THE EFFECTS OF FOREIGN DIRECT INVESTMENT ON ECONOMIC GROWTH: EMPIRICAL EVIDENCE FROM IRELAND

AUTHOR: PABLO DE LLANOS ARTERO*

DEGREE PROGRAM: BUSINESS ADMINISTRATION AND MANAGEMENT

SUPERVISOR: ROSELLA NICOLINI, PHD

JUNE, 8th 2018

***Acknowledgements:**

This research was supported by Prof. Rosella Nicollini, to whom I would like to express my sincere gratitude for her patient guidance, support and advice she has provided me throughout my thesis.

I would also like to thank our colleagues from Universitat de Barcelona, who allowed me access to their databases.

ABSTRACT

The purpose of this study is to disentangle the effects of foreign direct investment (FDI) on economic growth. The core of this paper is the empirical analysis for the case of Ireland, one of the leading FDI recipients in the EU. We build an original database by merging several data sources for the period 2000-2015, and we develop a theoretical framework that we exploit to interpret our econometric results. Estimates identify that FDIs have a spatial self-contained positive impact on economic growth, while spillovers effects between regions do not seem to be effective.

CONTENT

1. INTRODUCTION

Foreign direct investment (FDI) is a form of international investment that has been recently breaking through all around the world, especially during the last decade, which has been driven by globalization and the opening of world economies (Chirila-Donciu, 2013).

The present report intends to shed light on the impact of FDI on the economic performance of Ireland, as it is a small-sized European country (whose population size was about 4.75 million in 2016, according to the World Bank data) which has been a prominent example of this increasing trend of international investments.

The novelty of this contribution is mostly empirical. I build an original database by merging different data sources at regional level and firm-level, which enables me to include the spatial dimension of a phenomenon in the study. Moreover, in order to be effective in the conclusion, I focus just on one country (Ireland) that is one of the major EU recipients.

According to the World Bank data for 2016, Ireland is the sixth economy in the world by FDI net inflow[1] in USD (after the U.S., U.K., China, Netherlands and Hong Kong) as well as of percentage of gross domestic product (GDP) (right after Hungary, Luxembourg, Hong Kong and Mozambique). Furthermore, according to this same source of data, Ireland is also the second economy in the world by FDI per capita, just behind Luxembourg. However, it does not only act as an important FDI receiver but also as an investor to the rest of the world, being the fifth country on the face of the earth by FDI net outflows[2] in USD (after the U.S., Netherlands, China and Japan).[3]

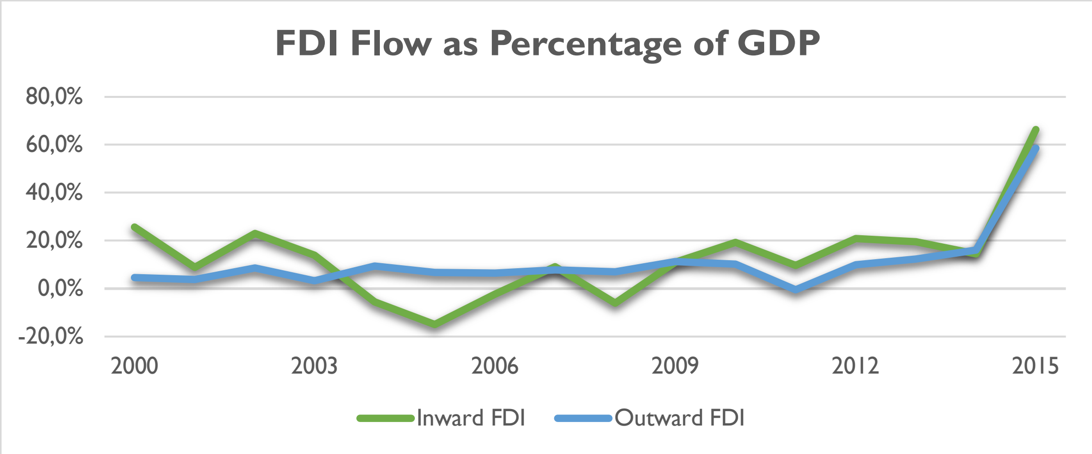
It is worth mentioning that Ireland grants very convenient fiscal and financial conditions to incoming firms, as I will discuss later.

[1] FDI net inflows are defined as the value of inward direct investment made by non-resident investors in the reporting economy, including reinvested earnings and intra-company loans, net of repatriation of capital and repayment of loans (World Bank, *Data help desk*).

[2] FDI net outflows are defined as the value of outward direct investment made by the residents of the reporting economy to external economies, including reinvested earnings and intra-company loans, net of receipts from the repatriation of capital and repayment of loans (World Bank, *Data help desk*).

[3] Note that nowadays the developed countries not only account for the overwhelming proportion of outward FDI, but they are also the major recipients of FDI, just as Markusen (2002) – the father of FDI theory – assessed 16 years ago.

Figure 1. Ireland's FDI inflow and outflow as % of GDP



Source: Own elaboration based on UNCTAD data

As you can observe in Figure 1, FDI is a pretty important economic issue for Ireland, as FDI inflow represented about 66% of the national GDP in 2015, while FDI outflow represented about 59% of the Irish GDP. For this reason, this report tries to investigate the effect that FDI has had on the economic growth of such a country.

My purpose is to answer the question on whether these massive investments in Ireland have translated into an improvement of its economy. This answer will not be straight-forward because there exists an open academic debate on the effect of FDI on economic growth, as will be discussed in detail in the following section. Basically, the mainstream view supports FDI to stimulate economic performance because they believe that (specially in developing countries) it can stimulate technological change through the adoption of foreign technology and know-how besides technological spillovers. On the contrary, the opponents to this theory hold that FDI may bring about external vulnerability and dependence into receiving countries, a crowding out effect on domestic investment, destructive competition of foreign affiliates with domestic firms, and "market-stealing effects" as a result of poor absorptive capacities (Wan, 2010).

In order to give an accurate answer to the abovementioned research question, the present paper is divided as follows: Section 2 covers the theoretical background and analysis of current literature on the relationship between FDI and economic growth (which does not provide a clear answer on whether FDI positively affects economic growth, or not). Section 3 provides a brief outline of the situation of Ireland regarding FDI flows into the country (and their possible effects on the country's output, besides), Section 4 relates the development of the theoretical framework I use as the basis to measure how different variables[4] affect the economic evolution of Ireland, Section 5 builds an econometric model using panel data covering the period 2000-2015, Section 6 provides the empirical results obtained when running the previous econometric model (which presents evidence that FDI has had a positive effect on Ireland's economic output during the period 2000-2015), and Section 7 concludes.

2. FDI AND ECONOMIC GROWTH

Eurostat defines FDI as a category of international investment in which 'a resident entity in one economy seeks to obtain a lasting interest in an enterprise resident in another economy'. This lasting interest implies 'the existence of a long-term relationship between the direct investor and the enterprise, and an investor's significant influence on the management of the enterprise', and it is deemed to exist when 'a direct investor owns 10% or more of the ordinary shares or voting rights (for an incorporated enterprise) or the equivalent (for an unincorporated enterprise)' (2018: *Glossary*, FDI).

FDI can take several forms, including the opening of a subsidiary or associate company in a foreign country, acquiring a controlling interest in an existing foreign company, or by means of a merger or joint venture with a foreign company, and it can be divided into two main categories (Markusen, 2002):

- Horizontal FDI: When the investor establishes the same kind of business operations in a foreign country as in its home country (e.g. a bank based in Luxembourg opens up branch offices in Ireland) because it aims at increasing the market potential of the company through the penetration into markets different from the home one. This form of investment is also known as market seeking FDI.
- Vertical FDI: When the investment aims at splitting the production chain in order to relocate part of it in other markets so as to have access to local facilities, improving its competitiveness (e.g. a US manufacturing company acquires shares of an Irish company that supplies parts or raw materials required for the manufacturing company to make its products).

  This kind of FDI may be defined as 'resource seeking'; meaning that foreign investment is motivated by the availability of natural resources and the need to secure raw materials or other kind of advantages on the production side such as e.g. low unit labor costs.

[4] This includes FDI, of course.

2.1 Literature Review

FDI is widely considered to play an important role in the economic development of host countries (Yu, Tu &Tan, 2011). There is a widespread belief that FDI boosts growth by increasing the capital stock and stimulating technological change through the adoption of foreign technologies.

It is also proven that they create technological spillovers through skill diffusion, employee training and the introduction of new processes and products by foreign firms (Zhu, 2010). As a consequence, FDI is viewed as a great tool for modernizing developing countries as well as to promote their economic development (Melnyk, Kubatko & Pysarenko, 2014).

However, there also exists an alternative stream of economic thought which does not positively consider FDI. This view emphasizes on poor absorptive capacities, crowding out effect on domestic investment, external vulnerability and dependence, a possible deterioration of the balance of payments as profits are repatriated and "market stealing effects" (Wan, 2010).

2.1.1 The effects of FDI in the host country

The neo-classical theory and the new theory of economic growth are clear on this issue: FDI is an important factor contributing to the growth of economies (Mauro, 1995). There is a strong complementarity connection between financial inflows and economic growth through the conduit of capital formation, suggesting that external finance does positively contribute to economic growth (Mallick & Moore 2008).

For example, Kotrajaras (2010) states that 'by applying the Solow-type standard neoclassical growth models [...] FDI increases the capital stock and thus growth in a host economy by financing capital formation. Nonetheless, in neoclassical growth models with diminishing returns to capital, FDI has only a short-run growth effect as countries move towards a new steady state. Accordingly, the impact of FDI on growth is identical to that of domestic investment' (2010: 13).

FDI may also be the main channel through which advanced technology is transferred to developing countries (Borensztein, De Gregorio & Lee, 1995). The OECD, for example, claims that 'FDI triggers technology spillovers, assists human capital formation, contributes to international trade integration, helps create a more competitive business environment, and enhances enterprise development' (2002: 5). Abebe, McMillan & Serafinelli (2018) also find out not only that foreign plants attract new economic activity to recipient districts in which FDI takes place but also that domestic firms learn from foreign firms through hiring workers previously employed at foreign firms, observing foreign firms, and through a direct contact with foreign firms via customer and supplier relationships. In addition, FDI can bring positive employment effects and create new jobs. What is more, should it become a substitute for imports or it serves to export goods and services to other economies it would also bring positive effects to the current account balance of host countries.

In contrast, FDI may not necessarily lead to a sustainable and long-term development. FDI may suffer from lack of adaptation to local context and might be used as a tool to exploit a country's resources (UNCTAD, 2007; Gerlach & Liu, 2010) and then taking the profits back to the parent company, which alongside the firms' subsidiaries import of inputs would have adverse effects on the balance of payments of the host country in the long run (Margeirsson, 2015). Moreover, it may also be the case that foreign firms drive indigenous competitors out of the market, creating a monopoly position (Wan, 2010).

For instance, Khaliq & Noy (2007) study the case of China and admit that even though at aggregate level FDI positively affects economic growth, FDI in the mining sector has a negative effect on economic growth.

2.2 What is Missing?

As discussed, we might observe inconclusive empirical findings.

On the one hand, FDI is (in fact) attracted to more competitive, less risky, growing and cultural-related economies (Antonakakis, & Tondl, 2015), which might create a reverse causality problem in many economic studies.

On the other hand, many researchers use cross-country growth regression specifications derived from the Solow growth model that involve the implicit assumption that each country is an isolated island (Dõgan & Taspinar, 2013). The majority of the econometric models used in order to catch up FDI effects on economic growth assume a collection of non-interacting closed economies, which does not provide a fair view of the reality (Acemoglu, 2009). Knowledge accumulated in one country depends on knowledge accumulated in other countries (Erthur & Koch, 2007). Thus, under this perspective, one could argue that the estimators of these econometric models are likely to suffer from omitted-variable bias since many of these studies cannot capture the fact that countries interact.

In this context, taking into account externalities is crucial since they appear essential for understanding why several countries grow at similar rates despite differing FDI incoming rates. For instance, Klenow & Clare (2005) construct a hybrid growth model which allows for international knowledge externalities and, when calibrated, the hybrid model shows that human capital and physical capital contribute to income differences both directly (as usual) and indirectly, by boosting resources devoted to technology adoption. Exploiting this model they estimate the hypothetical value of world GDP in the absence of international knowledge externalities. Their finding is that world GDP would be only 6% of its current level if countries did not share ideas.

Another point is that some authors - as Khaliq & Noy (2017) - have already found that some economic sectors may do not benefit from FDI inflows, or might even be harmed by FDI, at the same time as the whole country may benefit from it (on average). That is, FDI may have completely different effects on different industries, which adds a new problem to the methodology used in the vast majority of studies on the effects of foreign investment on economic growth, as they do not distinguish the data neither by regions nor industries.

For instance, Wan (2010) makes an extensive literature review on the relationship between FDI and economic growth and finds out that one of the main reasons for the literature to provide conflicting predictions concerning the growth effects of FDI is that existing studies have not been able to fully control country-specific effects and industry-specific effects. That is, existing econometric models do not go sufficiently into detail.

