The effect of patent boxes on foreign direct investment in Europe

Bachelor Thesis

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List of abbreviations

MNC   Multinational corporations

BEPS   Base Erosion and Profit Shifting

OECD   Organization for Economic Co-operation and Development

IP   Intellectual Property

FDI   Foreign Direct Investment

M&A   Mergers and Acquisitions

Patent Box   Intellectual Property Box

R&D   Research and Development

Abstract

Since Patent Boxes' first emergence in the 1970's in Ireland their presence has been fiercely debated. Since their appearance they have grown in numbers and are now present in a multitude of countries across the world. From the perspective of countries and their respective government the reason to their implementation are the following:
(i) to incentivize investment in R&D, (ii) to attract (or retain) mobile investments associated with knowledge creation and high-skilled jobs and to (iii) raise revenue more efficiently on mobile income streams. For multinational corporations the reason as to why patent boxes are valued is more straightforward, as their existence allow for larger profits by lowering the tax burden imposed and thus enabling larger net profits. This study examines the relationship between foreign direct investment inflow and patent boxes through time series regressions. The sample was divided into two groups, wealthy and not wealthy countries in order to capture fundamental differences among the subsets. The study confirms that patent boxes do have a positive significant effect on FDI, though only for the wealthy subset group. Why this result shows inconsistencies between the subsets is hard to determine and requires further examination.

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Table of contents

1.0 Introduction

After the patent box's first emergence other countries followed and the practice became relatively widespread around the world, though primarily in OECD-nations, OECD stands for the organization for economic cooperation and development. As described in Evers, Miller and Spengel (2015) there are three reasons as to why patent boxes are implemented.

(i) to incentivize firms to increase investment in innovative activities

(ii) to attract (or retain) mobile investments that may be associated with high-skilled jobs and knowledge creation

(iii) to raise revenue more efficiently by differentiating tax rates on more mobile income streams (Evers, Miller and Spengel, 2015).

Additionally, patent boxes, according to some scholars, do not increase research activities but rather multinationals use them mainly for tax planning purposes (Barrios et al., 2015). On the other hand, it can be argued that patent boxes generate spillover effects and positive external effects. In summary, the effect patent boxes have on economic activity is still controversial to this day. From a corporation's perspective patent boxes primary function is to potentially lower the tax-burden of revenue generated by intellectual property. This translates into lower costs for the company which makes investments more profitable and potentially leads to larger investments.

As intellectual property grows ever larger in volume and in share of the overall market asset value the policies directed at regulating these kinds of assets also become paramount to study. In a broader perspective patent boxes can constitute a problem through tax base distortion and harmful competition. Regardless of the patent boxes' objective for each country's establishment of such an entity, questions arose around the issue of unfair international tax codes. What might serve one country well in terms of generating tax revenue or investments might hinder the progress of another. Hence, disputes emerged of how to best regulate international tax codes and also how to cooperate with one another.

The topic of patent boxes is not a clear cut one in terms of which branch of economics it belongs to. Patent boxes' effect on FDI touches upon several branches of economics. Firstly, the decision of an enterprise can be viewed in terms of corporate finance. These

individual corporate decisions can then be aggregated which would engender a larger viewing-point. Furthermore, taxation pertains to public economics as do the implementation of patent boxes. This thesis is built on the integration of these different branches of economics as they do not exist independently of one another and interplay with each other. The upcoming section will briefly go through the results derived in this study.

This study's result indicates that patent boxes do have a significant positive effect on FDI though only for the wealthy subset. Furthermore, the result indicates a negative relationship between exchange rate and FDI for the wealthy subset and the inverse for the not wealthy subset.

In the next section I will present previous studies. Subsequently the method for this study will be addressed with a brief description of the data sample. As for the limitations there are some worthwhile aspects mentioning such as the difficulty in accessing data on patent boxes and differentiating FDI along with assessing the true effective tax rate for patent boxes.

1.1 Purpose

The purpose of this study is to further examine the effect of patent boxes in regard to FDI. The core question is as follows:

Do patent boxes affect FDI in any way, and to what extent?

