and benefits are in some cases hard to define. The process of FDI cannot be seen as a zero sum game (Moosa, 2002).

According to the literature FDI and TNCs can affect economic growth. They are probably more important for developing countries, where FDI is usually a vehicle for boosting economic development. FDI tends to influence growth through many channels such as capital accumulation, technical progress, spillover effect or human capital (foreign management). These positive attributes can spill over to local firms

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through interaction on the horizontal (competition) or vertical (buyers and suppliers) level (Fortainer, 2007). A large number of empirical studies confirms that FDI is a significant source of capital that complements domestic private investment and usually leads boosting the overall economy (Chowdhury & Mavrotas, 2005). Recent theories claim that capital accumulation is supposed to influence economic development the most. Exogenous technology was considered as the main element of economic growth in the 1950s, influenced by the traditional Solow growth model. Technology is no more seen as exogenous, but its level still plays a big role in the so-called catching-up process, which mainly has a large impact on the economy of developing countries. TNCs represent one of the most important sources of technology transfers abroad. The reason is that these international companies are concentrated in technology-intensive industries (Fortainer, 2007).

One of the analyses that did not find the positive impact of FDI was Javorcik (2004). His results did not provide any evidence of intrasectoral spillover effects based on firm-level data from Lithuania. This work is not the only which doubts the positive effect on host countries. It is necessary to also mention work done by Haddan and Harrison (1993) on Morocco or Djankov and Hoekman (2000) on the Czech Republic. Ambiguous results were brought by the Sub-Saharan Africa case. A positive effect was found only according to OLS[2] estimation, the panel analysis[3] showed the opposite, which was interpreted by the author as a sign of the crowding out effect in a host country (Adams, 2009). Papers that analysed FDI in Central and East Europe during transition periods found a positive link between FDI and exports and imports, which were claimed as complementary activities. This proof suggested that FDI's impact is more complex than standard theories provided (Brenton & Di Mauro, 2009).

Several studies found a clearly positive link. These researches have focused primarily on less developed countries. Less clear growth benefits for the recipients of FDI have been found in developed countries (Ozturk, 2007). The well-known positive attitude

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[2]Ordinary least squares, method for estimating the unknown parameters in linear regression.
[3]Statistical method that deals with two and n-dimensional panel data.

towards FDI is connected with J.H. Dunning and his so-called eclectic paradigm[4]. FDI can be seen as a tool for increasing productivity in various industries. Other examples: Panel data analysis was used on a sample of 18 Latin America countries. The results suggested a positive impact on economic growth in host countries. However, quality human capital, stable and liberalized markets were required in order to receive any benefits from FDI (Bengoa & Sanchez-Robles, 2003). Some papers also focused on indirect effects of FDI, using the interaction terms with FDI (Carkovic & Levine, 2002). Li and Liu (2005) found a strongly positive effect on growth through interaction of FDI with human capital, while interaction with technology gap was significantly negative. Another paper, which pointed out the human capital importance: Borensztein, De Gregorio and Lee (1998) showed empirically that FDI has a positive influence on the economic growth when the level of education is higher than a given threshold. To sum it up the proof of a positive effect on growth has to hold some conditions very often.

All these ambiguous results above may reflect the heterogeneity of studies and their different methodologies, samples, etc. However, we should also investigate the form of foreign investment. Two quite different types are often put together: Greenfield investment[5] (accumulation of capital) and mergers and acquisitions (transfer of ownership). These two forms are not likely to have the same impact on growth. Harms and Méon (2011) suggested that the difference is present. According to their results: "the growth effect of greenfield FDI is much stronger than the effect of M&A sales" (Harms & Méon, 2011, p. 2). Greenfield FDI is more suitable for bringing capital in the form of new technology or research and development facilities. This result implies that policy-makers interested in growth should be more careful with the composition of FDI inflows into the country.

For evaluation of relationship between FDI and growth the panel data or cross-section data are used. Among the most common dependent variables in regressions belong real GDP growth, GDP per capita, contrary independent variables: FDI as a share of GDP, openness of economy, inflation, size of government, average years of schooling

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[4]Eclectic Paradigm is a combination of many isolated theories of international economics, putting in one approach.

[5]Investment, that creates a new physical facility for business.

as proxy for human capital, black market premium or private capital as a share of GDP (Carkovic & Levine, 2002). Many authors use interaction terms of the above-mentioned variables to find more proper results.

Table 2 tries to summarize the most important effects connected with FDI inflow. It is obvious that FDI can be a crucial element for boosting the economy and can influence many of macroeconomics and social indicators. This is an explanation why so many countries are keen on attracting new foreign investors. On the other hand FDI may conceal many pitfalls that are capable of destabilizing the entire economic and social environment. The recipient country needs to find the ability of benefiting from FDI through correct policies and boundaries that lead the economy towards growth.

Table 2 Possible Effects of FDI on the host country

Positive Spillover Effects	Negative Spinnoff Effects
Inflow of capital in case of scarcity in public and private savings	Inflow of capital causes a crowding-out of home savings
Crowding-in effect, the new investments help to develop local firms	Crowding-out effect, local companies are disappearing as a result of high competition
Inflow of new modern technology and management skills	Creation of dual economy, overall rise in wages, but slower productivity growth in local companies
Improvement of awareness about the country and its image	Influence on exchange rate (appreciation) and inflation (higher) – slowdown in new investment activities
Impact on cultural and social sphere – lower unemployment, higher wages	Deterioration of balance of payments as consequence of gains repatriation
Positive impact on competitiveness and export performance of the host country	Competition in the field of incentives and its impact on economy – advantage of tax paradises
Development in infrastructure, stabilization of industries, better institutional environment	Environmental and social effects – damage of nature, prioritization of capital intensive sectors – higher unemployment

Source: author's own work in consideration of literature

Table 3 Summary of relevant literature connected to FDI and Growth

Authors	Conclusion	Methodology	Description
Javorcik (2004)	No evidence	Firm-level data (Lithuania), Olley-Pakes method	No evidence of intrasectoral spillovers effects
Adams (2009)	Ambiguous	OLS and panel analysis in Sub-Saharan Africa	The positive effect found by OLS, panel analysis opposite (sign of crowding out effect)
Djankov and Hoekman (2000)	Negative effect	Firm-level data from Czech Republic	Negative spillover effect on firms that do not have foreign partner
Carkovic and Levine (2005)	Negative effect	General Method of Moment (GMM), data from 1960-1995 (cross-country dataset)	FDI inflows do not provide influence on economic growth
Bengoa and Sanchez-Robles (2003)	Positive effect	Panel data analysis, sample of 18 Latin America countries	Positive impact on economic growth, with condition of high quality of human capital and stable market
Li & Liu (2005)	Positive effect	Panel data analysis of 84 countries (1970-1999)	Positive effect on growth through interaction of FDI with human capital
Borensztein, De Gregorio and Lee (1998)	Positive effect	Cross-country regressions, data on FDI flows from industrial countries to 69 developing states	Positive influence on growth when the level of education is higher than a given threshold

Source: author's own work in consideration of literature

2.2 Determinants of FDI

The phenomenon of FDI in not only the subject of expertise in the field of its impact on growth, but also individual determinants are in the spotlight. Many papers have analysed determinants that attract FDI to an exact country or to specific groups of countries. For instance, determinants were investigated in developing countries (Nunnenkamp, 2002), with the same subject of interest, but with a larger emphasis on human capital (Noorbakhsh, Paloni & Youssef, 2001) and with an emphasis on the impact of the democratization approach and the spread of information and communication technology (Addison & Heshmati, 2003). Regional distribution and determinants were analysed in Spain (Villaverde & Maza, 2012). These two authors also examined determinants of FDI flows in all European regions (Villaverde & Maza, 2015). The positive impact of the announcement about EU accession as a

determinant of FDI in Central and East Europe was explored as well (Bevan & Estrin, 2004). China, as the major player in attracting large amounts of FDI, has also been also analysed a lot (Ali & Guo, 2005). This work has a purpose to follow the principles of these analyses regarding Singapore.

The most suggested FDI determinants by the literature are business environment, economic liberalization, market size, market potential, labour costs, human capital, infrastructure, inflation, tax policy or agglomeration. All these and many other determinants are used in research papers, but there is no uniform system or classification for them. One approach is the division into three categories of FDI. The first one includes economic factors such as market size, growth potential or natural resources. The second category factors are related to political, social and cultural aspects of the host country. The last category observes the magnitude of transaction costs in the country (UNCTAD, 1998). According to this division many authors have concentrated their researches on the first category, because these determinants are relatively easier to measure.

Some of the researchers (Kahai, 2004) divide the determinants into traditional determinants such as GDP, inflation, export, labour cost and non-traditional determinants such as economic freedom, trade regulation or level of corruption. Another classification tries to distinguish between endogenous (attributes on the firm-level) and exogenous determinants (traditional - labour cost etc.). The determinants are often different according to the type of FDI. Horizontal and vertical FDI is another possible classification. The first one embodies the motivation for a firm to locate production in a new market in order to save the transportation costs. The comparative advantages among countries are motivations for the latter type. It is worth transferring some stages of production abroad. The benefit is seen in the lower production costs in the new country. The difference in factor prices creates the profit. The analyses of vertical FDI were driven by factor endowments connected mainly with authors such as Helpman and Krugman. Considering the horizontal FDI, why do firms prefer FDI rather than exporting or licensing even if FDI could be quite risky business? FDI is risky in a way of creating a firm from scratch, problems with different culture and communications troubles in the future. Two factors are very important: presence of

positive trade costs and economies of scale on the firm level. Literature suggests that a horizontal FDI is more likely to arise between similar countries (Protsenko, 2004).

The most common determinants will be introduced in more details in the following subsections. There is lack of consensus about determinants, but *Market size,* measured by GDP or GDP per capita, could be perceived as the most robust FDI determinant primarily for horizontal FDI (Artige & Nicolini, 2005). Most studies have found positive effect of domestic market size on attraction of FDI. The reasoning behind this is that countries with larger and growing markets promise higher returns on capital and in consequence higher profit from the whole investment.

Business and macroeconomics environment influence the additional costs of doing business abroad. These terms include firstly political risk regarding stability, level of corruption, the state of law enforcement, level of bureaucracy. Secondly, financial risk that could be measured in exchange rate stability, inflation, foreign debt position, etc. The mixture of these characteristics leads to a boost or decrease in FDI inflows. Previous research has found negative impact of unfavourable business climate on attracting FDI (Jaumotte, 2004). Singapore is considered according to many surveys as one of the most business-friendly economies in the world. This attitude makes them even stronger in the fight for new investors.

Infrastructure covers many types starting with paved roads, railways networks, ports and airports. Here is an interesting fact; poor infrastructure could be found as a hurdle and also opportunity for new investors. But still under invested infrastructure belongs among the main constraints for poor countries in the race to interest investors (Dermirhan & Masca, 2008). Developed infrastructure, as it is possible to see in Singapore, can promote excellent connectivity and accessibility to other markets. The findings connected with this topic: good infrastructure has a primarily positive effect on FDI inflow evenly as in the case of Pakistan (Rehman et al., 2011).