In conclusion, most of the econometric models measuring the effects of FDI in receiving countries' economies may be biased because they are not able to:

1. Quantify the effects of FDI among different industries.[5]
2. Detect spatial externalities at any geographical level.
3. Identify the effects of FDI among different regions within the same country.

   As most of the essential determinants of economic performance appear to reside within country regions (Porter, 2003), we might expect FDI not to have the same effects in any region of a given country. A few conditions such as the level of available qualified human capital (which might not be smoothly distributed within countries) can determine what the effects of FDI on economic performance are (Borensztein et al., 1995). Moreover, the economy needs time to embed FDI in their productive structure (Margeirsson, 2015), and this will depend on many

[5] We find a very good example of how to measure (heterogeneous) FDI effects within a specific economic sector in the recently published paper by Abebe, McMillan & Serafinelli (2018).

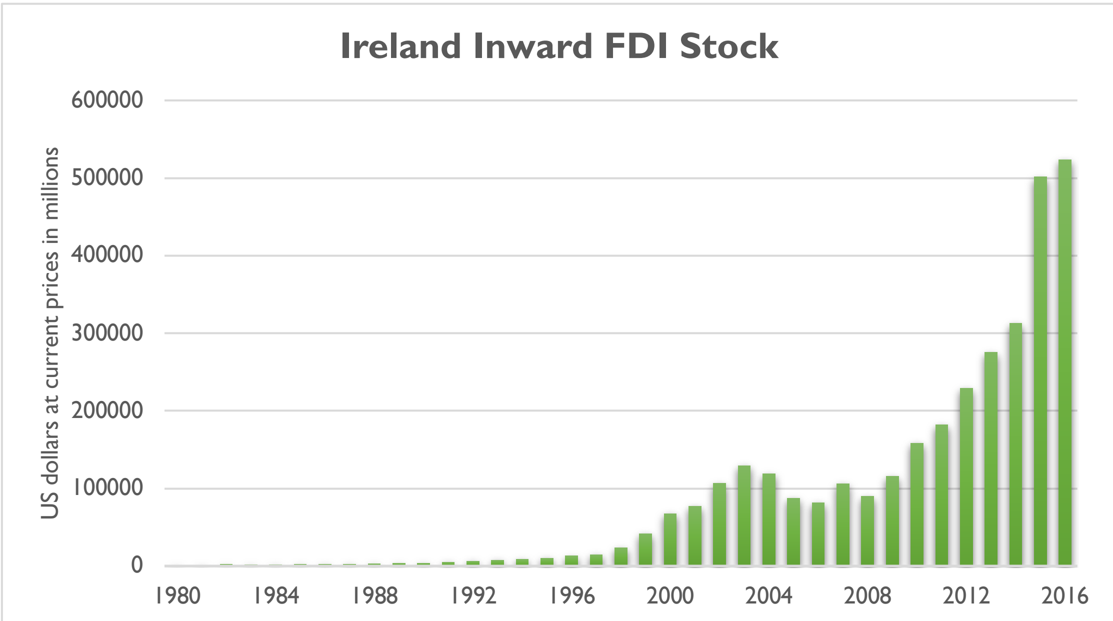
variables like the technology gap between home FDI and the recipient economy (Chen, 1994). And, again, this technology gap may be bigger or smaller depending on the (host) region where the investment takes place.

For this reason, the following sections are devoted to sketch the building blocks of a theoretical model that takes into account all my previous comments (as one of the novelties of this study).

3. FDI IN IRELAND

Over the last decade, inward FDI have experienced a sharp increase, with the value of Ireland's inward FDI stock rising a remarkable 638% between 2000 and 2015, according to UNCTAD data (as you can observe in Figure 2).

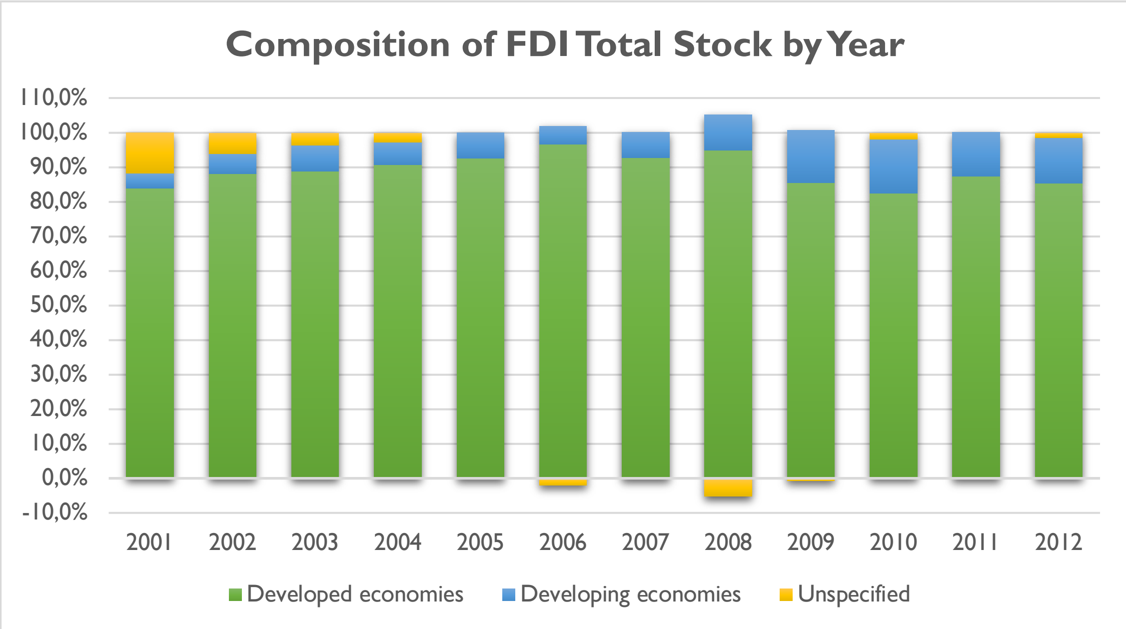
Figure 2. Ireland's inward FDI stock in US dollars at current prices (in millions)



Source: Own elaboration based on UNCTAD data
Note that negative FDI flow means divestment is greater than investment

Ireland offers a very favorable tax climate and ease of doing business (World Bank Group, 2018) as well as strong institutions and investor-friendly regulations (World Economic Forum, 2017) which can be appealing to many foreign corporations (Hornberger, Battat & Kusek, 2011). Moreover, there is a great foundation in terms of education and available educated workforce (World Economic Forum, 2017), and the language is obviously an asset. In addition, Ireland is known for having a great spirit and energy around supporting business activity, business growth and business investment which makes it a unique and very attractive spot for significant large multinationals. This is why the majority of investing countries are developed economies,[6] which is not surprising at all since there has always been a great deal of two-way FDI flows between pairs of developed countries (Markusen, 2002).

Figure 3. Ireland's inward FDI stock composition



Source: Own elaboration based on UNCTAD data

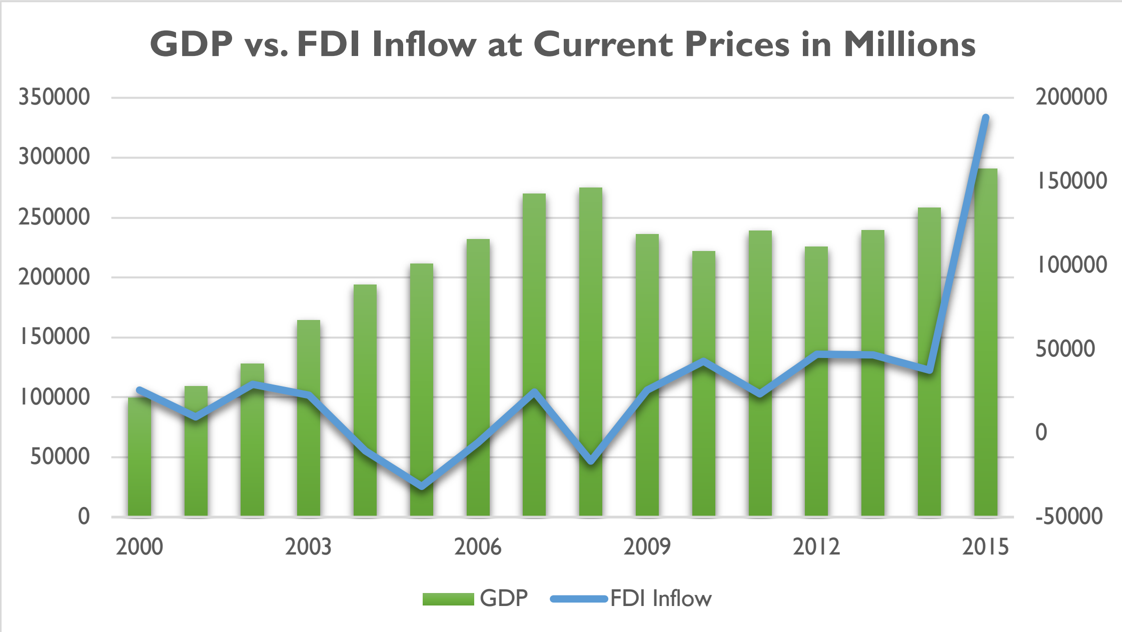
Hence, how are all these investments affecting the country? According to the World Bank data for 2016, Ireland is the fifth economy in the world by GDP per capita in USD, right after Luxembourg, Switzerland, Macao (China) and Norway. Nonetheless, when considering gross national income (GNI)[7] per capita, Ireland classifies tenth in the ranking of the world's richest countries, right after not only the abovementioned countries but also Denmark, the U.S., Iceland, Sweden and Australia. In fact, there is a difference of 10,215 USD between the Irish GDP per capita (64,185 USD) and the Irish GNI per capita (53,970 USD), which acts as a primary indicator of the magnitude of FDI in such a country, as this difference between GDP and GNI values arise from a negative balance of income in the country.

[6] See not only Figure 3 but also Appendix 2 for more details on the origin of inward FDI.

[7] GNI is the total domestic and foreign output claimed by residents of a country, consisting of GDP, plus factor incomes earned by foreign residents, minus income earned in the domestic economy by non-residents.

Then, does this mean that FDI is being used as a tool to exploit Ireland's resources (either human or capital) and then taking the profits back to the parent company, in line with the alternative stream of economic thought that has a negative view of FDI?

Figure 4. Ireland's GDP and FDI inflow association



Source: Own elaboration based on UNCTAD and World Bank data

If we take a look at Figure 4, we can infer a positive association between FDI and economic growth (as measured in terms of GDP growth), which might indicate a positive effect of FDI on economic growth, in line with the predictions of neo-classical theory and the new theory of economic growth. However, this information is far from enough so as to determine whether FDI has had a positive effect (if any) on the economic evolution of Ireland, as we might be facing a spurious relationship, a reverse-causality problem or even a two-way relationship, as FDI can support growth but growth can attract FDI too (Simionescu, 2016; Iamsiraroj & Doucouliagos, 2015).

Whatever is the case, this issue requires an in-depth analysis, and this is precisely the work I perform in the following sections.

4. THEORETICAL FRAMEWORK

The scope of this section is to outline a theoretical framework in line with the evidence discussed in 3.2, with the intention to propose a setting close to the evidence at hand and that allows for getting more conclusive results about measuring what have been the effects of FDI on the economic growth of Ireland.

In this section I develop the theoretical model that is used as a benchmark to carry out an empirical analysis in sections 5 and 6, where I try to identify how does FDI (as well as other factors) affect economic growth.

4.1 Model Development

In the new trade theory, trade is expected to be proportional to country size and inversely proportional to distance since individuals that make up firms engage in direct communication with their clients and suppliers, and information spreads through these direct interactions (Chaney, 2011). Therefore, based in the same idea of mobility of factors and space dimension that is embedded into the modern new trade theory, we might think that externalities emerging from the spillovers generated by foreign investment in host regions have similar correlations with distance, enriching nearby regions proportionally to the distance at which they are located.

In order to measure all of the questions abovementioned, I am inspiring from the setting developed by Dõgan & Taspinar (2013). This setting is valuable because it uses an extended Solow-type growth model which allows for spatial externalities; although its major drawback is not making a difference between sectors (which, as discussed in section 2.2, can be crucial).

Let me consider the following production function at sector(i)-region(r) level:

$$Y_{ir}(t) = A_{ir}(t)K_{ir}(t)^{\alpha}L_{ir}(t)^{\beta} \tag{1}$$

where $Y_{ir}(t)$ is total output, $K_{ir}(t)$ is the amount of physical capital, $L_{ir}(t)$ is labor[8] and $A_{ir}(t)$ is a parameter greater than zero that measures the availability of the current stock of technology for industry i in region r at time t,[9] while α and β are constants which we

[8] The number of workers.