Namely, these two hypotheses will be tested:

H1 - Patent Boxes have a significant positive effect on FDI

H0 - Patent Boxes do not have a significant effect on FDI

2.0 Theoretical background

2.1 Foreign direct investment

In order to understand foreign direct investment (FDI) as an aggregate measure it is crucial to understand the dynamics governing corporate decisions as these constitute FDI. Robinson (1961), Behrman (1962) and Wilkins (1970) argue that market size, market growth and maintaining market share were dominant determinants of FDI from a business perspective (Faeth, 2009). Foreign Direct Investment is typically divided into two categories, Horizontal FDI and Vertical FDI. Horizontal FDI refers to a direct investment in another nation within the same industry, typically involving an expansion of the existing enterprise. (Ramando, Rappoport and Ruhl, 2011). Horizontal FDI is carried out as means to gain more effective access to a (i) particular local economy, (ii) avoid trade barriers and to (iii) benefit from positive spillover effects from clustered enterprises. A clear-cut example of the clustering effect would be Silicone Valley for instance which often serves as a textbook example. Furthermore, Vertical FDI can occur in two ways, either through backward-investment or through forward investment. A backward investment is constituted by the investment of a downward supplier and hence a forward investment consists of investing upwards, for instance in distribution. To illustrate this further, if Toyota were to invest in a battery producer that action would be classified as backward-vertical FDI. If Toyota on the other hand would acquire the dealerships of their cars for instance in the European market this would constitute a forward-vertical FDI (Ramando, Rappoport and Ruhl, 2011).

After the above mentioned early studies of Robinson (1961), Behrman (1962) and Wilkins (1970), neoclassic trade theory stepped into the spotlight as the first theoretical model explaining FDI. Commonly named 2x2x2-model or the Heckscher-Ohlin theorem first published by Ohlin (1933) with the aid of Ohlin's student Heckscher, states that FDI can be seen as a part of international capital trade. To clarify the theorem assumes two factors of production (K and L) along with two goods. The exogenous input, which is the endowment of these two factors of production, results in a price difference of these two goods since the require different mixes of the inputs. Hence the necessity of trade to optimize the collective output, business output and thus also consumer utility. Later on, Schneider and Frey (1985) argued for a politico-economic model that integrated political factors in order to further the

development of explaining FDI. The politico-economic model lead to a better goodness of fit and ex-post prediction than previous models. A prominent more modern study on FDI by Blomström and Kokko (2003) emphasize the governing dynamics of FDI in terms of substantial subsidies by governments in order to attract investments and attain spillover effects along with general governance of the judicial and economic framework involving FDI.

In summary, scholars have added variables to the original models along the way and taken on a more integrated holistic approach with political, economic, technological and governance dimensions to better explain FDI. Foreign direct investment is typically divided into two categories, horizontal FDI and vertical FDI and my own study will be studying the merge of these two. Lastly my own study will focus primarily on how taxes through patent boxes affect FDI controlling for above mentioned variables such as governance and judicial framework through a set of proxies. These variables will be explained further later on in this study.

2.2 Forms of FDI

Greenfield FDI is one type of FDI that pertains to when MNCs establish new facilities in the host country. In other words, investing in new assets, which is arguably deemed to be positive as this investment increases the host country's stock of physical capital (Johnson, 2006). This is the term of investment often associated with overall positive economic effects and growth through an increase in capital stock, positive external effects and spillover effects. In comparison to greenfield FDI, brownfield FDI represents a change of ownership of existing assets rather than an inflow of new capital (Johnson, 2006). Arguably economies of scale, synergy-effects and a potentially more effective formation of capital may lead to an overall increase in production and thus also collective utility. Javorcik (2004) argues that this type of FDI may result in a positive effect in terms of technology spillover. He is far from the only scholar arguing for this point as it constitutes somewhat of a stronghold rhetoric wise. On the other hand, brownfield FDI may lead to cutbacks and oligopoly-like market conditions in the long run. In summary, the empirical evidence does not seem to favor one theory over another.

2.3.0 Determinants of FDI

In Faeth (2009) a number of possible determinants of FDI are studied and compared. She concludes that determinants of FDI are constituted by macroeconomic factors, microeconomic factors or a mix of both. Some mentioned scholars in her study emphasizes microeconomic factors such as risk diversification, proximity to markets and advantages in ownership structure while other point at macroeconomic factors such as size of the economy. Furthermore Vijayakumar, Sridharan & Rao (2010) have another take on the matter as they study FDI determinants in the BRIC-region (Brazil, Russia, India and China). Among these variables were currency valuation, trade openness, gross capital formation and market size. The take-home message is that FDI determinants comprise a myriad of microeconomic, macroeconomic, political and judicial factors. These all have support in previous literature such as these mentioned above earlier in this section. Studying some of these factors may form a problem in terms of quantifying and assessing while others may be accessed without great difficulty. An example of this would be finding a suitable proxy for policy making affecting decisions in investment, currency on the other hand is readily available to the scholars for example.