Human capital is empirically measured by average years of schooling, enrolment in secondary and tertiary education. These indicators reflect the level of qualified workforce, but on the other hand the labour costs as well. Lower labour costs are being exploited in developing countries. The ideal situation for investors is high labour productivity connected with lower labour costs compare to its home country.

The empirical findings: Noorbakhsh, Paloni and Youssef (2001) confirmed the significance of human capital as a determinant of FDI flows. Moreover, it is one of the most crucial aspects. Another interesting fact: its importance has become increasingly larger over time.

Finally, *Openness* (measured by export plus import to GDP) *and Liberalization of economy* (privatization) help to improve host country competitiveness. The hypothesis is the following: the investment projects appear at most in tradable sectors. In other words a higher degree of openness should lead to the increase of FDI. Jordaan (2006) came up with the statement that the impact of FDI depends on the type of investment. In cases such as the so-called market-seeking investments, restrictions may have a positive impact on FDI. A foreign firm sets up a subsidiary in order to overcome high tariffs and difficulties with import (thus less ratio of openness). In contrast with this, international companies engaged in export-oriented investments prefer more open economies resulting in lower transaction costs (Dermirhan & Masca, 2008).

To sum up the topic of FDI determinants is broad. The impact of individual factors is sometimes ambiguous and reflects differences in countries. The way of obtaining and interpreting data could vary as well. To accurately estimate FDI determinants depends on the type of methodology and observed period. The panel-data analysis is used very often and brings many interesting results. Some of the authors try to evaluate determinants with multiple linear regressions (OLS). Villaverde and Maza (2015) dealt with a higher number of variables by using factor analysis.

Table 4 Summary of relevant literature connected Determinants of FDI

| Authors	Subject of Interest	Methodology	Description
Noorbakhsh, Paloni and Youssef (2001)	Developing countries	Panel analysis	Confirmed the significance of human capital as determinant of FDI flows
Nunnenkamp (2002)	Developing countries (28)	Correlation matrixes	Traditional market-related determinants are still dominant compare to non-traditional
Villaverde and Maza (2015)	260 EU NUTS2 regions	Factor analysis	Economic potential, labour market, technological progress and competitiveness exert a significant impact on FDI
Bevan and Estrin (2004)	Central and East European countries	Panel analysis (data 1994-2000)	Found positive impact of announcement about EU accession on FDI inflow
Artige and Nicolini (2005)	Three European regions	Panel analysis (data 1995-2002)	Market size was found as the most robust FDI determinant
Demirhan and Masca (2008)	Developing countries (38)	Cross-sectional econometric model (2000-2004)	Found that investors are more attracted to a country with better infrastructure

Source: author's own work in consideration of literature

III. Empirical part – analysis of Foreign Direct Investment in Singapore

3.1 Trends of FDI in Singapore

Foreign direct investment has taken a significant role in Singapore's economic miracle. Singapore's government had been competing for attracting FDI by offering many incentives to foreign investors. From the beginning investors enjoyed many preferential advantages through subsidies and tax incentives. Local Singaporean business entities were eclipsed. Policy makers trusted that international companies are the best solution to acquire high technological approaches. This beneficial business environment made Singapore the right location for many global companies. The total stock of FDI in Singapore has been rising constantly and exceeded 800 billion USD in 2013. Singapore receives a half of ASEAN's total FDI. On graph 1 it is clearly visible that FDI inflows can be expressed as a significant part of GDP. The FDI figures crossed 25 % of GDP during the peaks (years 2006, 2007) and they have never been less than 6 % of GDP (2008). Looking to other developed countries such as the United States of America the share of FDI flow represents only 1,5 % of its GDP. The second example, the United Kingdom: its share fluctuates between 2-3 % of GDP. On the other hand, in the quite similar Hong Kong the FDI flow oscillates around 30 % of GDP.

Graph 1
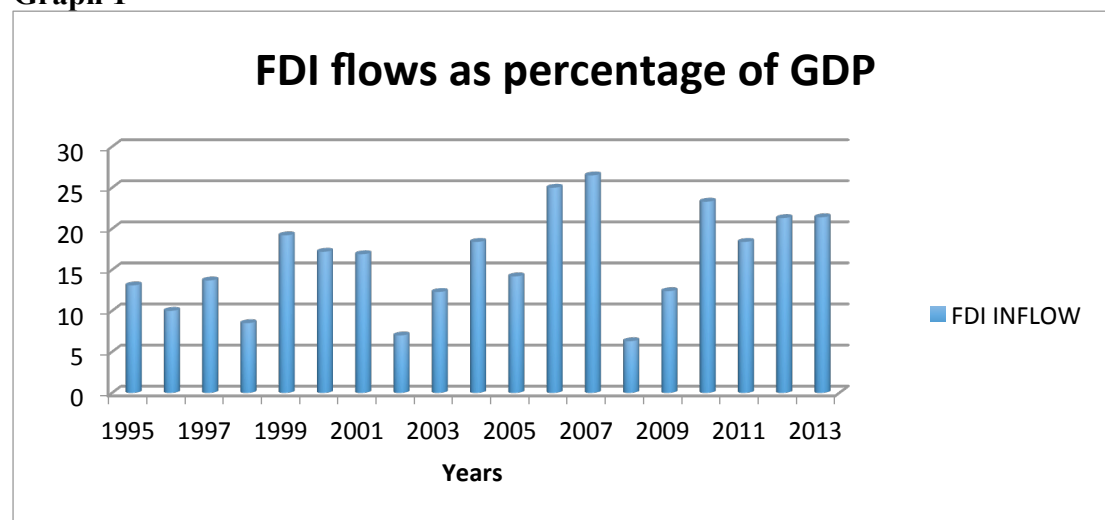
Source: author's own work in consideration to the World Bank statistics

Graph 2

FDI flows to Singapore
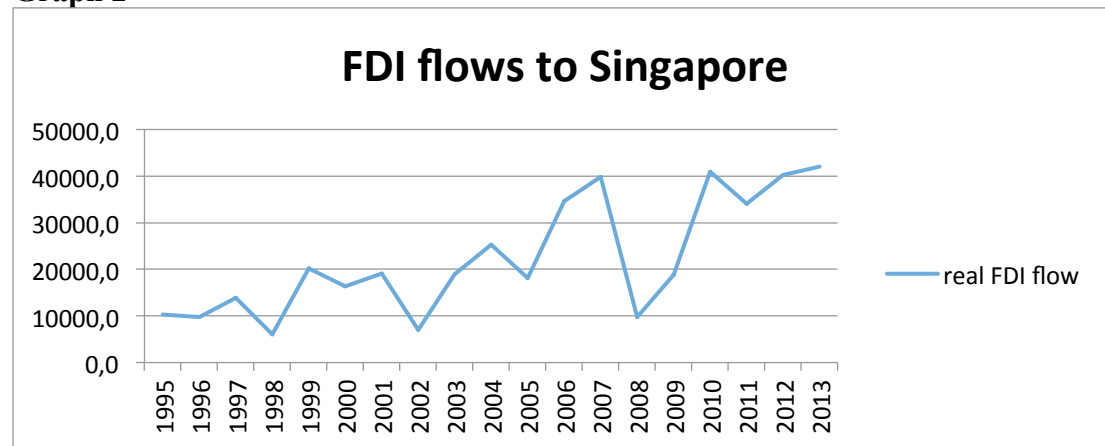
Source: author's own work in consideration to the World Bank statistics

FDI flows to Singapore have fluctuated significantly over the past decade as is depicted on the graph above. The real flow from all countries is represented in real dollars of the year 2005. The volume of this flow rose dramatically after the year 2005 and fell sharply in 2008. The latter massive decline (75%) was a result of global financial and economic crisis. Singapore authorities took steps to strength investor confidence and ensured financial stability as with promoting a new law - Bankruptcy Act, which provided a repayment scheme that gives debtors an opportunity to avoid bankruptcy. This project was highly successful (Hsu, 2012). According to the graph it is clear to discover when the crisis hit the economy. The declines in FDI flows strictly followed the entire economy results. When the crisis appears capital the flow begins to slow down. Most of the investors and debt, bondholders liquidate their holdings, which results in large capital outflow, until the optimism returns back on the market. This is the signal that FDI flows will increase again as in 2010. The rising trend of FDI persists only with the minor decrease in 2011. The highest amount of FDI was received in the year 2013. The real flow exhibited 42 billion USD of FDI. Singapore attracted the equivalent of 74 % of its GDP in the period of five years after the global credit crunch. According to the world average, countries have attracted only about 17% of GDP (UHY, 2014).

The question is: Why is Singapore so successful in attracting FDI? One of the answers is low corporation tax rate and attractive transfer pricing arrangements for international groups. The many tax incentives were established in important sectors like commodities trading, fund management, shipping or biotechnology. Lots of internet and PC software giants including Google, Apple, PayPal, LindkedIn have set

their Asian headquarters in Singapore (UHY, 2014). There are other complementary factors, such as a sophisticated ecosystem of suppliers or strong infrastructure. These determinants are needed to decide about the location. Singapore does not possess problems involving restrictions on foreign ownership, poor heath system, or a confusing policy for establishing a business like many other countries do.

3.1.1 Source regions for FDI

Europe and Asia – these two continents are on the top of source destinations for FDI in Singapore. Companies from both continents invested more than 60 % of all FDI at the end 2012. Asia held the first position with 33 % of all FDI in Singapore back in 1996. Europe was close in second place with 31% and in third place remained for the North America with 16%. The situation has slightly changed recently. As the pie chart (Graph 3) shows Europe took the lead with 36% of total inflow of FDI at end 2012. The impact of Asia declined to 24 % and the share of North America stayed almost the same as before namely 17,5 %. Europe is the main player in inflows of FDI in Singapore in these days. Therefore, this knowledge provides an answer as to why it is important to examine Singapore's FDI from European perspective.