[9] Ireland (country's) total output is defined as the sum of output across all sectors and regions (i.e. $\sum_i \sum_r Y_{ir}$).

do not assume to lead to constant returns to scale (i.e. β does not necessarily equal $1-\alpha$).

The stock of knowledge is expected to be composed by several factors and it is modelled in the following way:

$$A_{ir}(t)=\Omega(t)k_{ir}(t)^{\phi_1}h_{ir}(t)^{\phi_2}F_{ir}(t)^{\phi_3}\prod_{s\neq r}^{n}A_{is}{}^{\gamma w_{rs}}(t) \tag{2}$$

where $\Omega(t)=\Omega(0)e^{\mu t}$ is, as in the Solow model, some proportion of exogenously given technological progress identical in all regions within the country[10] and μ is its constant rate of growth. $k_{ir}(t)$, $h_{ir}(t)$ and $F_{ir}(t)$ are respectively physical capital per worker, human capital per worker and the level of FDI[11] in industry i within region r at time t, while parameters ϕ_1, ϕ_2 and ϕ_3, with $\phi_1\in[0,1)$, $\phi_2\in[0,1)$ and $\phi_3\in[0,1)$, represent the degrees of externalities generated by these variables. The idea of spatial externalities is captured by the term $\prod_{s\neq r}^{n}A_{is}{}^{\gamma w_{rs}}(t)$, which reflects a geometrically weighted average of the stock of knowledge of the neighbors of region r denoted by s. The parameter γ, with $\gamma\in[0,1)$, describes the degree of interregional technological interdependence generated by spatial externalities and is assumed to be identical for all regions. Finally, w_{rs}, with $w_{rs}\in[0,1]\ \forall\, r\neq s$ and $w_{rs}=0$ if $r=s$, represents the connectivity (namely spatial proximity) between region r and its neighbor regions ($s\neq r$), and it is assumed to be non-stochastic and finite. Moreover $\sum_{s\neq r}^{n}w_{rs}=1\ \forall\, r=1,\dots,n$. Thus, the more a region r is connected to its neighbor regions (i.e. $w_{rs}\rightarrow 1$) the more it benefits from spatial externalities.

According to Romer (1986), $k_{ir}(t)$ represents the aggregated capital of the economy since the investment of any firm helps increasing the stock of experience or knowledge of the rest. Such externalities can emerge from the so-called 'learning by doing' and 'knowledge spillovers' or 'know-how' described by Sala-i-Martin (2000).

In the same way, and as discussed in the previous section, the beneficial effects on growth of FDI come through higher efficiency rather than simply from higher capital accumulation (Borensztein et al., 1995). One may expect the increase in investment[12] by a given company not only to increase its own production but also to boost the production

---

[10] This is a theoretical value that is not measured in section 5.

[11] The introduction of $\mathrm{F}_{\mathrm{ir}}(t)$ is relevant since FDI plays a role of a conduit for the transfer of knowledge-based assets to host countries (Dõgan & Taspinar, 2013).

[12] Either the capital invested by any firm or the capital invested because of a FDI operation.

of other firms which surround it. Investing companies will acquire new experience and knowledge, and this knowledge will also be used by other companies. According to Acemoglu ‘knowledge is a largely non-rival good: once a particular technology has been discovered, many firms can make use of this technology without preventing others using the same knowledge’ (2009: 430).

If we combine (1) and (2) we obtain:

$$Y_{ir}(t) = K_{ir}(t)^{\alpha} L_{ir}(t)^{\beta} \Omega(t) k_{ir}(t)^{\phi_1} h_{ir}(t)^{\phi_2} F_{ir}(t)^{\phi_3} \prod_{s \neq r}^{n} A_{is}{}^{\gamma w_{rs}}(t) \tag{3}$$

that is the equation on which I have based my empirical analysis, in section 5.

4.2 Advantages of the New Theoretical Setting

The advantages of this approach are clear; we solve the issues raised in 3.2:

- The model emphasizes FDI spillovers within country borders so that we are able to measure the effects of FDI among different regions and industries.
- The model is spatially augmented. As a result, we are able to capture spatial externalities at regional level.
- Another point is that the model emphasizes human and physical capital externalities within country borders.

This regression with FDI as an independent variable might be subject to endogeneity problems, though. For example, there may be omitted variables that simultaneously affect both economic performance and the inflow of FDI, which could generate a correlation between FDI and the error term, causing the estimated coefficients to be biased.

This endogeneity problem is usually avoided by applying instrumental variable techniques, but there are no ideal instruments available (Borensztein et al., 1995). In this particular case, the dependent variable is not economic growth *per se,* but gross value added (GVA), and I try to solve any possible problem by using a cross-section panel data estimation which allows me to control for section-specific and time-invariant “fixed effects”. In addition, I consider including lagged variables if necessary (which can help to control for endogeneity bias), as Nair-Reichert & Weinhold (2000) recommend. Ensuring that the variances of the error terms are unrelated to the explanatory variables has also been considered.

5. EMPIRICAL ANALYSIS

The economic performance of Ireland is measured using the total firms' output for each sector, within each region, and for each calendar year. I employ the data for GVA[13] by NUTS[14] and classified by NACE[15] (*NACE Rev.2*)[16] for the period 2000-2015, which is provided by Eurostat.

5.1 Data and Variables

In order to bring equation (3) into data, I log-linearize it and I proxy the different variables with the available information. The dependent variable of the econometric model is the natural logarithm of GVA per industry (i), region (r) and time (t), defined as $\log y_{irt}$. Data are organized as a panel and the final model-equation to be estimated is the following:

$$\log y_{irt} = \beta_0 + \beta_1 \log K_{irt} + \beta_2 \log L_{irt} + \beta_3 \log A_{irt} + \zeta_i + \eta_r + \tau_t + \varepsilon_{irt} \qquad (4)$$

where ζ_i, η_r and τ_t are respectively industry, region and time fixed-effects, while ε_{irt} is the error term of the regression model.

Equation (4) is an approximation of theoretical equation (1) developed in the previous section but, in this case, the equation is taken in logarithm.

Then, following the same reasoning discussed section 4, the correspondent log-linearization of (3) that can be also obtained as an augmented version of (4) becomes:

---

[13] It is defined as output (at basic prices) minus intermediate consumption (at purchaser prices). The sum of GVA over all industries or sectors plus taxes on products minus subsidies on products gives GDP (Eurostat, 2017b).

[14] The Classification of Territorial Units for Statistics (NUTS) is a geocode standard for referencing the subdivisions of countries for statistical purposes. NUTS 2 (namely NUTS II) refers to regions belonging to the second level (Eurostat, 2016a). In Ireland, there are only two regions at NUTS 2 level: 'Border, Midlands and Western' region and 'Southern and Eastern' region. See Figure A1 and Figure A2 in the Appendix section for more details on this issue.

[15] The Statistical classification of economic activities in the European Community, abbreviated as NACE, is the classification of economic activities in the European Union (EU). NACE is a four-digit classification providing the framework for collecting and presenting a large range of statistical data (Eurostat, 2016b). See Figure A3 in the Appendix section for more details on this issue.

[16] NACE Rev. 2, a revised classification, was adopted at the end of 2006 and, in 2007, its implementation began. The first reference year for NACE Rev. 2 compatible statistics is 2008, after which NACE Rev. 2 will be consistently applied to all relevant statistical domains (Eurostat, 2016b).

$$\log y_{irt} = \beta_0 + \beta_1 \log L_{irt} + \beta_2 \log K_{irt} + \beta_3[\log k_{irt} + \log h_{irt} + \log \mathrm{F}_{irt} + \mathrm{W} \cdot \log \mathrm{F}_{ist}] + \zeta_i + \eta_r + \varepsilon_{irt} \quad (5)$$

where k_{irt}, h_{irt} and F_{irt} are respectively physical capital per worker, human capital per worker and FDI inflows (measured as the number of FDI operations) for industry i in region r at time t. F_{ist} stands for the number of FDI operations in industry i within neighbor region s at time t, while W is the $(n \times n)$ spatial neighbors Markov matrix consisting of the weights. Inside this matrix, w_{rs} denotes each $(r, s)^{\text{th}}$ element belonging to W. The (r, s) elements of this matrix tell us the extent (degree) to which region r is a neighbor of region s. However, in this particular case, W is simply an adjacency or proximity matrix that can be simply approximated with a dummy.[17] Thus, we take its diagonal elements to be zero, (i.e. region r is not a neighbor of itself), while we take a value of one if region r and region s are neighbors. As a result:

$$\log y_{irt} = \beta_0 + \beta_1 \log L_{irt} + \beta_2 \log K_{irt} + \beta_3 \log k_{irt} + \beta_4 \log h_{irt} + \beta_5 \log \mathrm{F}_{irt} + \beta_6(d_{rs} \cdot \log \mathrm{F}_{ist}) + \zeta_i + \eta_r + \tau_t + \varepsilon_{irt} \quad (6)$$

where d_{rs} is a dummy variable indicating border-proximity, which in the particular case of Ireland turns to be a constant equal to one since there are only two regions according to the NUTS 2 classification of the data employed in this report. Therefore, (6) becomes:

$$\log y_{irt} = \beta_0 + \beta_1 \log L_{irt} + \beta_2 \log K_{irt} + \beta_3 \log k_{irt} + \beta_4 \log h_{irt} + \beta_5 \log \mathrm{F}_{irt} + \beta_6 \log \mathrm{F}_{ist} + \zeta_i + \eta_r + \tau_t + \varepsilon_{irt} \quad (7)$$

and F_{ist} can be obtained by simply creating a new variable in the data set.[18]

5.1.1 Physical capital

Physical capital (K) is approximated with gross fixed capital formation (GFCF), which consists of resident producers' investments (deducting disposals) in fixed assets during a

[17] Otherwise, more complex forms including distances would lead to the adoption of spatial econometric models.

[18] That is, the variable F_{ist} (FDI operations in neighbor region) was not created with Gretl (the econometric software used in this project) but with Excel (the spreadsheet program used in this project to tabulate the raw data). This variable was introduced into input data by simply adding another column into the input table in Excel. The number of FDI operations in region 2 were written down in a new column for region 1 (under the name of *FDIneighbor)*, and *vice versa*.

given period. It also includes certain additions to the value of non-produced assets realized by producers or institutional units (Eurostat, 2017a).

On the other hand, the k indicator is calculated as an index indicating the availability of GFCF per worker. That is, $k_{irt} = \mathrm{GFCF}_{irt}/workers_{irt} = \mathrm{K}_{irt}/workers_{irt}$.

All this data is retrieved from Eurostat.

5.1.2 Labor

In the theoretical model, we consider that all the active population work for the same number of hours each year. However, evidence emphasizes that it is not always like that. Then, in order to take into account these differences, the variable L is approximated with the total number of hours worked per year in each industry within one region or another, specifically '*Employment (thousand hours worked) by NUTS 2 regions'*, which is also provided by Eurostat.

5.1.3 Human capital

My initial intention was to estimate this variable (h) as an index of employed people with tertiary education per unit of work. Nevertheless, this kind of data (the number of people with tertiary education) does not exist as classified by NUTS 2 and NACE at the same time. For this reason, I just take total employment by educational attainment level and NUTS 2 regions (provided by Eurostat) as a proxy.

I only include human capital at regional level, without discriminating by industry. The way I build this variable is the following: I take the total number of workers with tertiary education within one region and, then, I normalize it over the total number of workers within that region (i.e. I calculate the percentage of employed people with tertiary education for each region). After that, I use this value as a common indicator for all the industries within the same region.

5.1.4 FDI

There is no specific data for FDI divided by years and classified by NUTS 2 and NACE. Therefore, my approach used to estimate this variable has been the following one: From Amadeus database,[19] I got a set of data of different Irish companies with an ultimate

[19] This database provides disaggregated firm-level data on around 21 million companies across Europe.

owner or at least one shareholder located in any foreign country owning 10% (or more) of the firm. Once I had all these companies at hand, in order to identify in which year investment took place, I filtered data according to their 'date of incorporation' and I got 4,014 different FDI operations.
In this particular case, 587 out of these observations 4,014 provided an empty 'NUTS classification', while other 199 companies had the 'NACE section' in blank. The first issue was fixed successfully assigning the NUTS classification by hand, either referring to the company-address zip code or the legal name of the company in question.[20] However, the second issue had to be solved in a very different way, as this happened because these firms are (in most cases) either multiproduct or their investments take place in the finance sector (capital entry) but their final activity refers to another sector. Looking closely at the data, I realized that several of these companies were "holdings", which meant that (then) it went in the direction of my second explanation. For this reason, I applied the previous working hypothesis and assigned 178 of these firms to the "finance sector". Then, the remaining 21 companies were classified in other sectors, as it seemed somehow clear that their activity was focused on other sectors.
Once all the data at hand was processed I started filling in the number of operations that took place in each year for each industry and each region in a very basic way. I gathered all the information about all the companies in the same Excel table and, then, I applied the necessary filters (year, region and industry) to be able to count the number of FDI operations and writing them down, one by one.