2.3.1 Exchange rate effects

FDI is regarded to be affected by numerous factors as mentioned in the former section. Among these are determinants are exchange rate effects. The exchange rate between countries may very well affect FDI. An appreciation of the firm's residence country currency lowers the cost of assets abroad. In theory this ought not to affect the rate of return as the return would be lowered by the same amount as the discrepancy between the currencies. In reality this does seem to have an effect according to Klein & Rosengren (1992). Moreover Blonigen (1997) points out how changes in the exchange rate may affect inward FDI. In essence, if the currency hold by the MNC appreciates it can be used to acquire assets that are transferable across the enterprise at a lower rate, in order to be used across the board. An example of this would be technology or managerial skills. Therefore, differences in the exchange rate can be exploited in order to acquire assets at a lower price without effecting the

real rate of return on the investment. Exchange rate and the volatility of exchange rate has been examined by other previous scholars such as Froot and Stein (1991) who altered the previous conception of expected fluctuations in regard to rate of return of an asset. They brought forth an imperfect capital market theory which proclaimed that inward FDI would in fact be positively affected by currency deprecation through a simple regression method.

2.4 Tax and tax elasticity

Tax elasticity is central to understand in the context of international investments and FDI, especially in a highly integrated mobile capital environment. Tax elasticity also has an impact on tax elasticity of patent boxes examined in this study. Feld and Heckemeyer (2011) estimated the median semi tax-elasticity of FDI to be approximately - 2.49 and that this figure has been grossly overestimated in previous literature. A semi-tax elasticity of -2.49 of FDI means that an increase in corporate tax rate by 1 % will decrease FDI by 2.49 %. I will return to this study by these scholars as it is central to my own study's underpinnings and results.

2.5 Definition of IP and why IP ought to be protected

The use of patent boxes requires assets to be classified as intellectual property. How this classification is defined and how its implemented is crucial to understanding the underlaying dynamics of patent boxes. The WIPO's (World Intellectual Property Organization) definition of IP is as follows" Intellectual property rights are like any other property right. They allow creators, or owners, of patents, trademarks or copyrighted works to benefit from their own work or investment in a creation" (WIPO, 2004, p.3). This is the fundamental definition and role of IP universally. This right for individuals to bear fruit from one's labor is even outlined in Article 27 of the Universal Declaration of Human Rights. As corporations are independent judicial entities this right applies to these entities the same way. Furthermore WIPO (2004) states that the main reasons as to why the protection of IP is vital and necessary. These reasons are: i) progress and well-being of the humankind rests on its capacity to innovate and develop, ii) encourages further innovation, iii) spurs economic growth. These effects may be derived from positive external effects and spillover effects. Spillover effects and positive external effect may justify lower taxes as they contribute to the

collective welfare. Spillover effects and positive external effects are in turn linked to economic development in general, social and cultural well-being. In all the definition of IP is linked to the fundamental property right and is the underpinning for the patent boxes and therefore vital to understand in the context of patent boxes.

2.6 Patent boxes

The action of strategically moving valuable IPs to low-tax affiliates is called strategic location of IP. The MNC needs to have established subsidiaries in order to benefit from differences in tax-laws and tax-rates in different countries (Jedlicka, 2018). This enables MNCs to conduct Research and Development in one country and then transfer the produce of this R&D, which is IP, to another country where the derived income from IP is taxed at a lower rate (Beer, de Mooij and Liu, 2018). It is worthwhile mentioning that when R&D is carried out privately, as they are for separate MNCs, the amount of resources dedicated to this form of activity may be lower than that of the optimal level for society as a whole due to positive external effect. This fact may also warrant the use of patent boxes as MNCs arguably are not compensated for these positive external effects enough or at all in some cases.

Patent boxes cover different types of assets, operate through a variety of methods and carry different tax-rates for profits associated with intellectual property. As of 2018 the tax for these patent boxes located within EU ranged from 0 % in Turkey (applicable for technology development zone), San Marino and Hungary for qualified assets under the regulation of these separate patent boxes to a maximum of 15% in France (OECD, 2018). The difference in tax rate does not capture its full impact on taxation of IP as they differ in scope and for what types of IP are to be deemed as eligible. The nexus approach adds another dimension for MNCs in attempting to calculate the optimal allocation of IP as adjacent business operations, that need to be in place in order to obtain the benefits of the lower taxes through the usage of patent boxes are to be taxed at the statutory corporate tax rate. In other words, intangible assets, namely IP, cannot be moved freely regardless of where the MNC has located its business and R&D activities.