Graph 3
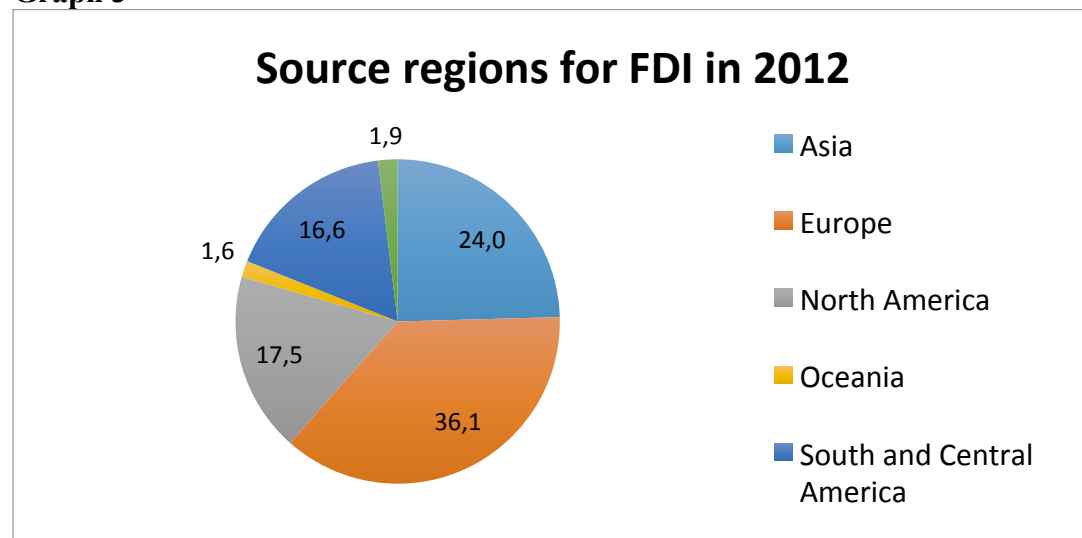
Source: author's own work in consideration to the Yearbook of Statistics of Singapore 2014

3.2 Analysis of the European FDI in Singapore

Graph 4 contains the figures of the real FDI flows from European countries in real millions of USD in the year 2005. According to the graph it is possible to detect the growing trend appearing with the new millennium. The real FDI boom could be identified mainly after the year 2004. There are two peaks; the first one is in the year 2006 right before the financial crisis hit and the second one could be seen as a sign of recovery from the previous crisis in the year 2013. In the year 2006 the total amount of FDI flow sent from Europe to Singapore was more than 30 billion USD. The figures has been fluctuating quite a lot after the financial crisis 2009. The real FDI flow has still not reached the volume of pre-crisis period. The lowest flows in 2008 and 2012 corresponded to poor economic performance in Europe. At that time countries fought with the so-called two-speed Europe because after the short recovery from the financial crisis, the debt-crisis came. Signs of stability were torn apart with debt difficulties in Greece, Ireland and Portugal. Pessimistic expectations connected to economic conditions therefore influenced the willingness of investing abroad.

Graph 4
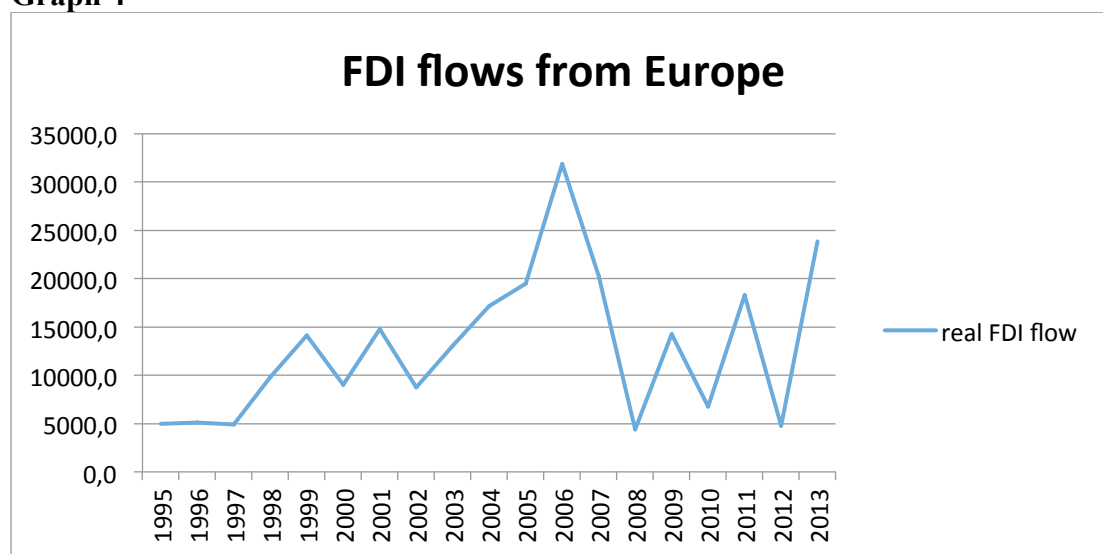
Source: author's own work in consideration to the Yearbook of Statistics of Singapore 2014

Graph 5 describes the division of total stock of FDI from Europe in the year 2013. This analysis of European countries will be used as an important component in the econometrics part of this work. As the pie chart shows there are nine very important European countries. The majority of these European investor's countries will be highlighted during the upcoming econometrics analysis: Netherlands, the United

Kingdom, Switzerland, Luxemburg, Norway, Germany, France, Denmark, and Ireland. Netherlands is the most important European investor according to total sum of FDI. Dutch companies are strong in the field of banking and insurance services. Rabobank, ING insurance company or Heineken belong among the companies that set their headquarters in Singapore. The second place is occupied by the United Kingdom; more specifically around seven hundred British companies are based in Singapore including firms like GlaxoSmithKline, Rolls-Royce, Standard Chartered Bank, HSBC, and Unilever. Switzerland follows in third place.

Graph 5
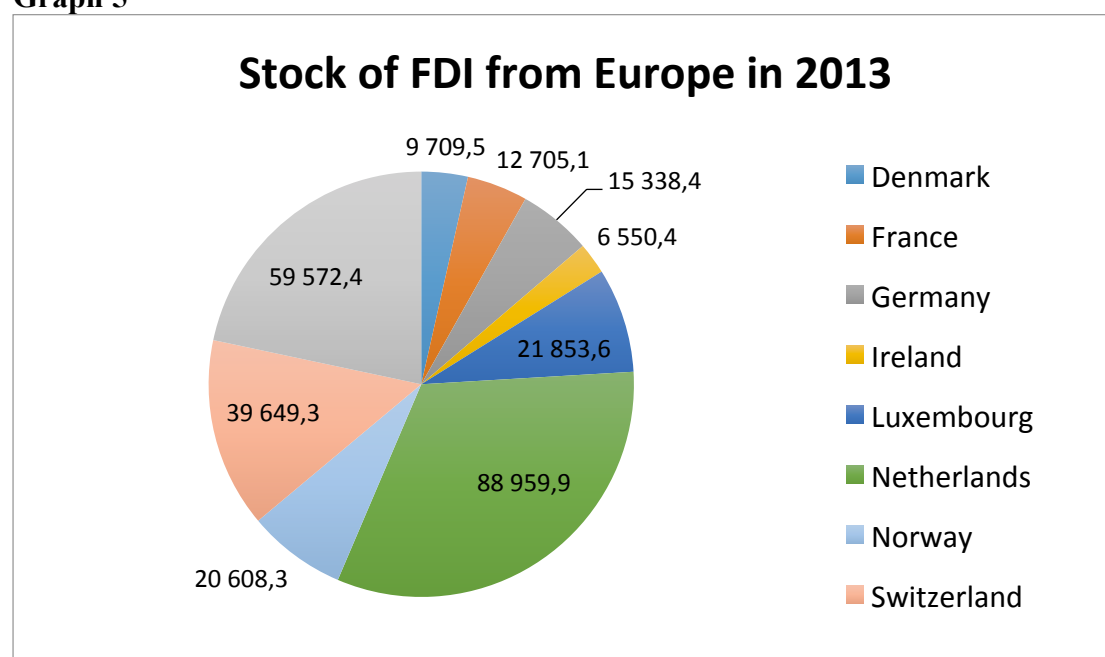
Source: author's own work in consideration to the Yearbook of Statistics of Singapore 2014

Table 5 Analysis of FDI flows from European countries

Years	NED	DEN	FRA	GER	IRL	LUX	NOR	SUI	UK
2003	2345	175	385	-1187	227	206	1822	1723	6597
2004	4658	357	1188	1142	909	1075	1569	-391	5832
2005	581	707	654	910	1256	639	2348	5828	5668
2006	16488	129	1086	-597	-1827	2054	6651	4840	5670
2007	2787	266	2871	1635	1570	629	1862	339	7263
2008	9582	914	-1453	2000	-271	2461	4187	-3948	-14985
2009	510	803	-1403	-90	-194	10088	1867	3346	1930
2010	-965	4336	-38	2810	1963	1826	-1085	314	-552

2011	8826	732	2544	268	2076	3829	-443	1400	6706
2012	5998	1053	1965	538	766	-2541	-1143	4021	-6788
2013	8979	-225	-329	516	-1135	1551	276	7633	9680

Source: author's own work in consideration to Yearbook of Statistics Singapore, 2014.

Table 5 presents more details in the issue of FDI flows from Europe. FDI flows were calculated as the difference between stocks of FDI at the end of every year with the previous one.[6] Under what circumstances can stock of FDI decline? Here are some examples:

- Enterprise is operating at a loss.
- Companies from Singapore are buying back its shares from foreign investors.
- "Dividends distributed to foreign shareholders are higher than current earnings recorded".
- "Partial or complete disinvestment by foreign direct investors" (Department of Statistics Singapore, 2013, p. 17).

It is almost impossible to identify any common pattern for all European countries. Denmark and Luxemburg first began to appear in the statistics of important investors at the beginning of new millennium. The UK was the leading investor for many years. This could be interpreted as the consequence of very long bilateral foreign relations. The UK hit its peak in 2007 and after a massive decline in stock of FDI in 2008 it has never returned to the previous level. Norway was once counted as a progressive investor in Singapore but after 2009 we could identify a long-term stagnation. French and German stocks of FDI rose steadily in the observed period. There are only a few minor declines, but the total volume of FDI has almost tripled. Ireland is the smallest from the important investors in Singapore. It is clear from data that Irish investors were busy with their own problems during the period after 2007 and their impact on investment in Singapore has not raised significantly. Switzerland has never abandoned the three top positions in investments. After the long stagnation Swiss investors almost doubled their investments in the recent 3 years. The year 2008 was a breakthrough for Dutch investments in Singapore. Since that time the Netherlands

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[6]The cumulative FDI flows would equal FDI Stocks. However, where FDI flow is collected from Exchange records and FDI stock data are derived from company surveys. In this case cumulative FDI flows do not generally match stocks. Reinvested earnings are often excluded from FDI flow data. (UNCTAD, 2015)

holds the position as the most important European investor. Investors are clearly in good shape as the strong stable rise of FDI is seen.

How does the future look? *Brightly* in one word – the Free Trade Agreement was signed in spring 2013. This message should be appreciated for businessmen on both sides. It will bring even easier access to the gateway to Asia for EU states. Not to mention that Singapore hosts already 9000 EU companies (Ministry of Foreign Affairs Singapore, 2013). The following tables investigate the main European investors companies in Singapore.

Table 6 Top European affiliates, ranked by sales

Rank	Company name	Industry	Parent company	Home country
1.	BP Singapore	Natural energy resources	BP plc	United Kingdom
2.	Vitol Asia Pte Ltd	Trading crude oil, petroleum	Vitol Holding BV	Netherlands
3.	Shell Eastern Petroleum	Petroleum and its products	Shell Chemicals Ltd.	United Kingdom
4.	Trafigura Pte LTD	Oil and oil product	Trafigura Beheer BV	Netherlands
5.	Glendore Singapore Pte Ltd	Commodities	Glendore Inter. Plc	Switzerland

Source: author's own work in consideration to Hsu (2012)

Table 7 Top Greenfield projects 2008 – 2010 by European investing firms

Rank	Company name	Industry	Business activity	Home country
1.	Standard Chartered Bank	Financial services	Business services	United Kingdom
2.	Lanxess	Rubber	Manufacturing	Germany
3.	Roche Group	Pharmaceuticals	Manufacturing	Switzerland
4.	Citco Group	Financial services	Business services	Netherlands
5.	Ubisoft Entertainment	Software and IT Services	Design development	France

Source: author's own work in consideration to Hsu (2012)

3.3 Effects of FDI on GDP growth

This part of the work explores the connection between FDI flows from the EU to Singapore and its effect on the GDP growth. As the literature suggests the growth effects of FDI are connected with conflicting predictions. There are many factors that can influence economic growth. This work will use some of the findings from Carkovic and Levine (2002) analysis. Their analysis tried to control for simultaneity bias, country-specific effects and the routine use of lagged dependent variable. These authors used new statistical techniques to examine economic growth and FDI. Methodologically they used the Generalized Method of Moments panel estimator. Their work was an inspiration for choosing independent variables that are recently used in the regression.