5.1.5 FDI spatial externalities

As we discussed in section 4, externalities may take place not only within but also across regions. This variable (F_{ist}) is aimed at measuring the latest – spatial -externalities across regions.

5.2 Econometric Approach

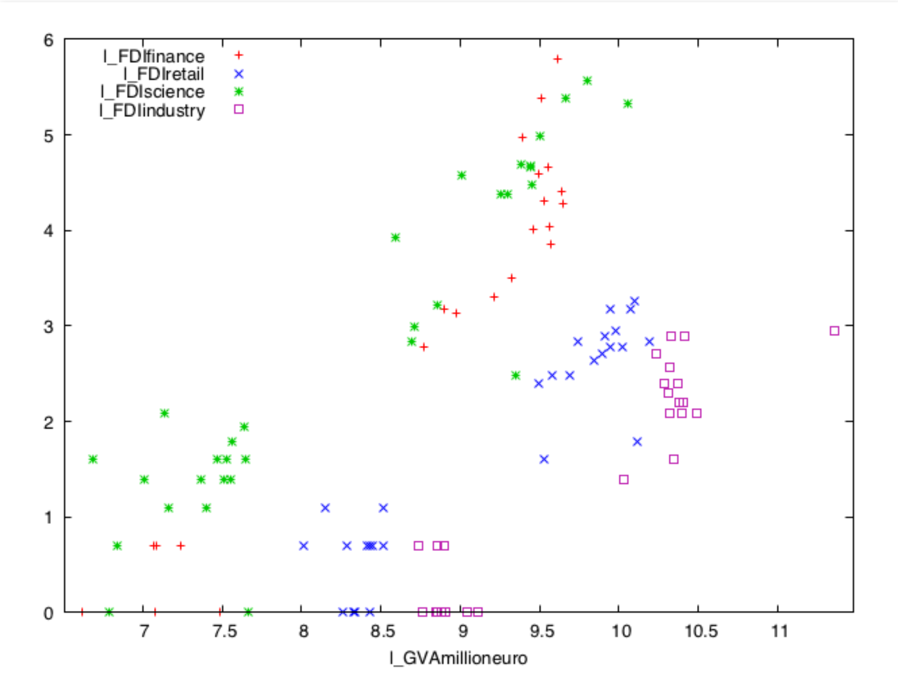
In this paper, I use panel data so as to be able to observe the behavior of different entities across time. This data structure allows me to control for non-measurable variables (through fixed-effects) such as industrial or regional factors (e.g. fiscal subsidies granted

[20] In such a case, the name of the company was checked in the Irish company and Irish director information search device *SoloCheck*.

by local governments), or differences in business practices across regions or industries, or variables that change over time but not across regions or industries.

My intention is to account for individual heterogeneity because it is actually present in my data, as you can observe in Figure 5:

Figure 5. The heterogeneity problem



Source: Gretl output

Figure 5 displays the association between the natural logarithm of GVA and the natural logarithm of FDI operations in different industries (the "B-E", "G-I", "K" and "M-N" industries, according to the NACE classification depicted in Figure A3, in Appendix 1. That is, the "industrial sector", the "wholesale and retail trade sector", the "financial sector", and the "research, professional services and scientific activities sector"). In this scatterplot, we can detect two components of heterogeneity: one is the presence of clusters of observations and the second is the dispersion of observations inside each cluster. The former issue is controlled by using a fixed effects (FE) model such as the one introduced in equation (7), and the latter by correcting estimations to be robust.

Furthermore, FE are also useful to control some unobserved variables (at region and industry level, such as local institutions or some features that differentiate one industry from another) that do not change over time but they may generate changes in the dependent variable.

5.2.1 Least squares dummy variable (LSDV)

A way to implement a FE model by using binary variables for each industry and region as well as for each time period is the least squares dummy variable (LSDV) estimation strategy. By adding the dummy for each industry, region and time-period we control for the unobserved heterogeneity and get the pure effect of the dependent variables of interest, inasmuch as each dummy is absorbing the effects particular to each industry, region and time period. This is equivalent to introducing a region-specific (and industry-specific, and time-specific) intercept into the model.

We can either include a dummy for all the cross-sections but one, and keep the intercept term, or estimate the model with a full set of specific dummies and no intercept – as in Wawro (2008).

This general approach of including unit-specific dummies, known as LSDV, is the approach used in this paper. Moreover, in order to avoid making mistakes in the form of heteroscedasticity and/or autocorrelation, I use the OLS estimator (which is unbiased for the parameters of a well-specified model) with robust estimates of the standard errors, so that the contrasts are valid, as previously discussed.

6. EMPIRICAL RESULTS

In Table 1, I present the descriptive statistics of our variables of choice. If we focus on the FDI and GVA variables, we see that they vary considerably. When observing their minimum and maximum values, we see they range from €206.11 million to €85,415 million and from 0 to 328 operations, respectively. The minimum value of GVA corresponds to the agricultural sector in the "Border, Midland and Western" region in 2009 (a year in which the Western economies were severally punished by the Great Recession), while the maximum value of GVA corresponds to the industrial sector in the "Southern and Eastern" region in 2015 (the last year of the period measured in this paper, in which Ireland achieved an annual 25.56% GDP growth, according to World Bank data). The minimum value of FDI may be associated to many industries, regions and years because (as hinted by the low median and the high skewness value) there are many observations (109) where the value of FDI operations is zero[21]. The maximum value of

[21] Note that having so many zero values can cause a problem when applying logarithms, as these observations give us a value equal to infinity and are automatically dropped from the sample. This is why section 6.2.1 is devoted exclusively to explain how I have addressed this issue.

FDI operations corresponds to the financial sector, in the "Southern and Eastern" region in the last year of available data, too.

Table 1. Descriptive statistics

Variable	Mean	Median	Minimum	Maximum	Std. Dev.	Skewness
GVA (mn)	7,661	4,338.5	206.11	85,415	9,159.5	2.9012
GFCF (mn)	1,977	860.18	−32.25	19,977	2,898.3	2.8261
L (000)	174,481	124,173	1,729.3	742,760	178,488	1.5712
Workers (000)	95.64	63.70	1.20	427.94	102.08	1.6943
FDI (units)	12.328	1	0	328	36.913	5.1537

Source: Own elaboration based on Gretl output

As previously discussed, my empirical analysis is implemented by means of LSDV model, using panel data to analyze the period between 2000-2015 for which I have availability of data regarding GVA, GFCF, L, Workers, and FDI operations within each industry and region of Ireland. That model takes the form presented in equation (7).

Table 2 depicts the results obtained when running different regression models. The first one (Regression I) represents equation (7) and its complete estimation outputs are presented in Figure A8, in Appendix 3. As shown in Table 2, the overall goodness of fit of the model is quite high. Nonetheless, as detected in Figure A9, in Appendix 3, the variable $\log k_{irt}$ must be omitted from the model in order to avoid a multicollinearity problem that makes hard the identification of the individual impact of each of the independent variables of the model (Verbeek, 2004; Wooldridge, 2009). Consequently, I need to run a second regression free of this multicollinearity problem: Regression II, that is also presented in Table 2.

At this point, in order to proceed with the estimation of the correct model and its interpretations, I have to take into account the possible presence of autocorrelated errors. As you can observe in Figure A12 and Figure A13 in Appendix 3, I do not find any presence of autocorrelation in Regression II.

In case I found autocorrelated errors in the regression specification, the OLS estimator would become inefficient since the formulas used to compute the standard errors would be no longer correct and confidence intervals and hypothesis tests using them would be wrong (Verbeek, 2004) – This is exactly what happens when I run Regression III, which I will explain later.

Eventually, I need to control for the presence of heteroscedasticity. In this case, the estimates have already been generated using the "robust" correction for standard errors t. In addition, as one can realize in Figure A18, when running the White's test for heteroscedasticity I get an LM test statistic equal to 26.9649, with a p-value of 0.798944, which does not allow me to reject the null hypothesis of no heteroscedasticity.

In conclusion, the tests of significance that assume the modelling errors are uncorrelated and uniform (i.e. that their variances do not vary with the effects being modelled) are not invalidated for Regression II. Therefore, I can assure my OLS estimator is still the best linear unbiased estimator (BLUE).

Table 2. Estimation regression (LSDV): variables of interest

Model dependent variable: $\log y_{irt}$				
	Regression I	Regression II	Regression III	Regression IV
constant	2.19371	-0.210105	-3.19426***	-2.67927***
	(0.3075)	(0.8863)	(0.0044)	(0.000)
$\log L_{irt}$	0.267352	0.601869***	0.837897***	0.715183***
	(0.2469)	(0.000)	(0.000)	(0.000)
$\log K_{irt}$	0.510340**	0.145679***	0.165531***	0.230738***
	(0.0158)	(0.0015)	(0.000)	(0.000)
$\log k_{irt}$	-0.362502*	-	-	-
	(0.0914)			
$\log h_{irt}$	0.559619***	0.606022***	0.496775***	0.356006***
	(0.000)	(0.000)	(0.000)	(0.000)
$\log \mathrm{F}_{irt}$	0.0668724**	0.0794279***	0.0776975**	0.0542321**
	(0.0102)	(0.0042)	(0.0190)	(0.0109)
$\log \mathrm{F}_{ist}$	-0.0509687**	-0.0546232**	-	-0.00328138
	(0.0494)	(0.0471)		(0.8847)
$\log \mathrm{F}_{ist-1}$	-	-	0.0360310*	-
			(0.0857)	
Observations	138	138	124	318
R-squared	0.982145	0.981704	0.978095	0.970451
F-test	188.6568	100.2851	60.40540	103.0734
	(0.000)	(0.000)	(0.000)	(0.000)

Source: Own elaboration based on Gretl output

6.1 Goodness-of-fit of the Estimations

Now that I established that Regression II is not biased, I can interpret its results.

To measure the goodness of fit of a model, we usually use the coefficient of determination (R-squared). In this particular case, its value is 0.981704, which implies that around 98% of the variation in log GVA can be explained by the variables included in the linear regression model.

Another measure on the overall goodness of fit of the model is the test for the joint insignificance of the slope coefficients. In this case the null hypothesis is $H_0\colon \beta_1 = \beta_2 = \cdots = \beta_{29} = 0$ while the alternative hypothesis is $H_A\colon \beta_1 \neq 0, and/or\ \beta_2 \neq 0, \ldots, \beta_{28} \neq 0, and/or\ \beta_{29} \neq 0$. This is carried out with an F-test giving a test statistic equal to 188.6568, with a p-value of (0.000). This means that, at any conventional level of significance, there is evidence to reject the null hypothesis of joint insignificance of the slope coefficients. In other words, all of the repressors together have some statistical role in explaining the dependent variable.

Furthermore, all the independent variables (including all the cross-sectional dummy variables) but the constant and the time dummy variables are individually statistically significant at a 10% significance level, as you can see in Figure A10, in Appendix 3. This result implies that each sector is differentiated by its own peculiarity constant over time (in terms of technology or form of organization of production, for example) that is statistically relevant and needs to be taken into consideration.

In addition, we should note that even though the time dummies are not individually significant, when I run a test for the joint significance of time dummies to see if the dummies for all years are equal to 0 and then no time fixed effects are needed, I have to reject this null hypothesis with an F-value of 2.62565 and a p-value of 0.0259396. That is, time fixed-effects are significant at a 5% significant level, as shown in Figure A18.

Finally, in this same figure we see that the Pesaran's test for cross sectional independence gives a z-value of -1.574449 with a p-value of 0.115374. This result does not allow me to reject the null hypothesis that there is no cross-sectional dependence in the model – i.e. the residuals are not correlated– while in Figure A19 we see that the F-test for the joint significance of differing group means (used to verify that the FE model is not more recommendable than the OLS model) gives an F-value of 1.29286 with a p-value of 0.208529. This last result does (also) not allow me to reject the null hypothesis that the pooled OLS model is adequate, against the fixed effects alternative, at any conventional level of significance.

6.1.1 Interpretation of the coefficients

Looking at the estimates of the coefficients, we can appreciate they are in line with the expected outcomes discussed in the theoretical setting. Overall, all factors of production display a positive association with the dependent variable, with the exclusion of the stock of FDI in the neighbor regions. All the coefficients except $\widehat{\beta_6}$ (for $\log \mathrm{F}_{ist-1}$) display their expected positive signs.

The negative sign of $\widehat{\beta_6}$ means that from a spatial perspective there are no spillover effects. All the FDI spillover effects are rather self-contained in a single spatial unit.

One can conclude that (in my sample), *ceteris paribus*, an additional percentage point of total working hours in the industry of a given region increases the GVA of that industry within that specific region, on average, by approximately 0.602%. Further, an additional percentage point of GFCF increases GVA by approximately 0.146%, while an increase of one percentage point in the proportion of employed people with tertiary education increases GVA by approximately 0.606%. Also, an increase of one percentage point in the number of FDI operations in the industry of a given region increases the GVA of that industry within that specific region by approximately 0.0794%. Finally, an increase of one percentage point in the number of FDI operations in the same industry and region decreases the GVA of that industry within the neighbor region by approximately 0.0546%.