Whether the FDI flows from European countries have an effect on Singapore's GDP growth or not, the analysis needs to set up the time framework, in this case quarterly figures observed during the period 1995 – 2013. The data were obtained from the Department of Statistics Singapore, IMF and the World Bank. Therefore, the database is the author's work. A time series analysis will be performed. A time series analysis could be defined as a collection of observations of well-defined data that are obtained throughout repeated measurements over a time period.

The analysis will begin by offering some descriptive statistics and showing the development of the variables over time. Then it is necessary to undertake stationary testing in order to fulfil econometrics assumptions relative to the stationarity of variables. Econometric models based on so-called spurious regressions may lead to unreliable results, as for example mentioned by Verbeek (2012). To test the stationarity of the variables the Augmented Dickey Fuller test (ADF test) is used, which states null hypothesis of non-stationarity (existence of unit root test). In cases of rejecting the null hypothesis it is assumed that variable is stationary.

Our time series analysis will employ the following equation:

$$GDP = \beta_0 + \beta_1 FDI + \beta_2 INFLAT + \beta_3 OPEN + \beta_4 SCHOOL + \beta_5 CREDIT + \beta_6 GOV + \varepsilon$$

The dependent variable of the equation is production measured by real *GDP*. β_0 is a constant.

FDI - is defined as total FDI flows from the main European source countries, as a share of GDP.

The rest of variables could be defined as non-FDI factors, some of which have connection to Carkovic and Levine (2002) paper. Five independent variables were chosen in attempt to reflect stability of the business environment, business potential, human capital and size of government.

INFLAT – Inflation in Singapore is defined as the consumer price index that reflects changes in the cost of a specific basket of goods and services. The base was set: 2010=100.

OPEN – Degree of openness of Singapore is defined as the quarterly sum of exports and imports to the real GDP.

SCHOOL – This variable is defined as the average years of schooling among the working population.

CREDIT – Credit that was given to the private sector as a share of GDP.

GOV - Government size ratio in Singapore is defined as the government revenue to GDP.

3.4 The determinants of FDI in Singapore

Another step in evaluating the impact of FDI is to explore the main determinants of FDI flows to Singapore. The literature review has suggested that some of the main determinants are business environment, economic liberalization, market size, market potential, labour costs, human capital, infrastructure, inflation, tax policy or agglomeration. The majority of authors, who have focused on analysing empirically the FDI determinants, have used panel analysis; see, for instance Noorbakhsh, Paloni and Youssef (2001), Bevan and Estrin (2004) or Artige and Nicolini (2005). Villaverde and Maza (2015) came up with another solution – factor analysis. The panel data approach was chosen for our analysis. "Panel data set is one that follows a given sample of individuals over time, and thus provides multiple observations on each individual in the sample" (Hsiao, 2003, p.1). What are the advantages compared to a cross-section analysis? This approach usually gives large number of data points, higher degrees of freedom; reduces the collinearity among all variables. It also helps researchers to analyse more economic questions that cannot be accurately explored by cross section or time-series datasets. In other words, panel data analysis, improves the quality of the econometrics estimations (Hsiao, 2003).

As it is customary, the analysis will begin by showing some descriptive statistics and the development of variable FDI for individual countries. Stationarity testing will be part of the analysis as well. Another step is to investigate what technique to use in panel analysis. In this case the technique will be selected formally by using a combination of Bresuch-Pagan and Hausmann tests.

The dependent variable in the regression is the FDI flows from nine European countries during the observed period 2000 – 2013 to the Singaporean GDP. The countries are: Denmark, France, Germany, Ireland, Luxembourg, Netherlands, Norway, Switzerland and the United Kingdom. These countries have been providing the largest volume of FDI flows to Singapore from Europe (data from Department of Statistics Singapore).

Our panel data analysis will employ the following equation:

$$(FDI/GDP)_{it} = \beta_0 + \beta_1 GROWTH_{jt} + \beta_2 UNIV_{jt} + \beta_3 R\&D_{jt} + \beta_4 PRODUC_{jt} + \beta_5 INFRA_{jt} + \varepsilon_{it}$$

The year is denoted by t, the host country by j and the source country by i. β_0 is a constant and ε_{it} stands for an error term. Five independent variables were chosen in order to reflect some of the main comparative advantages of Singapore. Our model tries to capture and estimate the attributes that are often highlighted: fast growth of economy, well educated work force, many facilities for innovations, increasing labour productivity and modern infrastructure.

Description of independent variables:
GROWTH – This variable represents real *GDP* growth in Singapore. This variable could be interpreted as dynamism of economy, which reflects changes on the market and in the entire business environment (data from Department of Statistics Singapore).

UNIV – This variable reflects human capital. In this case the proxy is measured by the percentage of population with a university diploma (tertiary education) in age group of 25-34 in Singapore (data from Department of Statistics Singapore).

R&D – Research and Development expenditures as percentage of GDP. This variable could be seen as national innovative capacity or technological capacity. R&D is the main tool of innovation and efficiency (data from Department of Statistics Singapore).

PRODUC – This variable stands for GDP per hour worked. This is a general measure of labour productivity for the entire economy. The data were obtained from ILC-Bureau of Labor Statistics.

INFRA – Infrastructure, as one of the widely used determinant of FDI, is represented in our model by kilometres of paved roads in Singapore (data from Department of Statistics Singapore).

IV. Empirical evidence – discussion

4.1 Results of regressions connected to growth case

As mentioned, the investigation for Singapore was focused on the link between the FDI flows and their impact on GDP growth. Time series estimation was used. The analysis began with checking descriptive statistics and the development of variables in time. No significant anomaly was found (see appendix 1,2). Then the analysis proceeded to stationarity testing.

Table 8 Unit root tests

Variable	ADF test	ADF test (seasonal difference)	ADF test (2nd seasonal difference)
GDP	Non-stationary	Non-stationary	Stationary
FDI	Stationary		
INFLAT	Non-stationary	Non-stationary	Stationary
OPEN	Non-stationary	Non-stationary	Stationary
SCHOOL	Non-stationary	Non-stationary	Non-stationary
CREDIT	Non-stationary	Non-stationary	Stationary
GOV	Non-stationary	Non-stationary	Stationary

Source: Author's own work

The results (Table 8) showed that most of the variables were non-stationary in levels. To solve this problem, one approach was to use differentiate them to find support for cointegration of the variables. It was not possible to prove it because all the variables were not cointegrated in the same order. As far as working with quarterly data, which were oscillating through seasons, we used seasonal differencing as a remedy. This approach fixed two problems – seasonality of the variables and non-stationarity of variables. Most of the variables were found stationary after taking second seasonal differences.

However, there was one variable which was found to be stationary at the beginning – FDI. This variable exhibited the problem with seasonality so it needed to be seasonally adjusted, for which, the moving average technique for four periods (MA(4)) was used (see appendix 3). The variable SCHOOL could not be a part of

final regression due to the too high level of multicollinearity in the model with other explanatory variables.

The model was estimated using Ordinary Least Squares method (OLS) with robust standard errors on adjusted and seasonally differenced data. The results obtained are depicted in Table 9. The next step contained statistical and econometric verification. The checks for heteroscedasticity (White's test), autocorrelation (Lagrange Multiplicators test), multicollinearity (Variance Inflation Factors) and normality (Jarque Bera test) were needed. None of these checks showed that the model is misspecified (see appendix 6-9). The R-Squared informed us that the model explains 69 % of the variability of the dependent variable, which is considered as a high explanatory power.

Table 9 Impact of selected factors on GDP (for the entire result see Appendix 5)

	Coefficient	T-ratio	p-value
constant	-2421.117	-1.453	0.1566
ma_FDI	348.366	1.770	0.0819*
sd_sd_INFLAT	-640.891	-1.848	0.0695*
sd_Sd_OPEN	104.113	6.510	1.70e-08***
sd_sd_CREDIT	-19.9298	-0.7877	0.4390
sd_sd_GOV	-617.770	-2.089	0.0409**

Note: *Significance at the 10 % level, ** at the 5 % level, *** at the 1% level

The analysis proceeds to the economic explanation of all variables in regression. The highest attention was paid to FDI. This variable displays a positive and significant effect on growth. Thus it is possible to claim that FDI flows from European countries have a positive and strong impact on Singapore's economy and accelerate economic growth. This result confirms that offering special treatment to foreign investors to attract FDI is beneficial and not a waste of money. This could be a proof that the policies are set correctly to allow exploiting positive effects and reduce the negative effects of FDI on economic growth.

Even if inflation was low and stable during the observed time period, the negative effect on GDP was expected, as this result was also obtained in the research of OECD

countries. Negative impact increases as the inflation rate falls (Gillman, Harris & Mátyás, 2004).

The degree of openness has a positive and highly significant effect. Nearly all empirical literature claims the same. The participation in the international economy is considered as a primary source of growth. Processes of globalization, increasing openness, sharing of ideas or technologies, these attributes are mainly associated with rich countries experiencing high growth (Andersen & Babula, 2008). Singapore is definitely one of these. In other words, openness is not an engine of growth but it is a catalyst for ignition of growth through market access, R&D and lower transaction costs (Nowbutsing et al., 2014).

Government size ratio has negative and significant effect. It is also an expected result as many other studies have found before, especially in rich countries. In a very simplistic way of thinking, higher revenues from collecting taxes means less financial sources for companies to invest and less money for ordinary people for consumption. The potential is seen in restructuring taxes and government expenditures so that the negative effect on growth for a given government size are minimized. Here are two pieces of advice that are supposed to help in higher economic growth: Indirect taxes are better than direct taxes on income and the second one: Investment in human capital, meaning supporting education and knowledge in the society, is better than direct social transfers (Bergh & Henrekson, 2011).

The variable credit to the private sector was found as insignificant.

To sum up this empirical analysis:
The investigation of FDI effect on growth has confirmed the hypothesis that FDI flows from the main European investor countries exhibit a strong positive effect on GDP growth. Another positive effect is represented by a high degree of openness. On the other hand: inflation and government size were found as having significantly negative effects on growth.

4.2 Check of the robustness in the time series model

After the estimation of the regression model, we need to test its robustness, which allows us to fulfil assumptions of validity and reliability of the model. By robustness we usually search for extreme values, which may bias the results. Further we try to redefine the variables or omit some explanatory variables. Finally we use different estimation techniques to be sure that our main conclusions are not biased.

For the time series model, we began firstly with use of different estimation techniques, then we tried to add a variable representing economic recession and lastly we omitted the variable FDI.