Referring to the role of FDI on regional growth, my analysis delivers an interesting finding: the growth of a region exclusively relies on the incoming FDI of the same territory. The same is negatively influenced by the FDI of the neighboring regions, which implies that only the FDI operations of a region influence its growth while those of the neighboring zones do not promote, and rather limit or dampen, its economic performance. Thus, the FDI effect is limited to one locality and, when referring to FDI operations, spatial externalities across Irish regional territory seem not existing at least in the short term.

A possible explanation for these results can refer to the potential FDI competition across regions. That is, when there is a FDI operation in one region, this territory may attract the resources from its neighbor region, "stealing" its assets and, therefore, reducing its potential GVA growth.

6.2 Alternative Model Specifications

As identified in Table 2, Regression III estimates the same model but, in this case, the FDI in the neighbor region is lagged by one time period. The idea behind it is to check whether negative neighbor FDI effects found in Regression II arise because they are measured in the same year as the other variables. In this respect one may argue that spatial externalities could take some time to translate into positive spillover effects in neighbor regions.

When running this last specification of the model, $\widehat{\beta_6}$ becomes positive, indicating that – under *ceteris paribus* conditions – when considering a specific industry within a specific region, an increase of 1% in the number of FDI operations in the analogous industry of a neighbor region increases the GVA of that industry within the firstly mentioned region by approximately 0.036%.

Nonetheless, as you can observe in Figure A15 in Appendix 3, Regression III suffers from positively autocorrelated errors, which implies that the estimation method of this regression is no longer efficient. Therefore, I still prefer to rely on the previous regression model (Regression II).

6.2.1 Robustness check

Another issue that arises when considering Regression II is that the model only employs 138 out of the 320 observations provided by the sample data. This happens because, when using logs, all the values equal to zero imply a log value equal to infinity and, therefore, Gretl eliminates these observations.

Furthermore, this problem becomes more stringent when measuring the FDI operations made in neighbor regions, as all the zero values appear twice in the sample, eliminating several observations that otherwise would be included in the sample if not testing for spatial externalities.

Therefore, in Table 2 I implement an additional estimation (Regression IV), which accounts for that problem with zero values. This regression specification exploits a sample data in which I add a unit-value to all "0" observation values. Then, applying the logarithm transformation, all these observations – now taking value $\log(1) = 0$ – will appear back into the sample, allowing me to retrieve the full 318 observations.[22] For this reason, Regression IV is a further robustness check.

As one can appreciate in Table 2, in general, all the estimated coefficients of interest for Regression IV take very similar values to those in Regression II. The coefficient measuring the effect of FDI operations in the receiving region shows a positive value (0.0542321) that falls within the 95% confidence interval obtained in Regression II ($[0.028378, 0.130478]$), when using only 138 observations.

In contrast, the coefficient that measures the effect of FDI operations in neighbor countries ($\widehat{\beta_6}$) loses its statistical significance, which is a further signal that FDIs have only a spatial self-contained positive impact on economic growth since spillovers effects between regions do not seem to be effective.

Consequently, I assess that my core regression (Regression II) is valid and my estimated coefficients are reliable, because they are supported by different robustness checks.

7. CONCLUSIONS

The effect of FDI on economic growth has been studied for several years and by several authors. However, the empirical literature has been a bit inconclusive to provide clear evidence for the positive impact of FDI on economic growth.

In this study, I reviewed both strand of literature. The former focus on the contributions that have empirically supported the idea that FDI stimulates economic growth through different technological spillovers – such as Abebe et al. (2018), Borensztein et al. (1995), Dõgan & Taspinar (2013), Kotrajaras (2013), Mallick & Moore (2008), Markusen (2002), Mauro (1995), Melnyk et al. (2014), Yu et al. (2011) or Zhu (2010). The latter includes studies that have empirically supported the idea that FDI may bring external vulnerability and dependence into receiving countries, jointly with a crowding out effect of domestic investment, destructive competition between foreign affiliates and domestic firms, and "market-stealing effects" as a result of poor absorptive capacities – such as Gerlach & Liu (2010), Khaliq & Noy (2007), Margeirsson (2015), or Wan (2010).

However, despite efforts made to measure the effect of FDI on economic growth, I discussed that several models used in the current literature are biased because they are

[22] There are two missing observations corresponding to the construction industry in 2011 (in both regions) due to GFCF negative values.

not able to well identify heterogeneity problems in FDI compositions, or any spatial externality neither at the national nor the regional level.

With the intention to shed some light on this issue, I developed a novel theoretical mathematical model that took into account all my previous critiques. When testing this model by using an original database created by merging different regional-level and firm-level data, my study presents empirical evidence that (within country borders) each sector and region is differentiated by its own peculiarity that is statistically relevant and must be taken into consideration. Otherwise, we would obtain biased results when running any regression model.

Moreover, I find empirical evidence that FDI has a positive effect on the output of host countries, in line with the mainstream economic theory. The estimation results based on the LSDV model and the data for Ireland during the period 2000-2015 indicate that one percentage point increase in the number of FDI operations increases the country's output approximately by 0.03 to 0.13 percent, with a 95% confidence level. However, from a spatial perspective, I fail to find positive spillover effects between regions within country borders. All the FDI spillover effects are rather self-contained in a single spatial unit.

Thus, my analysis delivers the results that the growth of a region depends on the number of FDI operations within that same territory, while those of the neighboring regions do not promote, and rather dampen, its economic growth (at least in the year in which the FDI operation takes place).

Nevertheless, there are some limitations in this study that should not be overlooked. At first, because of no availability of data classified by NUTS 2 and NACE 3 at the same time, the variable measuring human capital in my econometric model is defined just as the percentage of employed people with tertiary education for each region, as a proxy for all the industries located in the same regions. Exploration for more detailed data in this respect would be valuable.

Another limitation is that 5% of the observations[23] in my sample do not provide a clear industry classification of FDI operations, as they had to be reclassified under some specific assumptions about data. In order to overcome this problem, I manually fixed the missing information adopting an ad-hoc working hypothesis. Once more, it could be interesting to check the validity of the strategy I adopted.

[23] 199 out of 4,014 observations.

Furthermore, there exists further potential development of this study that deserve to be taken into consideration. First, we would get more precise results if we worked with even more disaggregated data (e.g. at firm-level). Secondly, when data is available, we ought to work with longer time intervals so as to obtain more robust results. Finally, in this study I was not able to find FDI spatial externalities across regions in the short term, but there is space for new studies to measure FDI spillover effects in the longer term.

In conclusion, my results provide evidence that the high level of inward FDI in Ireland positively influences the country's output, but there is a lot of potential for further studies on this topic. For instance, we could introduce fiscal conditions into the research as to check whether FDI impulses growth limited to one region because of fiscal subsidies granted by local governments, which fuel the creation of local networks of suppliers limited to one region. We could also study what is causing the presence of the clusters of observations found in section 5.2. Are they the result of different local institutions' policies and/or different governing political parties (for example)? Having this information at hand would allow us to have a deeper understanding of the topic, as well as it would eliminate the necessity to include region fixed-effects in our econometric models.

APPENDIX

APPENDIX 1: DATA CLASSIFICATION

Figure A1. NUTS 2 regions of Ireland

Source: ResearchGate

Figure A2. Ireland's counties

Source: Ireland B&B

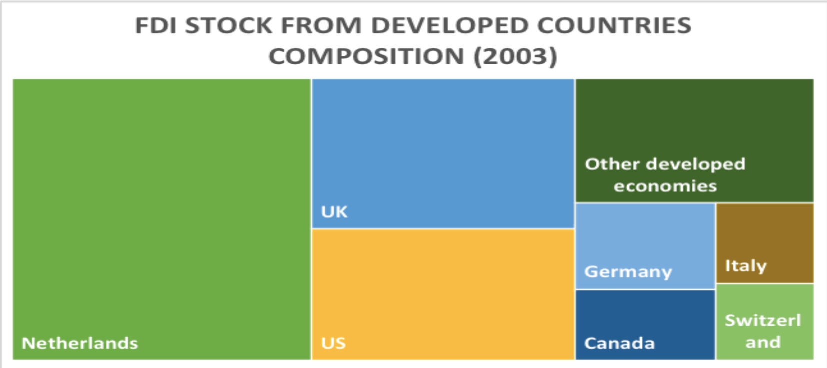
Figure A3. NACE classification of economic activities

A	Agriculture, forestry and fishing
B - E	Industry (except construction)
F	Construction
G - I	Wholesale and retail trade, transport, accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M - N	Professional, scientific and technical activities; administrative and support service activities
O - Q	Public administration, defence, education, human health and social work activities
R - S	Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies

Source: Own elaboration based on Eurostat data

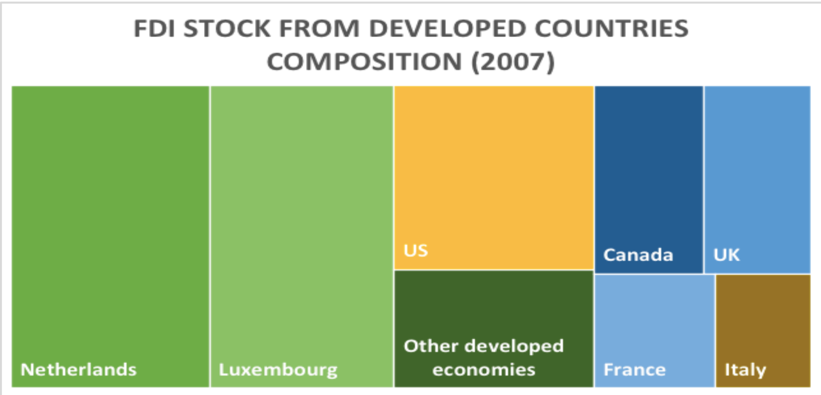
APPENDIX 2: IRELAND'S INWARD FDI, COUNTRY OF ORIGIN

Figure A4. Ireland's inward FDI stock from developed countries origin in 2003



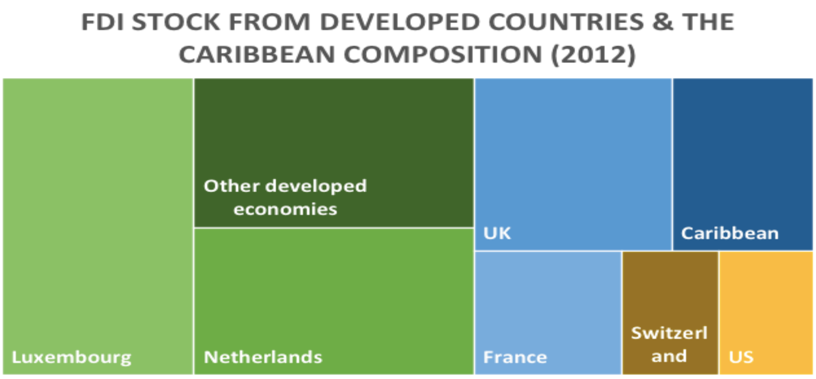
Source: Own elaboration based on UNCTAD data

Figure A5. Ireland's inward FDI stock from developed countries origin in 2007



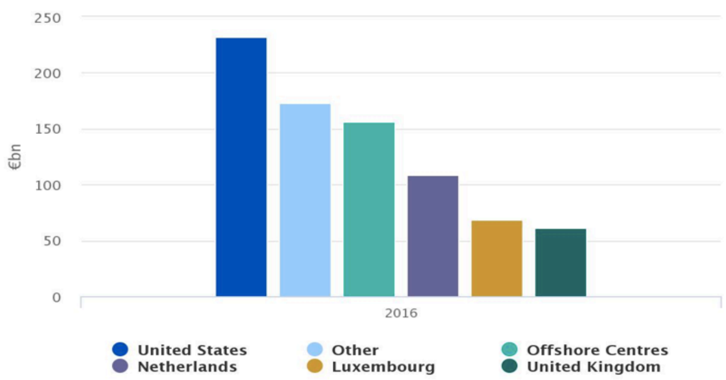
Source: Own elaboration based on UNCTAD data