1. Different Estimation Techniques

Our approach estimates the models using High-Precision OLS and Heteroscedasticity-Corrected methods. The purpose of this step is to observe whether there was any change in the signs of the explanatory variables or the coefficients. As expected, in comparison with OLS with Robust Standard Errors, both techniques brought different coefficients, but the signs of the variables and the significance of the variables remained the same. We conclude that the technique did not bias the results.

Table 10 Comparison of results (for the entire results see Appendix 10, 11)

	OLS	High Precision OLS	Heteroscedasticity Corrected methods
	Coefficient	**Coefficient**	**Coefficient**
const	-2421.17	-2421.17*	-3259.49 ***
ma_FDI	348.366*	348.366*	440.283 ***
sd_sd_INFLAT	-640.891*	-640.891**	-568.606 **
sd_sd_OPEN	104.113***	104.113***	107.434 ***
sd_sd_CREDIT	-19.9298	-19.9298	-12.1558
sd_sd_GOV	-617.770**	-617.77 **	-562.94*

Source: Author's own work
Note: *Significance at the 10% level, ** at the 5% level, *** at the 1% level

2. Adding time variable representing economic recession during the years 2008-2010

The check of descriptive statistics did not reveal any suspected observations (outliers) so we have decided to represent with the dummy variable economic recession during the years 2008-2010, which made significant changes in the GDP of countries all over the world. The variable Crisis was not found to be statistically significant and the coefficients did not even slightly change. The signs and significance remained the same (see appendix 12).

3. Omitting variable FDI

The key variable of the analysis was FDI. We need to investigate how the results of the model change if we exclude the variable from the model. The signs of the explanatory variables and their significance remained the same. For comparison we may use information criteria – adjusted R-Squared and Akaike and Schwarz criterion. Those criteria were better in the model with FDI so we suggest leaving the variable in the model because it has its explanatory power (see appendix 13).

Table 11 Comparison of information criteria

	OLS	OLS excluding FDI
R-Squared	0.686184	0.664612
Akaike criterion	1260.141	1299.209
Schwarz criterion	1273.279	1310.306

Source: Author's own work

4.2.1 Granger causality between GDP and FDI

The time series are very often correlated in both directions. We are not often sure in which directions the causality between variables goes. Time series offers a Granger-Causality test, which is based on the bilateral relationships among variables and their ability to predict one another (Tsay, 2005). We estimated Granger-Causality between FDI and GDP. Both hypothesis of "Non Granger Causing" were rejected on a 10% level of significance, which says that the relationship between FDI and GDP indicates double sided causality, both variables predict each other.

Table 12 Causality Test

Pairwise Granger Causality Tests			
Sample: 1995Q1-2013Q4			
Lags: 10			
Null Hypothesis	Obs.	F-statis.	Prob.
SD_SD_GDP does not Granger Cause ma_FDI	56	4.11083	0.0009
ma_FDI does not Granger Cause SD_SD_GDP		1.93929	0.0725

Source: Author's own work

4.3 Results of Determinants analysis

Panel data analysis was used to examine some of the major determinants that attract FDI flows to Singapore. Descriptive statistics and development of variable FDI did not find any anomaly (see appendix 15, 16). We have to obey the same rule: it is not allowed to estimate regressions on the non-stationary data. Results of stationarity testing are displayed in Table 10. It was necessary to use first difference for variables PRODUC and INFRA to make them stationary.

Table 13 Unit root tests

Variable	ADF test	ADF test (first difference)
FDI	Stationary	
GROWTH	Stationary	
UNIV	Stationary	
R&D	Stationary	
PRODUC	Non-stationary	Stationary
INFRA	Non-stationary	Stationary

Source: Author's own work

Breusch-Pagan and Hausmann tests were used to identify the right technique for estimation of panel analysis. The Breusch-Pagan test rejected on the 5% level of significance the null hypothesis (p-value was lower than 0,05), which states that Pooled OLS was the right specification for data and accepted the alternative that fixed effects are a better specification than Pooled OLS. The Hausmann test states that fixed effects specification is the recommended one for analysis (see appendix 18). The model is thus estimated by Fixed Effect Method.

Table 14 Results of panel analysis (the entire results are in Appendix 19)

	Coefficient	T-ration	p-value
const	4.97555	2.7452	0.0071***
GROWTH	0.159975	2.6241	0.0100**
UNIV	0.0677751	1.6621	0.0995*
R&D	-2.03494	-2.4755	0.0149**
d_PRODUC	-0.517545	-2.5584	0.0120**
d_INFRA	0.0119757	0.8840	0.3788

Note: *Significance at the 10% level, **at the 5 % level, *** at the 1% level

To make sure that the model does not face any problems with heteroscedasticity and autocorrelation, the model was estimated with robust standard errors. However, it is still necessary to measure the intensity of relationships among explanatory variables – multicollinearity. The test confirmed that the intensity was in limits. A graph of fitted and estimated values by regression is attached in appendix 20. The R-Squared informs us that the model explains 32 % of the variability of the dependent variable, which is considered as quite a good explanatory power.

The explanation of results:

The real GDP growth was used as a proxy of economy dynamism in Singapore. The variable has a significant and positive effect on FDI, which indicates the high importance for foreign investors. The average real GDP growth was five times higher compared to the European Union in the observed period. Investors perceive Singapore as a safe location for their investments and they expect further positive economic development. The prompt and successful reaction of the Singaporean government to the global economic crisis is just one of many examples of proof. Thus, it is possible to claim that GDP growth is a crucial determinant for attracting FDI.

The percentage of people with tertiary education in a specific productive age group was used as proxy for human capital. This variable has a significant and positive coefficient. This result has confirmed the hypothesis that the level of education of the labour force is an essential aspect for decision about the investment. According to available statistics, the number of residents in the age group 25-34 with university diploma has risen dramatically. Singapore has been for almost a decade at or near the top of all surveys considering quality of global education. All of these attributes lead to higher attractiveness for foreign investors. In addition, a higher level of education in population should have a positive influence on the exploiting of FDI spillover effects as Borensztein, De Gregorio and Lee (1998) claimed.

The R&D expenditures as a percentage of GDP have a significant and negative effect on FDI. It indicates the following situation: when the host country attracts more foreign investors it tends to spend less on R&D. The logic is the following: foreign firms already possess better technology than the majority of local firms (Fan & Hu, 2007). Foreign investors do not appreciate high technological competition. They want to exploit their comparative advantage on the new market. Thus, expenditures to R&D do not provide larger inflow of FDI.

GDP per hour was used as a proxy for measuring productivity in Singapore. Its figures were rising during the observed period. However, the variable has a significant and negative effect on FDI. The economic explanation: as productivity, education and skills of workers are increasing; all of this has an impact on labour costs. Employees desire to be paid adequately. It could be seen in many analyses that higher labour

costs reduce the FDI inflow to the host country. The labour costs rose more than the level of productivity in observed period. The average monthly earnings have increased by 55 %. On the other hand, productivity has increased only by 28 %. Therefore, we could claim that the labour productivity was not found as one of the key determinants that help to pull up foreign investors.

The infrastructure has a positive effect on FDI. This finding suggests that we can confirm the hypothesis that modern infrastructure is also one of the important determinants of FDI even in developed countries.

To summarize the findings: the dynamism of economy, human capital and infrastructure have been confirmed as some of the very important determinants that attracts FDI to Singapore. On the other hand the opposite impact could be seen between FDI flows and R&D expenditures and labour productivity, because a negative relationship was found.

4.4 Check of the robustness in the panel model

For the panel model, we began with different estimation techniques, then we added a new variable representing economic recession and lastly we tried to omit variable GROWTH.

1. Different Estimation Techniques

Since the OLS technique was not found as an appropriate technique, we estimated the model using random effects. The purpose of this is to see whether there is any difference between Fixed and Random Effects. The results showed, that the models are the same and by using these techniques, so too could we claim that the results are not biased (see appendix 21).

2. Adding a new variable economic recession

The descriptive statistics did not detect any suspected observations (outliers) so we have decided to represent the economic recession (2008-2010) by dummy variable. The three dummy variables for development during the years 2008, 2009 and 2010 have been included in the model. In comparison with other years, during the year 2009 we may observe a significant decline in FDI flows. The parameters of the model did not change so we may conclude that the results are consistent against outliers (see appendix 22).

3. Omitting variable GROWTH

One of the most important variables was GROWTH. We want to see how the results of the model change if we exclude the variable from the model. Once we have done this, there were several changes in the variables. Firstly, almost all variables except variable d_INFRA became insignificant. On the other hand, variable d_INFRA became significant at the 10% level of significance. Also, the sign of the variable d_PRODUC changed from negative into positive. The coefficients have changed a little, but the signs of the main variables remained unchanged. For comparison of the models we may again use information criteria – Akaike, Hannan and Schwarz criterion. Those criteria were better in the model with GROWTH included. We suggest retaining the variable in the model because it has its explanatory power in the model, despite the fact that several changes after omitting it have occurred (appendix 23).

V. Conclusions

FDI was the subject of interest in this dissertation as one of the drivers of the enormous Singaporean economic development in recent decades. The aims of this work were the following: analyze the trends of FDI flows, investigate whether FDI flows from European countries have a positive impact on economic performance and attempt to confirm empirically some of the main determinants that attract FDI.

The first analysis compared the economic results of Singapore and the European Union. The figures suggested that the Singaporean economic environment is in much better condition considering the GDP growth and unemployment rate despite a significant dependence on European demand for imports. The main macroeconomics indicators confirm the fact that Singapore is attractive for investors due to its stability and capability of further economic growth.

The literature review supported the disunited perception of FDI effects on hosting countries. The work summarized the possible spillover and spinoff effects. The correctly set policies are the keys for drawing benefits from FDI in the recipient country. Considering the determinants of FDI, no exclusive system or classification was found. The dissertation summarized and described the main determinants according to the relevant literature. The impact of individual determinants could be ambiguous due to different interpretations, obtained data or simply diverse economy development among the countries.

The first empirical section revealed that the stock of FDI from whole world has been rising constantly and can be expressed as a significant part of Singaporean GDP. The analysis stressed the importance of Europe, which became number one among source regions for Singaporean FDI inflows. The impact of European investors is large despite quite unstable FDI flows that have corresponded to the volatile economic performance in Europe recently.

The main empirical analysis examined the relationship between Singaporean GDP growth and FDI flows from Europe. The expected positive link was confirmed empirically. Additionally, Singapore gains largely from being an important market,

financial center and gateway to Southeast Asia for many foreign investors. The impact of the previous statement was verified by the highly positive effect of degree of openness on growth.

The last empirical analysis investigated some of the main determinants of FDI inflows from European countries. Results revealed that dynamism of economy, human capital and infrastructure could be counted among the main positive determinants of FDI in Singapore. However, labor productivity and R&D expenditures could be perceived as the negative determinants of FDI flows in case of Singapore. The robustness checks helped us to verify the validity of results in both examined models.