Figure A6. Ireland's inward FDI stock from developed countries origin in 2012



Source: Own elaboration based on UNCTAD data

Figure A7. Ireland's stock of inward FDI by immediate investor in 2016



Source: CSO Ireland

APPENDIX 3: GRETL SCREENSHOTS

Figure A8. Regression I

```
Model 2: Pooled OLS, using 138 observations
Included 20 cross-sectional units
Time-series length: minimum 4, maximum 9
Dependent variable: l_GVAmillioneuro
Robust (HAC) standard errors
Omitted due to exact collinearity: dt_16

                       coefficient   std. error   t-ratio    p-value
  ---------------------------------------------------------------------
  const                 2.19371      2.09213       1.049     0.3075
  l_Lhoursinthousa~     0.267352     0.223785      1.195     0.2469
  l_GFCFmilioneuro      0.510340     0.192486      2.651     0.0158    **
  l_k_workers          -0.362502     0.203849     -1.778     0.0914    *
  l_hHavgeL             0.559619     0.0796701     7.024     1.09e-06  ***
  l_FDIoperationsi~     0.0668724    0.0234402     2.853     0.0102    **
  l_FDIneighbor        -0.0509687    0.0242840    -2.099     0.0494    **
  DIndustry_2           1.65526      0.138680     11.94      2.84e-10  ***
  DIndustry_3           1.19354      0.0747508    15.97      1.83e-12  ***
  DIndustry_4           0.800647     0.150015      5.337     3.77e-05  ***
  DIndustry_5           1.28974      0.158139      8.156     1.26e-07  ***
  DIndustry_6           1.47601      0.186672      7.907     1.99e-07  ***
  DIndustry_7           2.62886      0.366803      7.167     8.24e-07  ***
  DIndustry_8           0.926125     0.116528      7.948     1.85e-07  ***
  DIndustry_9           1.16641      0.130884      8.912     3.25e-08  ***
  DIndustry_10          0.307233     0.166301      1.847     0.0803    *
  DRegion_2             0.237031     0.118630      1.998     0.0602    *
  dt_2                 -0.0163813    0.0560511    -0.2923    0.7733
  dt_3                 -0.0377658    0.161922     -0.2332    0.8181
  dt_4                  0.0733107    0.0686685     1.068     0.2991
  dt_5                 -0.115368     0.117897     -0.9785    0.3401
  dt_6                  0.0304393    0.0532714     0.5714    0.5744
  dt_7                 -0.0448425    0.127048     -0.3530    0.7280
  dt_8                  0.112849     0.0769716     1.466     0.1590
  dt_9                 -0.122720     0.150874     -0.8134    0.4261
  dt_10                 0.0538848    0.0682960     0.7890    0.4399
  dt_11                -2.03824e-05  0.160907     -0.0001267 0.9999
  dt_12                 0.0306659    0.100996      0.3036    0.7647
  dt_13                -0.0643927    0.134097     -0.4802    0.6366
  dt_14                 0.0859624    0.0606400     1.418     0.1725
  dt_15                 0.131955     0.129260      1.021     0.3202

Mean dependent var   8.629281   S.D. dependent var   1.132919
Sum squared resid    3.139613   S.E. of regression   0.171296
R-squared            0.982145   Adjusted R-squared   0.977139
F(30, 19)            188.6568   P-value(F)           3.71e-18
Log-likelihood       65.22413   Akaike criterion    -68.44826
Schwarz criterion    22.29661   Hannan-Quinn        -31.57179
rho                  0.316210   Durbin-Watson        0.967472

Excluding the constant, p-value was highest for variable 47 (dt_11)
```

Source: Gretl output

Figure A9. Regression I – Collinearity

```
Variance Inflation Factors
Minimum possible value = 1.0
Values > 10.0 may indicate a collinearity problem

    l_Lhoursinthousand  439.579
      l_GFCFmilioneuro  473.285
           l_k_workers  601.825
             l_hHavgeL    2.310
l_FDIoperationsinunits    8.655
         l_FDIneighbor    6.808
           DIndustry_2   25.160
           DIndustry_3    6.768
           DIndustry_4   32.615
           DIndustry_5   10.197
           DIndustry_6   19.775
           DIndustry_7   39.397
           DIndustry_8   36.774
           DIndustry_9   10.456
          DIndustry_10    6.839
             DRegion_2   12.971
                  dt_2    1.693
                  dt_3    3.653
                  dt_4    2.084
                  dt_5    5.257
                  dt_6    1.767
                  dt_7    2.619
                  dt_8    1.950
                  dt_9    4.874
                 dt_10    2.072
                 dt_11    4.208
                 dt_12    1.648
                 dt_13    4.076
                 dt_14    2.007
                 dt_15    5.868

VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient
between variable j and the other independent variables
```

Source: Gretl output

Figure A10. Regression II

```
Test on Model 2:

  Null hypothesis: the regression parameter is zero for l_k_workers
  Test statistic: Robust F(1, 19) = 3.16231, p-value 0.0913642
  Omitting variables improved 1 of 3 information criteria.

Model 3: Pooled OLS, using 138 observations
Included 20 cross-sectional units
Time-series length: minimum 4, maximum 9
Dependent variable: l_GVAmillioneuro
Robust (HAC) standard errors

                      coefficient   std. error   t-ratio    p-value
  -----------------------------------------------------------------
  const               -0.210105     1.45006      -0.1449    0.8863
  l_Lhoursinthousa~    0.601869     0.116029      5.187     5.24e-05 ***
  l_GFCFmilioneuro     0.145679     0.0393368     3.703     0.0015   ***
  l_hHavgeL            0.606022     0.0909623     6.662     2.26e-06 ***
  l_FDIoperationsi~    0.0794279    0.0243904     3.257     0.0042   ***
  l_FDIneighbor       -0.0546232    0.0257247    -2.123     0.0471   **
  DIndustry_2          1.70488      0.142399     11.97      2.69e-10 ***
  DIndustry_3          1.24238      0.0702935    17.67      2.98e-13 ***
  DIndustry_4          0.912493     0.157059      5.810     1.35e-05 ***
  DIndustry_5          1.30515      0.163755      7.970     1.77e-07 ***
  DIndustry_6          1.48977      0.184262      8.085     1.43e-07 ***
  DIndustry_7          2.62446      0.384670      6.823     1.64e-06 ***
  DIndustry_8          0.962345     0.112533      8.552     6.14e-08 ***
  DIndustry_9          1.31268      0.115942     11.32      6.88e-10 ***
  DIndustry_10         0.385502     0.162585      2.371     0.0285   **
  DRegion_2            0.233375     0.122059      1.912     0.0711   *
  dt_2                -0.0182095    0.0524626    -0.3471    0.7323
  dt_3                -0.0268066    0.177020     -0.1514    0.8812
  dt_4                 0.0824959    0.0649421     1.270     0.2193
  dt_5                -0.103028     0.129527     -0.7954    0.4362
  dt_6                 0.0282086    0.0564886     0.4994    0.6233
  dt_7                -0.0551715    0.134765     -0.4094    0.6868
  dt_8                 0.107543     0.0746498     1.441     0.1660
  dt_9                -0.117646     0.165760     -0.7097    0.4865
  dt_10                0.0467109    0.0661817     0.7058    0.4889
  dt_11               -0.00418158   0.174764     -0.02393   0.9812
  dt_12                0.0209620    0.0900787     0.2327    0.8185
  dt_13               -0.0603130    0.139226     -0.4332    0.6697
  dt_14                0.0800129    0.0541991     1.476     0.1563
  dt_15                0.152258     0.136885      1.112     0.2799

Mean dependent var   8.629281   S.D. dependent var   1.132919
Sum squared resid    3.217153   S.E. of regression   0.172593
R-squared            0.981704   Adjusted R-squared   0.976791
F(29, 19)            100.2851   P-value(F)           1.50e-15
Log-likelihood       63.54070   Akaike criterion    -67.08140
Schwarz criterion    20.73621   Hannan-Quinn        -31.39449
rho                  0.287235   Durbin-Watson        1.002424

Excluding the constant, p-value was highest for variable 47 (dt_11)
```

Source: Gretl output

Figure A11. Regression II – Collinearity

```
Variance Inflation Factors
Minimum possible value = 1.0
Values > 10.0 may indicate a collinearity problem

    l_Lhoursinthousand    53.610
      l_GFCFmilioneuro    10.026
             l_hHavgeL     2.034
l_FDIoperationsinunits     7.953
          l_FDIneighbor    6.748
           DIndustry_2    24.617
           DIndustry_3     6.483
           DIndustry_4    29.417
           DIndustry_5    10.169
           DIndustry_6    19.748
           DIndustry_7    39.394
           DIndustry_8    36.359
           DIndustry_9     7.897
          DIndustry_10     6.532
             DRegion_2    12.965
                  dt_2     1.693
                  dt_3     3.645
                  dt_4     2.070
                  dt_5     5.242
                  dt_6     1.766
                  dt_7     2.615
                  dt_8     1.946
                  dt_9     4.872
                 dt_10     2.064
                 dt_11     4.207
                 dt_12     1.639
                 dt_13     4.075
                 dt_14     2.002
                 dt_15     5.824

VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient
between variable j and the other independent variables
```

Source: Gretl output

Figure A12. Regression II – First order autocorrelation: AR(1)

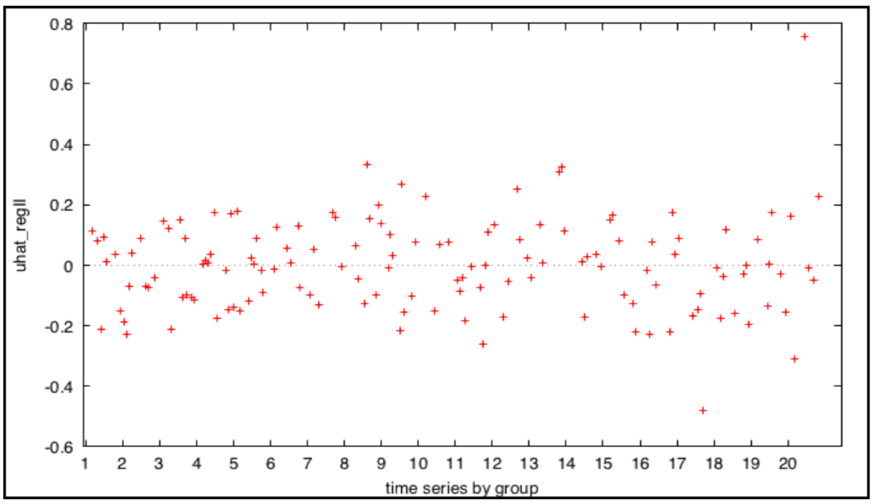
```
Model 12: Pooled OLS, using 59 observations
Included 18 cross-sectional units
Time-series length: minimum 1, maximum 6
Dependent variable: uhat_regII

                    coefficient   std. error   t-ratio   p-value
  ---------------------------------------------------------------
  const             -0.00562769   0.0202233    -0.2783   0.7818
  uhat_regII_lag1    0.0546876    0.137250      0.3985   0.6918

Mean dependent var  -0.005906   S.D. dependent var   0.154115
Sum squared resid    1.373762   S.E. of regression   0.155245
R-squared            0.002778   Adjusted R-squared  -0.014718
F(1, 57)             0.158764   P-value(F)           0.691786
Log-likelihood       27.20218   Akaike criterion    -50.40436
Schwarz criterion   -46.24928   Hannan-Quinn        -48.78238
rho                 -0.042237   Durbin-Watson        1.156124
```

Source: Gretl output

Figure A13. Regression II – The nature of autocorrelation: ‘time’ vs. ‘saved errors’



Source: Gretl output

Figure A14. Regression III

```
Model 14: Pooled OLS, using 124 observations
Included 20 cross-sectional units
Time-series length: minimum 3, maximum 10
Dependent variable: l_GVAmillioneuro
Robust (HAC) standard errors
Omitted due to exact collinearity: dt_15

                      coefficient   std. error   t-ratio   p-value
  ----------------------------------------------------------------
  const               -3.19426      0.987806     -3.234    0.0044    ***
  l_Lhoursinthousa~    0.837897     0.0747641    11.21     8.14e-10  ***
  l_GFCFmilioneuro     0.165531     0.0386955     4.278    0.0004    ***
  l_hHavgeL            0.496775     0.0924055     5.376    3.46e-05  ***
  l_FDIoperationsi~    0.0776975    0.0303177     2.563    0.0190    **
  l_FDIneighbor_1      0.0360310    0.0198782     1.813    0.0857    *
  DIndustry_2          1.51603      0.133305     11.37     6.38e-10  ***
  DIndustry_3          1.19118      0.114467     10.41     2.76e-09  ***
  DIndustry_4          0.561863     0.136936      4.103    0.0006    ***
  DIndustry_5          1.70538      0.147419     11.57     4.80e-10  ***
  DIndustry_6          1.64338      0.195196      8.419    7.79e-08  ***
  DIndustry_7          3.31287      0.262109     12.64     1.07e-10  ***
  DIndustry_8          0.823227     0.152812      5.387    3.37e-05  ***
  DIndustry_9          1.07548      0.161855      6.645    2.35e-06  ***
  DIndustry_10         0.669210     0.181386      3.689    0.0016    ***
  DRegion_2            0.0144429    0.123738      0.1167   0.9083
  dt_3                -0.0645170    0.0797691    -0.8088   0.4286
  dt_4                 0.0711310    0.130109      0.5467   0.5909
  dt_5                -0.205207     0.100285     -2.046    0.0548    *
  dt_6                 0.103947     0.0935305     1.111    0.2803
  dt_7                -0.113874     0.0739666    -1.540    0.1402
  dt_8                 0.0673240    0.0872729     0.7714   0.4499
  dt_9                -0.173130     0.0804239    -2.153    0.0444    **
  dt_10                0.0908908    0.0968875     0.9381   0.3600
  dt_11               -0.0909901    0.0851144    -1.069    0.2984
  dt_12                0.106514     0.137734      0.7733   0.4488
  dt_13               -0.224535     0.0945687    -2.374    0.0283    **
  dt_14                0.122422     0.0945788     1.294    0.2110
  dt_16                0.0516219    0.0963946     0.5355   0.5985

Mean dependent var   8.460417   S.D. dependent var   1.069465
Sum squared resid    3.081602   S.E. of regression   0.180105
R-squared            0.978095   Adjusted R-squared   0.971639
F(28, 19)            60.40540   P-value(F)           1.81e-13
Log-likelihood       53.13120   Akaike criterion    -48.26240
Schwarz criterion    33.52577   Hannan-Quinn        -15.03812
rho                  0.449732   Durbin-Watson        0.887564

Excluding the constant, p-value was highest for variable 36 (DRegion_2)
```

Source: Gretl output

Figure A15. Regression III – First order autocorrelation: AR(1)

```
Model 15: Pooled OLS, using 53 observations
Included 18 cross-sectional units
Time-series length: minimum 1, maximum 6
Dependent variable: uhat_regIII

                  coefficient   std. error   t-ratio   p-value
  ------------------------------------------------------------
  const           0.00185136    0.0226241    0.08183   0.9351
  uhat_regIII_lag1 0.323411     0.150385     2.151     0.0363   **

Mean dependent var   0.001380   S.D. dependent var   0.170342
Sum squared resid    1.383400   S.E. of regression   0.164698
R-squared            0.083144   Adjusted R-squared   0.065167
F(1, 51)             4.624904   P-value(F)           0.036274
Log-likelihood       21.40858   Akaike criterion    -38.81716
Schwarz criterion   -34.87657   Hannan-Quinn        -37.30180
rho                  0.228178   Durbin-Watson        1.008628
```

Source: Gretl output

Figure A16. Regression IV

Model 16: Pooled OLS, using 318 observations
Included 20 cross-sectional units
Time-series length: minimum 15, maximum 16
Dependent variable: l_GVAmillioneuro
Robust (HAC) standard errors
Omitted due to exact collinearity: dt_16

	coefficient	std. error	t-ratio	p-value	
const	−2.67927	0.505600	−5.299	4.09e-05	***
l_Lhoursinthousa~	0.715183	0.0495105	14.45	1.07e-11	***
l_GFCFmilioneuro	0.230738	0.0198894	11.60	4.58e-10	***
l_hHavgeL	0.356006	0.0550680	6.465	3.39e-06	***
l_FDIrobust	0.0542321	0.0192122	2.823	0.0109	**
l_FDIneighborrob~	−0.00328138	0.0223204	−0.1470	0.8847	
DIndustry_2	1.85795	0.162861	11.41	6.06e-10	***
DIndustry_3	1.36547	0.0877683	15.56	2.89e-12	***
DIndustry_4	1.03129	0.156289	6.599	2.58e-06	***
DIndustry_5	1.60679	0.101285	15.86	2.05e-12	***
DIndustry_6	2.12115	0.166639	12.73	9.51e-11	***
DIndustry_7	3.02973	0.176479	17.17	5.01e-13	***
DIndustry_8	1.29598	0.182170	7.114	9.15e-07	***
DIndustry_9	1.35179	0.102211	13.23	4.93e-11	***
DIndustry_10	1.04166	0.117889	8.836	3.71e-08	***
DRegion_2	0.136774	0.0480023	2.849	0.0103	**
dt_2	0.00695919	0.0367076	0.1896	0.8516	
dt_3	0.184905	0.100094	1.847	0.0803	*
dt_4	0.00150702	0.0481627	0.03129	0.9754	
dt_5	0.00265429	0.0973432	0.02727	0.9785	
dt_6	0.00962651	0.0482755	0.1994	0.8441	
dt_7	0.168388	0.0857888	1.963	0.0645	*
dt_8	0.0712886	0.0624050	1.142	0.2675	
dt_9	0.00554302	0.109458	0.05064	0.9601	
dt_10	0.0138050	0.0552268	0.2500	0.8053	
dt_11	0.154299	0.0880995	1.751	0.0960	*
dt_12	0.0150665	0.0533538	0.2824	0.7807	
dt_13	−0.0207665	0.101385	−0.2048	0.8399	
dt_14	0.0178050	0.0404756	0.4399	0.6650	
dt_15	0.187862	0.112232	1.674	0.1105	

Mean dependent var	8.281263	S.D. dependent var	1.239290
Sum squared resid	14.38631	S.E. of regression	0.223501
R-squared	0.970451	Adjusted R-squared	0.967475
F(29, 19)	103.0734	P-value(F)	1.16e-15
Log-likelihood	41.00563	Akaike criterion	−22.01126
Schwarz criterion	90.85028	Hannan-Quinn	23.06635
rho	0.016148	Durbin-Watson	1.776414

Excluding the constant, p-value was highest for variable 41 (dt_5)

Source: Gretl output

Figure A17. Regression IV – First order autocorrelation: AR(1)

Model 17: Pooled OLS, using 296 observations
Included 20 cross-sectional units
Time-series length: minimum 13, maximum 15
Dependent variable: uhat_regIV

	coefficient	std. error	t-ratio	p-value
const	9.40473e-05	0.0118100	0.007963	0.9937
uhat_regIV_lag1	0.0160561	0.0545986	0.2941	0.7689

Mean dependent var	0.000073	S.D. dependent var	0.202869
Sum squared resid	12.13738	S.E. of regression	0.203184
R-squared	0.000294	Adjusted R-squared	−0.003106
F(1, 294)	0.086480	P-value(F)	0.768908
Log-likelihood	52.71645	Akaike criterion	−101.4329
Schwarz criterion	−94.05217	Hannan-Quinn	−98.47780
rho	−0.005730	Durbin-Watson	1.935419

Source: Gretl output

Figure A18. Regression II – Tests

```
Test for omission of variables -
  Null hypothesis: parameters are zero for the variables
    DRegion_2
  Test statistic: F(1, 19) = 3.65568
  with p-value = P(F(1, 19) > 3.65568) = 0.0710781

Test for omission of variables -
  Null hypothesis: parameters are zero for the variables
    dt_2
    dt_3
    dt_4
    dt_5
    dt_6
    dt_7
    dt_8
    dt_9
    dt_10
    dt_11
    dt_12
    dt_13
    dt_14
    dt_15
  Test statistic: F(14, 19) = 2.62565
  with p-value = P(F(14, 19) > 2.62565) = 0.0259396

White's test for heteroskedasticity -
  Null hypothesis: heteroskedasticity not present
  Test statistic: LM = 26.9649
  with p-value = P(Chi-square(34) > 26.9649) = 0.798944

Distribution free Wald test for heteroskedasticity -
  Null hypothesis: the units have a common error variance
  Asymptotic test statistic: Chi-square(20) = 70.411
  with p-value = 1.56042e-07

Pesaran CD test for cross-sectional dependence -
  Null hypothesis: No cross-sectional dependence
  Asymptotic test statistic: z = -1.57449
  with p-value = 0.115374
```

Source: Gretl output

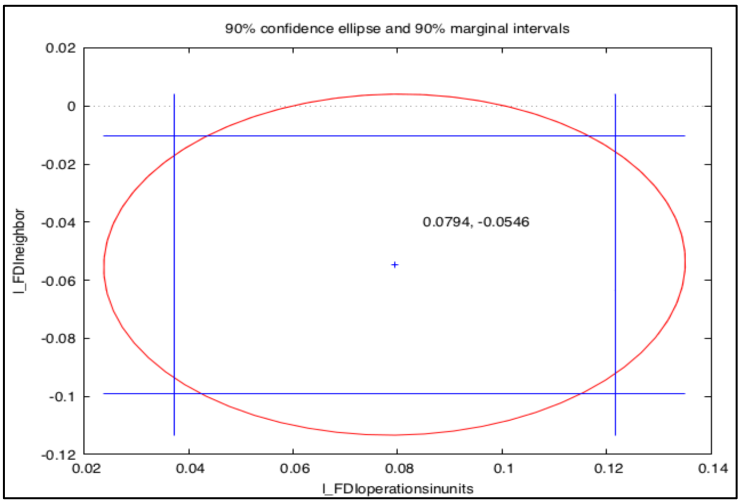
Figure A19. Regression II – F Test

```
Residual variance: 2.52127/(138 - 49) = 0.0283289

Joint significance of differing group means:
 F(19, 89) = 1.29286 with p-value 0.208529
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative.)
```

Source: Gretl output

Figure A20. Regression II – Confidence ellipse



Source: Gretl output

Figure A20. Regression IV – Tests

```
Test for omission of variables -
  Null hypothesis: parameters are zero for the variables
    DRegion_2
  Test statistic: F(1, 19) = 8.11861
  with p-value = P(F(1, 19) > 8.11861) = 0.0102576

Test for omission of variables -
  Null hypothesis: parameters are zero for the variables
    dt_2
    dt_3
    dt_4
    dt_5
    dt_6
    dt_7
    dt_8
    dt_9
    dt_10
    dt_11
    dt_12
    dt_13
    dt_14
    dt_15
  Test statistic: F(14, 19) = 5.23101
  with p-value = P(F(14, 19) > 5.23101) = 0.000563615

White's test for heteroskedasticity -
  Null hypothesis: heteroskedasticity not present
  Test statistic: LM = 50.1328
  with p-value = P(Chi-square(34) > 50.1328) = 0.0367337

Distribution free Wald test for heteroskedasticity -
  Null hypothesis: the units have a common error variance
  Asymptotic test statistic: Chi-square(20) = 497.683
  with p-value = 8.89021e-93

Pesaran CD test for cross-sectional dependence -
  Null hypothesis: No cross-sectional dependence
  Asymptotic test statistic: z = -2.37291
  with p-value = 0.0176487
```

Source: Gretl output

Figure A21. Regression IV – F Test

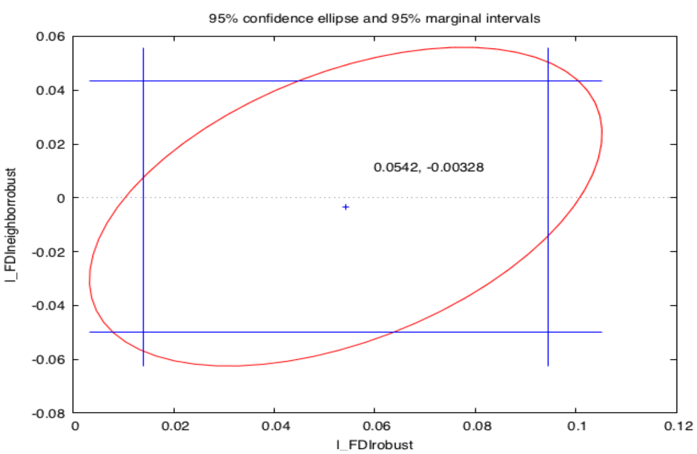
```
Residual variance: 13.108/(318 - 49) = 0.0487285

Joint significance of differing group means:
 F(19, 269) = 1.38076 with p-value 0.135499
(A low p-value counts against the null hypothesis that the pooled OLS model
is adequate, in favor of the fixed effects alternative.)

Omitting group means regression: insufficient degrees of freedom
```

Source: Gretl output

Figure A20. Regression IV – Confidence ellipse



Source: Gretl output

BIBLIOGRAPHY

Abebe, G., McMillan, M. & Serafinelli, M.. 2018. Foreign direct investment and knowledge diffusion in poor locations: evidence from Ethiopia. MIMEO. Last updated version checked: 22 February 2018.

Acemoglu, D. 2009. Introduction to Modern Economic Growth: Parts 1-5. Massachusetts Institute of Technology, Department of Economics. http://users.econ.umn.edu/~guvenen/DaronBook1.pdf Accessed 20 December 2017.

Anderson, J.E. 2016. The gravity model of economic interaction. MIMEO (August 17, 2016).

Antonakakis, N., & Tondl, G. 2015. Robust determinants of OECD FDI in developing countries: Insights from Bayesian model averaging. *Cogent Economics & Finance*, 3(1), 1095851. https://doi.org/10.1080/23322039.2015.1095851.

Beveren, I.V. 2008. Total factor productivity estimation: a practical review. LICOS Centre for Institutions and Economic Performance, *LICOS Discussion Paper Series*, Discussion Paper 182/2007. Updated version 2008.

Borensztein, E., J. De Gregorio & J.W. Lee. 1995. How does foreign direct investment affect economic growth?. NBER Working Paper Series. Working paper No. 5057.

Bureau Van Dijk, *Amadeus database* [online]. Available in Web: https://www.bvdinfo.com/es-es/our-products/company-information/international-products/amadeus [Consulted: 18th April 2018].