To sum up, Singapore might serve as a model for developing countries on how to boost economic development. Not only the Economic Development Board of Singapore knows how to set the policies for attracting the foreign investors, but it also provides a pattern on how to obtain backward linkages and spillovers. That could be seen, for instance, in providing motivation for managers of TNC that invited local firms for participation on projects, training programs or in identifying promising local suppliers (Moran, Graham & Blomström, 2005). Singapore focuses on reinforcement of human capital and even setting a flourishing economic environment. The newly signed Free Trade Agreement with Europe may contribute positively as well. With this in mind, Singapore is prepared to benefit from European FDI flows in the following decades as well.

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Appendix

Appendix 1 Descriptive statistics

Summary Statistics, using the observations 1995:1 – 2013:4

Variable	Mean	Median	Minimum	Maximum
GDP	39822.9	31655.7	22585.9	76009.5
FDI	7.63057	7.43245	-3.36660	18.1248
INFLAT	91.4407	87.5172	81.1031	113.716
OPEN	230.371	222.320	156.948	322.982
SCHOOL	9.03158	8.89215	7.52819	10.5589
CREDIT	100.300	98.5378	83.2325	127.750
GOV	10.2120	9.45739	6.46793	17.0560
Variable	Std. Dev.	C.V.	Skewness	Ex. kurtosis
GDP	16943.7	0.425476	0.854824	-0.695955
FDI	4.18548	0.548514	-0.0567805	0.385627
INFLAT	9.30931	0.101807	1.08006	-0.0994973
OPEN	47.8596	0.207750	0.298462	-1.15932
SCHOOL	0.886035	0.0981041	0.0617173	-1.16262
CREDIT	10.8009	0.107686	0.661920	0.0164577
GOV	2.67506	0.261952	0.750072	-0.365477
Variable	5% Perc.	95% Perc.	IQ range	Missing obs.
GDP	23504.9	73228.3	24863.4	0
FDI	-0.00302600	14.5708	5.47324	0
INFLAT	81.7579	111.636	12.7255	0
OPEN	166.317	308.962	83.6242	0
SCHOOL	7.68453	10.4447	1.47951	0
CREDIT	84.2587	124.250	13.2988	0
GOV	6.63074	15.3821	3.71173	0

Appendix 2 Development of variables in time
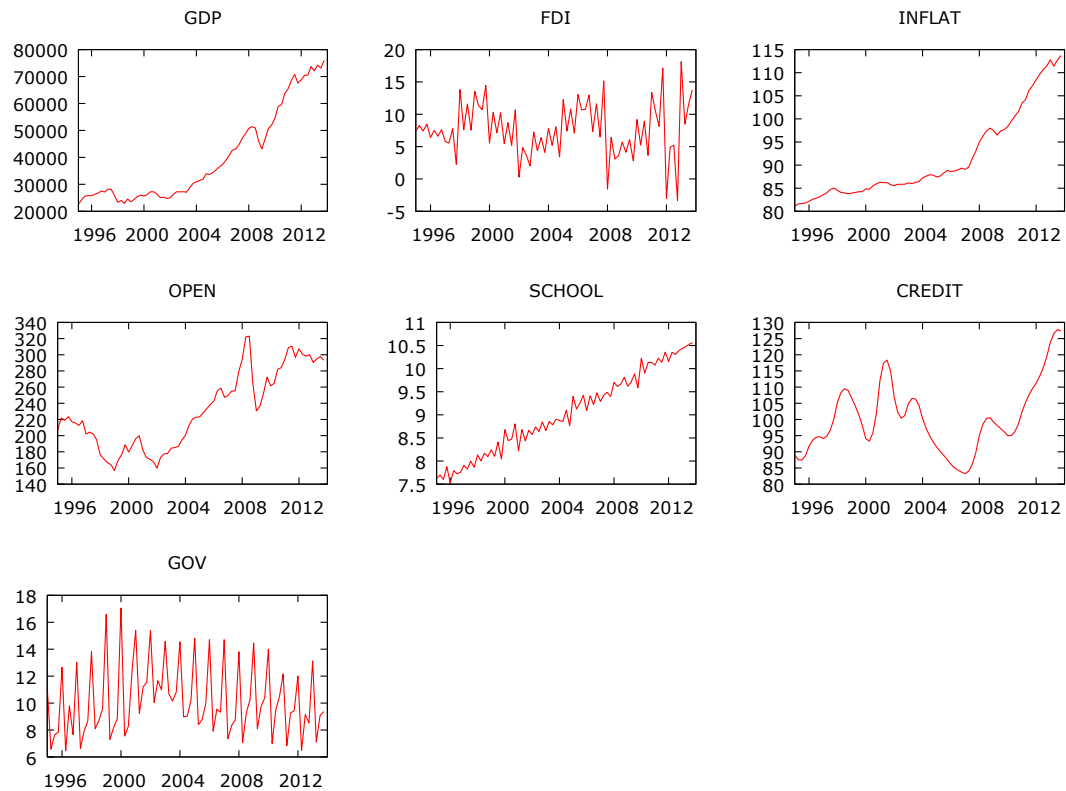
Appendix 3 the seasonally adjusted data of FDI
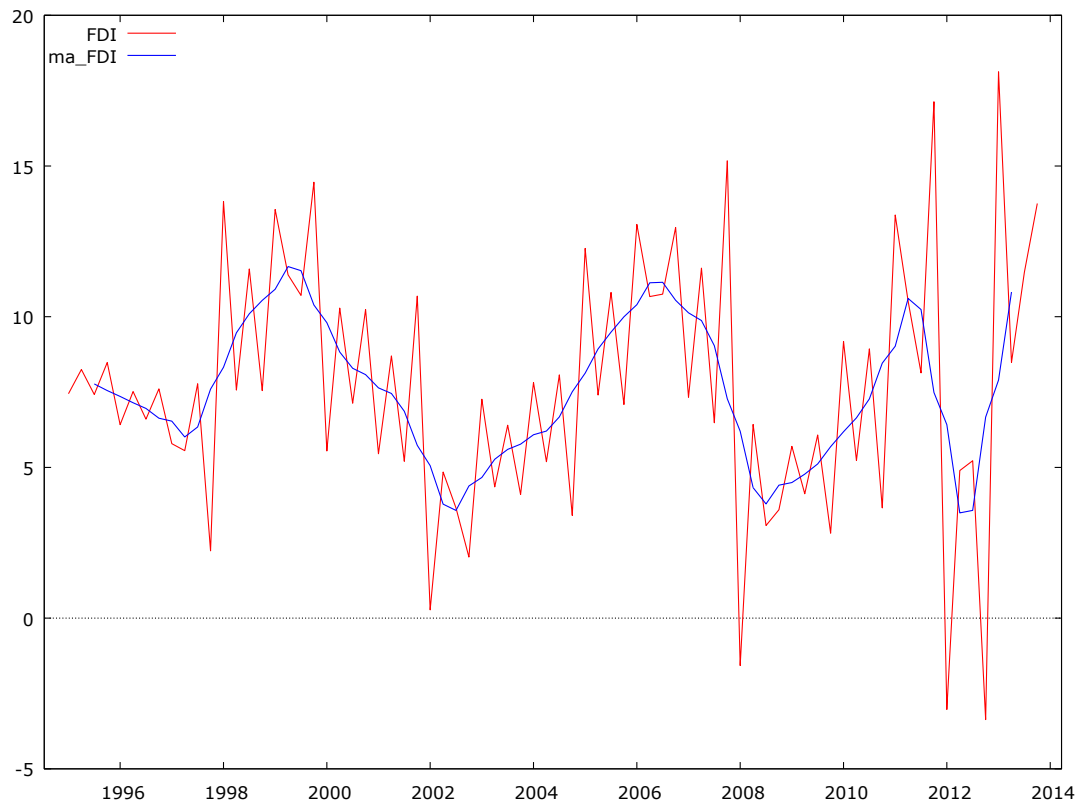
Appendix 4 Unit root tests, ADF

Variable	ADF p-value	First sd ADF p-value	Second sd ADF p-value
GDP	0.9483	0.534	0.00014
FDI	0.0008		
INFLAT	0.9999	0.3463	0.0001165
OPEN	0.8065	0.4572	0.003903
CREDIT	0.7011	0.5101	0.03831
GOV	0.1201	0.1928	0.01125
SCHOOL	0.9797	0.3425	0.2103

Appendix 5 Result of regression connected to GDP growth and FDI

OLS, using observations 1997:1-2013:2 (T = 66)
Dependent variable: sd_sd_GDP
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value	
const	−2421.17	1687.53	−1.4347	0.1566	
sd_sd_INFLAT	−640.891	346.775	−1.8481	0.0695	*
sd_sd_OPEN	104.113	15.9922	6.5102	<0.0001	***
sd_sd_CREDIT	−19.9298	25.3016	−0.7877	0.4340	
sd_sd_GOV	−617.77	295.688	−2.0893	0.0409	**
ma_FDI	348.366	196.861	1.7696	0.0819	*

Mean dependent var	77.95570	S.D. dependent var	5562.396
Sum squared resid	6.31e+08	S.E. of regression	3243.249
R-squared	0.686184	Adjusted R-squared	0.660033
F(5, 60)	20.13704	P-value(F)	9.81e-12
Log-likelihood	−624.0705	Akaike criterion	1260.141
Schwarz criterion	1273.279	Hannan-Quinn	1265.333
rho	0.270359	Durbin-Watson	1.457544

Appendix 6 Heteroscedasticity

The heteroscedasticity was tested using White′s test stating null hypothesis that our model is free of heteroscedasticity and the alternative one, that our model has problems with heteroscedasticity. The null hypothesis could not be rejected on 5% level of statistical significance (p-value 0,566 > 0,05) so our model does not have heteroscedastic variance.

White's test for heteroscedasticity

Null hypothesis: heteroscedasticity not present

Test statistic: LM = 18.3225

with p-value = P(Chi-square(20) > 18.3225) = 0.566173

Appendix 7 Autocorrelation

The time dependency of series is a very often problem in time series analysis. For testing we used Lagrange Multiplicators test (LM test) having null hypothesis that residuals are not correlated in time and alternative that they are. We had to reject the null hypothesis on the 5% level of significance (p-value < 0,05). As a remedy estimation with Robust Standard Errors was used. This kind of estimation makes reliable tests of significance of the model and variables using Ch-Square distribution.

LM test for autocorrelation up to order 10

Null hypothesis: no autocorrelation

Test statistic: LMF = 10.5682

with p-value = $P(F(10, 50) > 10.5682) = 2.52991e{-}009$

Appendix 8 Multicollinearity

To high level of collinearity (correlation among dependent variables) means that we cannot rely on coefficients of the regression. For testing we used Variance Inflation Factors which measures level of collinearity – all values were lower than 10 and this means that we have no problems with multicollinearity in the model.

Variance Inflation Factors

Minimum possible value = 1.0

Values > 10.0 may indicate a collinearity problem

sd_sd_INFLAT	2.029
sd_sd_OPEN	1.878
sd_sd_CREDIT	1.444
sd_sd_GOV	1.154
ma_FDI	1.068

$VIF(j) = 1/(1 - R(j)^2)$, where R(j) is the multiple correlation coefficient

between variable j and the other independent variables.

Appendix 9 Statistical Verification

General statistic assumption is regarding to normality of residuals. The distribution was tested using Jarque Bera test of normality residuals. We were unable to reject the null hypothesis so the model follows general statistical assumptions.
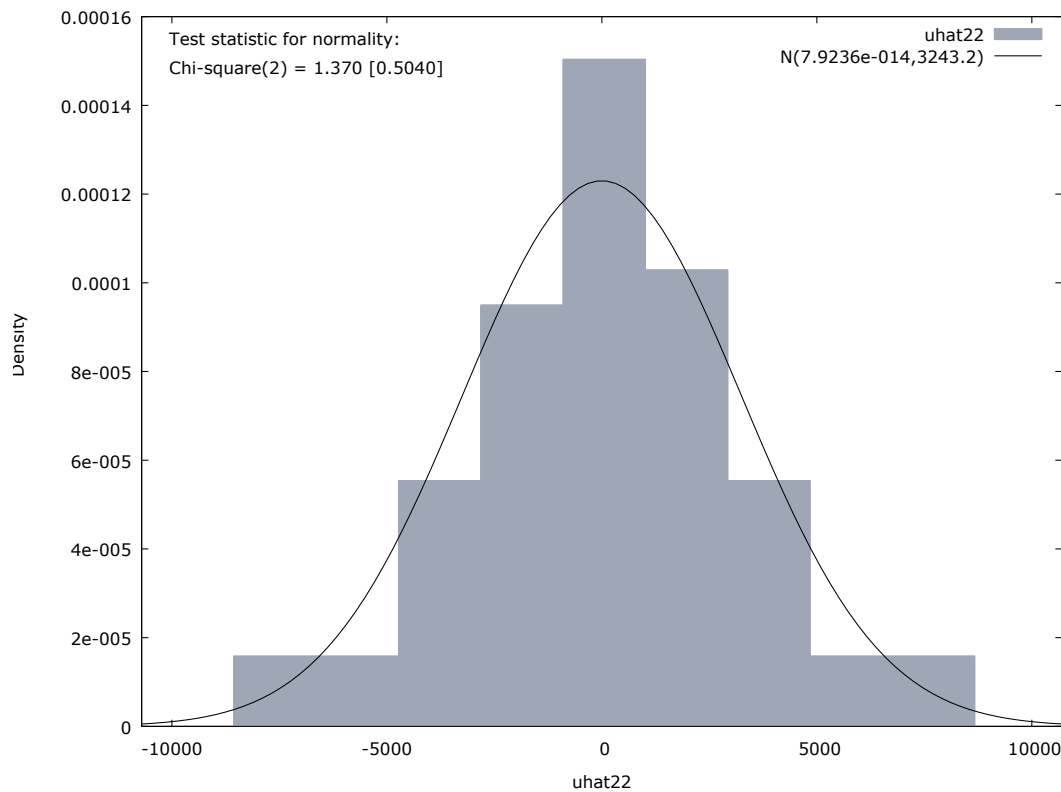
The model is statistically significant on 5% level of significance (the p-value is lower than 0,05). All variables excluding variable sd_sd_CREDIT were found to be statistically significant on 10% level of significance. It is possible to reject the null hypothesis of statistical non-significance of the model and of the variables.

Appendix 10 High-Precision OLS results

High-Precision OLS, using observations 1997:1-2013:2 (T = 66)
Dependent variable: sd_sd_GDP

	Coefficient	Std. Error			
const	−2421.17	1394.38	−1.7364	0.0876	*
sd_sd_INFLAT	−640.891	245.525	−2.6103	0.0114	**
sd_sd_OPEN	104.113	12.1933	8.5385	<0.0001	***
sd_sd_CREDIT	−19.9298	33.0266	−0.6034	0.5485	
sd_sd_GOV	−617.77	276.697	−2.2327	0.0293	**
ma_FDI	348.366	177.017	1.9680	0.0537	*

Mean dependent var	7.795570312322001E+001
S.D. dependent var	5.562396038623799E+003
Sum squared resid	6.311199062907385E+008
S.E. of regression	3.243249158613263E+003
R-squared	6.861842707481615E-001
Adjusted R-squared	6.600329599771749E-001
F(5, 60)	2.623900104882872E+001
P-value(F)	6.068466162910579E-014
Log-likelihood	−6.240705488375531E+002
Akaike criterion	1.260141097675106E+003
Schwarz criterion	1.273279026127265E+003
Hannan-Quinn	1.265332517635921E+003
rho	2.703588281991485E-001
Durbin-Watson	1.457543663419648E+000

Appendix 11 Heteroskedasticity-corrected model

Heteroskedasticity-corrected, using observations 1997:1-2013:2 (T = 66)
Dependent variable: sd_sd_GDP

	Coefficient	Std. Error	t-ratio	p-value	
const	−3259.49	1082.37	−3.0114	0.0038	***
sd_sd_INFLAT	−568.606	241.087	−2.3585	0.0216	**
sd_sd_OPEN	107.434	13.1009	8.2005	<0.0001	***
sd_sd_CREDIT	−12.1588	23.7637	−0.5117	0.6108	
sd_sd_GOV	−562.94	288.254	−1.9529	0.0555	*
ma_FDI	440.283	145.211	3.0320	0.0036	***

Statistics based on the weighted data:

Sum squared resid	294.9709	S.E. of regression	2.217246
R-squared	0.670527	Adjusted R-squared	0.643071
F(5, 60)	24.42183	P-value(F)	2.53e-13
Log-likelihood	−143.0583	Akaike criterion	298.1165
Schwarz criterion	311.2545	Hannan-Quinn	303.3079
rho	0.294791	Durbin-Watson	1.408079

Statistics based on the original data:

Mean dependent var	77.95570	S.D. dependent var	5562.396
Sum squared resid	6.44e+08	S.E. of regression	3274.936

Appendix 12 OLS model with a new variable Crisis

Model 9: OLS, using observations 1997:1-2013:2 (T = 66)
Dependent variable: sd_sd_GDP
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value	
const	−2459.48	1646.36	−1.4939	0.1405	
sd_sd_INFLAT	−641.086	346.897	−1.8481	0.0696	*
sd_sd_OPEN	104.203	16.787	6.2074	<0.0001	***
sd_sd_CREDIT	−19.8972	25.3339	−0.7854	0.4354	
sd_sd_GOV	−619.65	303.674	−2.0405	0.0458	**
ma_FDI	352.337	192.264	1.8326	0.0719	*
crisis	69.4882	1533.78	0.0453	0.9640	

Mean dependent var	77.95570	S.D. dependent var	5562.396
Sum squared resid	6.31e+08	S.E. of regression	3270.552
R-squared	0.686197	Adjusted R-squared	0.654285
F(6, 59)	17.78629	P-value(F)	1.21e-11
Log-likelihood	−624.0692	Akaike criterion	1262.138
Schwarz criterion	1277.466	Hannan-Quinn	1268.195
rho	0.269281	Durbin-Watson	1.459664

Appendix 13 OLS excluding variable FDI

OLS, using observations 1997:1-2013:4 (T = 68)
Dependent variable: sd_sd_GDP
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value	
const	150.747	505.652	0.2981	0.7666	
sd_sd_INFLAT	−675.533	295.132	−2.2889	0.0254	**
sd_sd_OPEN	107.794	13.3658	8.0649	<0.0001	***
sd_sd_CREDIT	−7.39623	21.5035	−0.3440	0.7320	
sd_sd_GOV	−630.186	320.089	−1.9688	0.0534	*

Mean dependent var	61.46724	S.D. dependent var	5509.230
Sum squared resid	6.82e+08	S.E. of regression	3290.270
R-squared	0.664612	Adjusted R-squared	0.643318
F(4, 63)	26.90608	P-value(F)	4.89e-13
Log-likelihood	−644.6044	Akaike criterion	1299.209
Schwarz criterion	1310.306	Hannan-Quinn	1303.606
rho	0.266271	Durbin-Watson	1.460725

Appendix 14 Granger Causality between GDP and FDI

Pairwise Granger Causality Tests

Sample: 1995Q1 2013Q4
Lags: 10

Null Hypothesis:	Obs	F-Statistic	Prob.
SD_SD_GDP does not Granger Cause FDI_SA	56	4.11083	0.0009
FDI_SA does not Granger Cause SD_SD_GDP		1.93929	0.0725

Appendix 15 Descriptive statistics of panel analysis

Variable	Mean	Median	Minimum	Maximum
FDI	0.810077	0.409580	-3.44880	6.57678
gGDP	5.43312	4.87031	-1.15440	14.7808
LABOR	38.6743	39.4850	32.8400	43.0200
UNIV	39.3357	40.0500	24.5000	51.1000
RD	3.72467	3.70344	3.02917	4.69912
INFRA	119.143	128.500	60.0000	158.000
Variable	Std. Dev.	C.V.	Skewness	Ex. kurtosis
FDI	1.39903	1.72703	1.16432	2.64776
gGDP	4.34254	0.799273	0.298632	-0.516380
LABOR	3.23773	0.0837179	-0.488198	-1.07646
UNIV	8.09432	0.205775	-0.305345	-1.08678
RD	0.435795	0.117002	0.436260	-0.234612
INFRA	32.2013	0.270275	-0.382001	-1.27058
Variable	5% Perc.	95% Perc.	IQ range	Missing obs.
FDI	-0.691032	3.73857	1.10189	0

gGDP	-1.15440	14.7808	7.27190	0
LABOR	32.8400	43.0200	4.73000	0
UNIV	24.5000	51.1000	12.4000	0
RD	3.02917	4.69912	0.680584	0
INFRA	60.0000	158.000	59.0000	0

Appendix 16 Development of variables across time – FDI
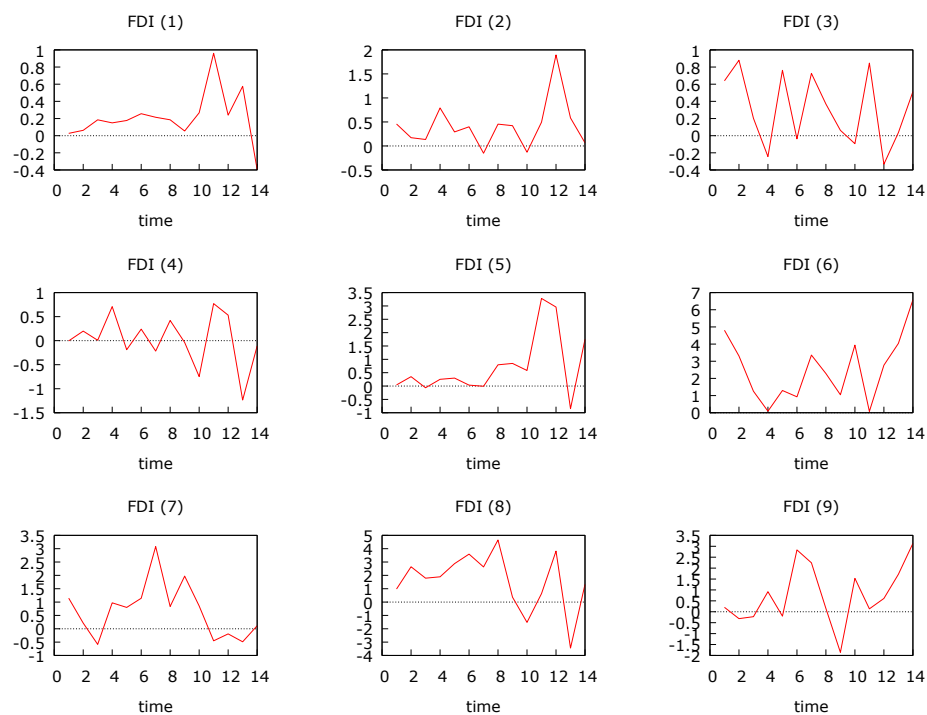
Appendix 17 Unit root tests