Chakraborty, C., & Nunnenkamp, P. 2006. Economic reforms, foreign direct investment and its economic effects in India. The Kiel Institute for the World Economy, Germany. Kiel Working paper no. 1272. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.163.6783&rep=rep1&type=pdf. Accessed 19 December 2017.

Chaney, T. 2011. The gravity equation in international trade: an explanation. MIMEO, Advance online publication September 2011. https://www.tse-fr.eu/sites/default/files/medias/doc/by/chaney/distance.pdf. Accessed 3 March 2018.

Chirila-Donciu, E. 2013. Globalization and foreign direct investments. CES Working Papers, 2013, vol. 5(2), issue 2, 177-186.

CSO Ireland, *Statistics* – Data view – Foreign direct investment annual 2016 [online]. Available in Web: http://www.cso.ie/en/releasesandpublications/er/fdi/foreigndirectinvestmentannual2016/ [Consulted: 19th April 2018].

Dõgan, O. & Taspinar, S. 2013. The effect of FDI on economic growth: a spatial econometric approach. *SSRN Electronic Journal*. 10.2139/ssrn.2228348.

Chen, E. 1994. Transnational corporations and technology transfer to developing countries. The United Nations library on transnational corporations, v.18.

Edward, M. & Kremer, M. 2004. Worms: Identifying impact on education and health in the presence of treatment externalities. *Econometrica*, Vol. 72. No. 1 (January 2004), 159-217.

Ertur, C. & Koch, W. 2007. Growth, technological interdependence and spatial externalities: theory and evidence. *Journal of Applied Econometrics*, 22: 1033–1062.

Eurostat. 2016a. *Glossary* – Nomenclature of territorial units for statistics (NUTS) [online]. Available in Web: http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Nomenclature_of_territorial_units_for_statistics_(NUTS) [Consulted: 21st April 2018].

Eurostat. 2016b. *Glossary* – Statistical classification of economic activities in the European Community (NACE) [online]. Available in Web: http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Statistical_classification_of_economic_activities_in_the_European_Community_(NACE) [Consulted: 21st April 2018].

Eurostat. 2017a. *Glossary* – Gross fixed capital formation (GFCF) [online]. Available in Web: http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Gross_fixed_capital_formation_(GFCF) [Consulted: 21st April 2018].

Eurostat. 2017b. *Glossary* – Gross value added [online]. Available in Web: http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Gross_value_added [Consulted: 21st April 2018].

Eurostat, *Database* – Table view – Employment (thousand hours worked) by NUTS 2 regions (nama_10r_2emhrw) [online]. Available in Web: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10r_2emhrw&lang=en [Consulted: 14th April 2018].

Eurostat, *Database* – Table view – Employment (thousand persons) by NUTS 3 regions (nama_10r_3empers) [online]. Available in Web: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10r_3empers&lang=en [Consulted: 14th April 2018].

Eurostat, *Database* – Table view – Employment by sex, age, educational attainment level and NUTS 2 regions (1 000) [online]. Available in Web: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfst_r_lfe2eedu&lang=en [Consulted: 14th April 2018].

Eurostat, *Database* – Table view – Gross fixed capital formation by NUTS 2 regions (nama_10r_2gfcf) [online]. Available in Web: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10r_2gfcf&lang=en [Consulted: 14th April 2018].

Eurostat, *Database* – Table view – Gross value added at basic prices by NUTS 3 regions (nama_10r_3gva) [online]. Available in Web:

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10r_3gva&lang=en [Consulted: 14th April 2018].

Eurostat. 2018. *Glossary* – Foreign direct investment (FDI) [online]. Available in Web: http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Foreign_direct_investment_(FDI) [Consulted: 30th February 2018].

Gerlach, A-C. & Liu, P. 2010. Resource-seeking foreign direct investment in African agriculture. FAO Commodity and Trade Policy Research Working Paper No.31.

Hornberger, K., Battat, J. & Kusek, P. 2011. Attracting FDI. The World Bank Group. Financial and Private Sector Development Vice Presidency, August 2011. Note Number 327.

Iamsiraroj, S. & Doucouliagos, H. 2015. Does growth attract FDI?. Economics Discussion Papers, No 2015-18, Kiel Institute for the World Economy. doi: http://www.economics-ejournal.org/economics/discussionpapers/2015-18.

Investopedia, *Foreign direct investment – FDI* [online]. Available in Web: https://www.investopedia.com/terms/f/fdi.asp [Consulted: 28th November 2017].

Ireland B&B, *Ireland Bed & Breakfast Map* [online]. Available in Web: https://ireland-bnb.com/map-of-ireland.html [Consulted: 25th April 2018].

Keller, W. 2002. Geographic localization of international technology diffusion. *American Economic Review*, 92(1):120-142.

Khaliq, A. & Noy, I. 2007. Foreign direct investment and economic growth: empirical evidence from sectoral data in Indonesia. No 200726, Working Papers, University of Hawaii at Manoa, Department of Economics.

Klenow, P.J. & Clare, A.R. 2005. Externalities and growth. In Handbook of Economic Growth: 818-861. Volume 1A. Amsterdam, NL: Elsevier B.V.

Kotrajaras, P. 2010. Foreign direct investment and economic growth: a comparative study among East Asian countries. *Applied Economics Journal* 17 (2): 12-26.

Mallick, S. & Moore, T. 2008. Foreign capital in a growth model. *Review of Development Economics*, 12: 143-159. doi: https://doi.org/10.1111/j.1467-9361.2008.00437.x.

Mankiw, G. 1995. The growth of nations. *Brookings Papers on Economic Activity* (1995), vol. 26, issue 1, 25th Anniversary Issue, 275-326.

Mankiw, G. 2010. Macroeconomics, 7th edition. New York: Worth Publishers.

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

Margeirsson, O. 2015. Foreign direct investment: a focused literature review. Binzagr Institute for Sustainable Prosperity, Working Paper No. 104.

Markusen, J.R. 2002. Multinational firms and the theory of international trade. MIT Press. Cambridge, Massachusetts.

Mauro, P. 1995. Corruption and growth. *The Quarterly Journal of Economics*, Vol. 110, No. 3 (Aug., 1995), pp. 681-712.

Melnyk, L., Kubatko, O. & Pysarenko, S. 2014. The impact of foreign direct investment on economic growth: case of post communism transition economies. Business Perspectives.org, *Problems and Perspectives in Management*, Volume 12, Issue 1, 2014.

Mottaleb, K.A. & Kalirajan, K. 2010. Determinants of foreign direct investment in developing countries: a comparative analysis. The Australian national University, Australia South Asia Research Centre Working paper 2010/13 https://crawford.anu.edu.au/acde/asarc/pdf/papers/2010/WP2010_13.pdf. Accessed 2 March 2018.

Nair-Reichert, U. & Weinhold, D. 2000. Causality tests for cross-country panels: a new look at FDI and economic growth in developing countries. *Oxford Bulletin of Economics and Statistics*. Volume 63, Issue 2, pp. 153-171. doi: https://doi.org/10.1111/1468-0084.00214.

OECD, *Data* – Unit labour costs [online]. Available in Web: https://data.oecd.org/lprdty/unit-labour-costs.htm [Consulted: 7th June 2018].

OECD. 2002. Foreign direct investment for development: maximising benefits, minimising costs. Report prepared within the framework of the activities of the Committee on International Investment and Multinational Enterprises (CIME). OECD Publications Service. https://www.oecd.org/investment/investmentfordevelopment/1959815.pdf. Accessed 10 April 2018.

Porter, M. 2003. The economic performance of regions. *Regional Studies*, Vol. 37.6&7, pp. 549–578. DOI: 10.1080/0034340032000108688.

Protsenko, A. 2003. Vertical and horizontal foreign direct investments in transition countries. Inaugural-Dissertation, *Munich Dissertations in Economics* from University of Munich, Department of Economics.

ResearchGate, *Figure 3.1 – NUTS 2 Regions of Ireland* [online]. Available in Web: https://www.researchgate.net/figure/NUTS-2-Regions-of-Ireland_fig1_267829883 [Consulted: 4th January 2018].

Romer, D. 2012. Advanced macroeconomics, 4th edition. New York: McGraw-Hill Irwin.

Romer, P.M. 1986. Increasing returns and long-run growth. *The Journal of Political Economy*, Vol. 94, No. 5 (Oct., 1986), pp. 1002-1037.

Sala-i-Martin, X. 2000. Notes on economic growth, 2nd edition. Antoni Bosch, editor, S.A.

Simionescu, M. 2016. The relation between economic growth and foreign direct investment during the economic crisis in the European Union. *Journal of Economics and Business*, Vol. 34, No. 1, 2016, pp. 187-213.

SoloCheck.ie, *Check companies (Ireland)* [online]. Available in Web: https://www.solocheck.ie/checkCompanies.jsp [Consulted: 18th April – 24th April].

Solow, R. 1956. A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, Vol. 70, No. 1 (Feb., 1956), pp. 65-94.

Swan, T. 1956. Economic growth and capital accumulation. *Economic Record*. Volume 32, Issue 2: 334-361.

Tinbergen, J. 1962. Shaping the world economy; suggestions for an international economic policy. New York: Twentieth Century Fund.

UNCTAD. 2017. World Investment Report 2017: Investment and the Digital Economy. United Nations Publication. Sales No. E.17.II.D.3.

UNCTAD, *Data center* – Table view – Foreign direct investment: Inward and outward flows and stock, annual, 1970-2016 [online]. Available in Web: http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=96740 [Consulted: 8th April 2018].

UNCTAD, *UNCTADstat* – Bilateral FDI Statistics [online]. Available in Web: http://unctad.org/en/Pages/DIAE/FDI%20Statistics/FDI-Statistics-Bilateral.aspx [Consulted: 21st April 2018].

UNECE Task Force. 2016. Guide on measuring human capital, Item IV (f) of the Provisional Agenda. In Meeting of the 2015/2016 Bureau, 9-10 February 2016, Luxembourg.

Verbeek, M. 2004. A guide to modern econometrics, 2nd edition. England: John Wiley & Sons, Ltd.

Wan, X. 2010. A literature review on the relationship between foreign direct investment and economic growth. CSSEnet.org, *International Business Research*, Vol.3 No.1, pp. 52-56 (January 2010).

Wawro, G. 2008. POLS W4912: Multivariate political analysis, spring 2008. http://www.columbia.edu/~gjw10/w4912_notes.pd Accessed 17 May 2018.

Wooldridge, J. 2009. *Introductory econometrics: a modern approach*, 4th edition. USA: South-Western Cengage Learning.

World Bank Group. 2018. Doing Business 2018: Reforming to create jobs. A World Bank Group Flagship Report. Washington DC: World Bank Publications.

World Bank, *Data* – Foreign direct investment, net inflows (BoP, current US$) [online]. Available in Web: https://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD?year_high_desc=true [Consulted: 12th March 2018].

World Bank, *Data* – Foreign direct investment, net outflows (BoP, current US$) [online]. Available in Web: https://data.worldbank.org/indicator/BM.KLT.DINV.CD.WD?view=chart&year_high_desc=true [Consulted: 12th March 2018].

World Bank, *Data* – GDP (current US$) [online]. Available in Web: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD. http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=96740. [Consulted: 21st April 2018].

World Bank, *Data* – GDP growth (annual %) [online]. Available in Web: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=IEAccess [Consulted: 12th March 2018].

World Bank, *Data* – GDP per capita (current US$) [online]. Available in Web: https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?year_high_desc=trueAcc [Consulted: 12th March 2018].

World Bank, *Data* – GNI per capita, PPP (current international $) [online]. Available in Web: https://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD?year_high_desc=true [Consulted: 12th March 2018].

World Bank, *Data* – Population, total [online]. Available in Web: https://data.worldbank.org/indicator/SP.POP.TOTL?year_high_desc=false [Consulted: 8th June 2018].

World Bank, *Data help desk*– What is the difference between Foreign Direct Investment (FDI) net inflows and net outflows? [online]. Available in Web: https://datahelpdesk.worldbank.org/knowledgebase/articles/114954-what-is-the-difference-between-foreign-direct-inve [Consulted: 30th March 2018].

World Economic Forum. 2017. The Global Competitiveness Report 2017-2018 (edited by Klaus Schwab). Insight Report. Geneva: World Economic Forum. http://www3.weforum.org/docs/GCR2017-2018/05FullReport/TheGlobalCompetitivenessReport2017%E2%80%932018.pdf. Accessed 7 June 2018.

World Postal Code, *Ireland Post Codes* [online]. Available in Web: https://worldpostalcode.com/ireland/ [Consulted: 18th – 22nd April 2018].

Yu, N., Tu, Y. & Tan, X. 2011.Technology spillovers from FDI: the case of ASEAN. MIMEO. Electronic copy available at: http://ssrn.com/abstract=1970015. Accessed 29 December 2017.

Zhu, Y. 2010. An analysis on technology spillover effect of foreign direct investment and its countermeasures. *International Journal of Business and Management*. Vol. 5, No. 4, pp. 178-182; April 2010.