Variable	ADF	ADF First differ.
FDI	0.0000	
GROWTH	0.0000	
UNIV	0.0677	
R&D	0.0959	
PRODUC	0.8647	0.0000
INFRA	1.0000	0.0000

Appendix 18 Breusch-Pagan and Hausmann tests

Diagnostics: assuming a balanced panel with 9 cross-sectional units observed over 13 periods

Fixed effects estimator
allows for differing intercepts by cross-sectional unit
slope standard errors in parentheses, p-values in brackets

```
      const:       4.9756        (2.6166)      [0.06003]
     GROWTH:       0.15998       (0.082568)    [0.05542]
       UNIV:       0.067775      (0.032649)    [0.04040]
         RD:      -2.0349        (0.97027)     [0.03842]
   d_PRODUC:      -0.51755       (0.28281)     [0.07014]
    d_INFRA:       0.011976      (0.017742)    [0.50119]
```

9 group means were subtracted from the data

Residual variance: 154.032/(117 - 14) = 1.49546
Joint significance of differing group means:
 F(8, 103) = 4.96641 with p-value 3.2331e-005
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative)

Means of pooled OLS residuals for cross-sectional units:

```
unit  1:        -0.576
unit  2:       -0.38427
unit  3:       -0.51776
unit  4:       -0.77546
unit  5:       -0.014643
unit  6:        1.5805
unit  7:       -0.16581
unit  8:        0.83392
unit  9:        0.019468
```

Breusch-Pagan test statistic:
 LM = 33.4317 with p-value = prob (chi-square(1) > 33.4317) = 7.38109e-009
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the random effects alternative)

Variance estimators:
between = 0.571312
within = 1.49546
theta used for quasi-demeaning = 0.551277

Random effects estimator
allows for a unit-specific component to the error term
(standard errors in parentheses, p-values in brackets)

```
      const:       4.9756        (2.6263)      [0.06076]
       gGDP:       0.15998       (0.082568)    [0.05522]
       UNIV:       0.067775      (0.032649)    [0.04022]
         RD:      -2.0349        (0.97027)     [0.03824]
   d_PRODUC:      -0.51755       (0.28281)     [0.06993]
    d_INFRA:       0.011976      (0.017742)    [0.50108]
```

Hausman test statistic:
 H = 7.79377e-014 with p-value = prob(chi-square(5) > 7.79377e-014) = 1
(A low p-value counts against the null hypothesis that the random effects model is consistent, in favor of the fixed effects model)

Appendix 19 Results of panel analysis

Fixed-effects, using 117 observations
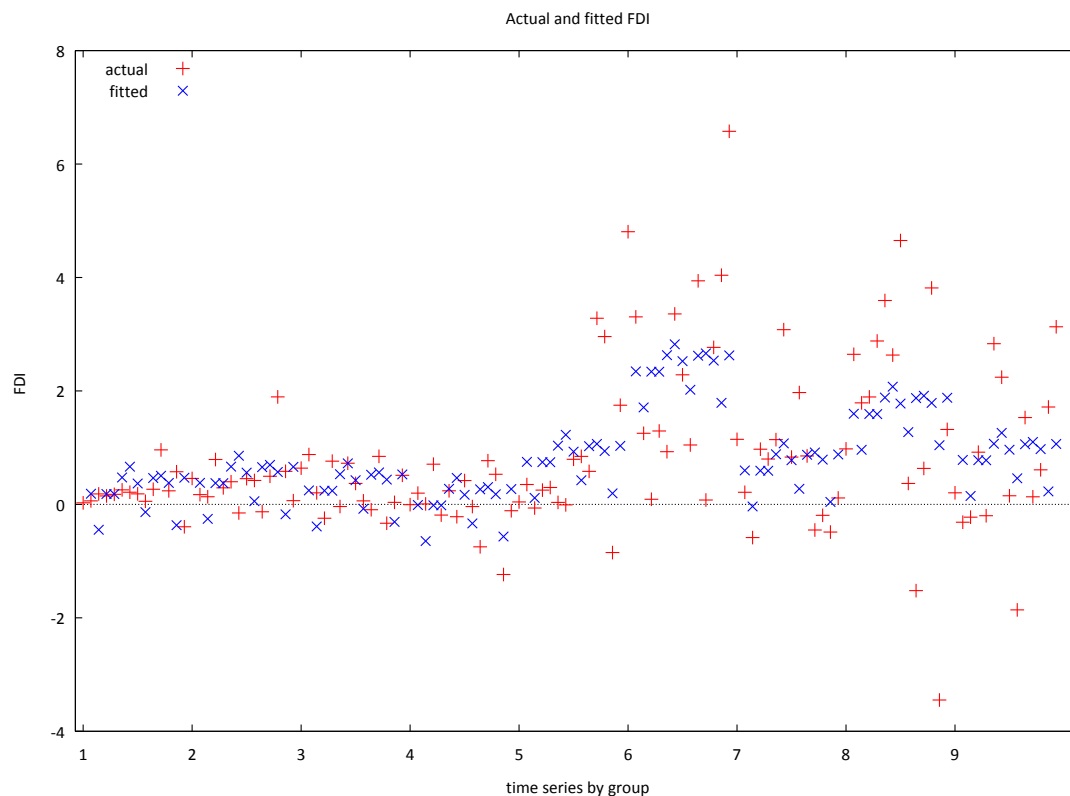Included 9 cross-sectional units
Time-series length = 13
Dependent variable: FDI
Robust (HAC) standard errors

	Coefficient	Std. Error	t-ratio	p-value	
const	4.97555	1.81243	2.7452	0.0071	***
GROWTH	0.159975	0.0609636	2.6241	0.0100	**
UNIV	0.0677751	0.0407768	1.6621	0.0995	*
RD	−2.03494	0.822046	−2.4755	0.0149	**
d_PRODUC	−0.517545	0.202294	−2.5584	0.0120	**
d_INFRA	0.0119757	0.0135475	0.8840	0.3788	

Mean dependent var	0.801466	S.D. dependent var	1.396267
Sum squared resid	154.0319	S.E. of regression	1.222888
LSDV R-squared	0.318893	Within R-squared	0.076175
Log-likelihood	−182.1025	Akaike criterion	392.2050
Schwarz criterion	430.8754	Hannan-Quinn	407.9047
rho	0.122414	Durbin-Watson	1.613351

Appendix 20 Graph of fitted and estimated values by regression

Actual and fitted FDI

Appendix 21 Panel data analysis with Random-Effects

Random-effects (GLS), using 117 observations
Included 9 cross-sectional units
Time-series length = 13
Dependent variable: FDI

	Coefficient	Std. Error	t-ratio	p-value	
const	4.97555	2.62626	1.8945	0.0608	*
GROWTH	0.159975	0.0825677	1.9375	0.0552	*
UNIV	0.0677751	0.0326495	2.0758	0.0402	**
RD	−2.03494	0.970266	−2.0973	0.0382	**
d_PRODUC	−0.517545	0.282812	−1.8300	0.0699	*
d_INFRA	0.0119757	0.0177417	0.6750	0.5011	

Mean dependent var	0.801466	S.D. dependent var	1.396267
Sum squared resid	213.4484	S.E. of regression	1.380503
Log-likelihood	−201.1872	Akaike criterion	414.3745
Schwarz criterion	430.9475	Hannan-Quinn	421.1029

'Within' variance = 1.49546
        'Between' variance = 0.571312
        theta used for quasi-demeaning = 0.551277
Breusch-Pagan test -
 Null hypothesis: Variance of the unit-specific error = 0
 Asymptotic test statistic: Chi-square(1) = 33.4317
 with p-value = 7.38109e-009

Hausman test -
 Null hypothesis: GLS estimates are consistent
 Asymptotic test statistic: Chi-square(5) = 7.79377e-014
 with p-value = 1

Appendix 22 Panel analysis with dummy variable for economic recession

Fixed-effects, using 117 observations
Included 9 cross-sectional units
Time-series length = 13
Dependent variable: FDI
Robust (HAC) standard errors

	Coefficient	Std. Error	t-ratio	p-value	
const	5.87557	2.03402	2.8886	0.0047	***
GROWTH	0.188187	0.0787392	2.3900	0.0187	**
UNIV	0.0854959	0.0389575	2.1946	0.0305	**
RD	−2.38316	0.870546	−2.7375	0.0073	***
d_PRODUC	−0.769565	0.244356	−3.1494	0.0022	***
d_INFRA	0.00726472	0.0116057	0.6260	0.5328	
dt_9	−0.715386	0.592461	−1.2075	0.2301	
dt_10	−1.17276	0.469699	−2.4968	0.0142	**
dt_11	0.138139	0.538439	0.2566	0.7980	

Mean dependent var	0.801466	S.D. dependent var	1.396267
Sum squared resid	147.7008	S.E. of regression	1.215322
LSDV R-squared	0.346888	Within R-squared	0.114147
Log-likelihood	−179.6472	Akaike criterion	393.2943
Schwarz criterion	440.2513	Hannan-Quinn	412.3583
rho	0.124947	Durbin-Watson	1.615029

Joint test on named regressors -
 Test statistic: $F(8, 100) = 11.0112$
 with p-value = $P(F(8, 100) > 11.0112) = 4.92562e{-}011$

Robust test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch $F(8, 44.6) = 3.65395$
 with p-value = $P(F(8, 44.6) > 3.65395) = 0.00237706$

Appendix 23 Panel analysis, excluded variable GROWTH

Fixed-effects, using 117 observations
Included 9 cross-sectional units
Time-series length = 13
Dependent variable: FDI
Robust (HAC) standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.770662	1.37134	0.5620	0.5753	
UNIV	0.0269813	0.0454509	0.5936	0.5540	
RD	−0.501554	0.790978	−0.6341	0.5274	
d_PRODUC	0.000364971	0.126939	0.0029	0.9977	
d_INFRA	0.0306909	0.0159909	1.9193	0.0577	*

Mean dependent var	0.801466	S.D. dependent var	1.396267
Sum squared resid	159.6458	S.E. of regression	1.238974
LSDV R-squared	0.294069	Within R-squared	0.042506
Log-likelihood	−184.1966	Akaike criterion	394.3933
Schwarz criterion	430.3015	Hannan-Quinn	408.9716
rho	0.085524	Durbin-Watson	1.678926

Joint test on named regressors -
 Test statistic: $F(4, 104) = 2.01582$
 with p-value = $P(F(4, 104) > 2.01582) = 0.0976246$

Robust test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch $F(8, 44.4) = 3.45329$
 with p-value = $P(F(8, 44.4) > 3.45329) = 0.00356256$