Broadly, patent boxes can according to Directorate-general for internal policies (2015) be divided into two groups: i) Incentivizing R&D investment and innovation, and ii) Attraction

of Mobile IP Income. In group i), one can find Belgium, the Netherlands and UK. Cyprus, France, Hungary, Malta and the Swiss Canton of Nidwalden belong to the second group. As the first group arguably has, at least on paper, implemented the patent box in order to promote a certain kind of economic activity targeted at growth and development the second group has not. Naturally there are different lines of reasoning to this and one may claim that the overall lower effective tax rate can promote the supply side of economics in the long run. Different thoughts of school give different explanations as to how these Patent Boxes may or may not affect both individual MNCs and economies.

2.7 Heterogeneity in patent box taxes

The heterogeneity in Patent Box taxes also exist for corporate tax rates. The corporate taxes in EU (for the countries with a regulatory framework for patent boxes in place) range from 9% in Hungary to 34.43 % in France. One ought to keep in mind is that the patent box and corporate tax rate do not fully capture the tax environment for an enterprise as there are numerous taxes that apply to enterprises. Among these are social security taxes and property taxes to mention a few examples of such taxes.

2.8 Income shifting

The behavior of multinational corporations reflects the pursuit of after-tax profits, of which tax minimization is one aspect (Hines & Rice, 1994). This study brought forth the expression "Hines-Rice" approach (Dharmapala, 2014). Hines & Rice (1994) point out the evident difference in how profits arise on paper in contrast to the presence of different markets. This pursuit of after-tax profits is assumed in my own study and helps to define the behavior of MNCs. Another scholar, Grubert (2003) confirms the idea of MNCs shifting profit from high-tax location to that of a lower tax location through intra-firm transitions of intangible assets. As normally assumed in economics, a firm's objective is to maximize profit, and income shifting is a viable way to pursue this objective, hence the above-mentioned relationship.

Income shifting can be achieved in a number of different ways. One way to go about income shifting is through transfer pricing. Transfer pricing pertains to the accounting practice of what division of a company charges another for the transfer of assets. One of the most common accounting and valuation methods is the arm's length principle. The arm's length principle builds on comparison of similar transactions regarding IP observed on the market. It acts as a framework that benchmarks what is reasonable in relation to how the market generally values a particular asset. For instance, if MNC x and MNC y value patent abc at 1.1 billion USD, then MNC z should value it similarly or the same. The principle assumes that economic actors act rationally, if not fully to a great extent and therefore is able to set a benchmark for other economic actors. This also beautifully eliminates the need for a third party to value assets by letting the overall market decide. This constitutes a spillover effect in a way as data derived from transactions are used to regulate the market without anyone paying for that indispensable information.

The definition of transfer pricing is fundamentally important to understand as it is an imperative to be able to use patent boxes as it requires assets to be transferred. OECD (2017, p.17) define transfer pricing as following: "Transfer Prices are the prices at which an enterprise transfers physical goods and intangible property or provides services to associated enterprises". This guideline has a major drawback, namely the dilemma when intra-firm transactions do not have any comparable markets outside of the firm, leaving the firm immense leeway to price assets on their own. This dilemma is particularly problematic concerning the transfer pricing of IP, as quantifying the potential value of an IP is intuitively and empirically difficult. This transfer pricing can be exploited by MNCs to report higher earnings for subsidiaries with lower tax burden and vice versa. This translates into having tax discrepancies between jurisdictions where the MNC operates makes for a possible reduction in the overall tax incidence. Understandably, miss-use of the arm's length principle is challenging to determine to say the least. The complete Transfer Pricing Guideline from OECD can be viewed in appendix 2.

The need for a Transfer Pricing Guideline is a result of the inability to view taxation of MNC in isolation. Taxation from MNCs must be addressed in a broader international context in order to deal with multi-national presence and complex taxation issues related to this matter. The international taxation principles are to serve the dual objectives of securing appropriate tax base in each jurisdiction as well as avoiding double taxation (OECD, 2017).

In addition to this some light is shed upon the effect on capital structure for MNCs as high tax jurisdictions tend to lead to higher levels of debt and thus also lower levels of equity.

The OECD initiative of base erosion and profit shifting (BEPS) tries to address and solve the issue of how MNCs shifts profit within the firm in an attempt to reduce the overall tax burden. This is made possible by exploiting the underlying heterogeneity in tax-structure among countries.

It is believed that BEPS practices mount up to 100-240 billion USD in lost revenue annually, which in turn equates to around 4 -10% of the global corporate tax revenue (OECD, 2020). This equates to a daunting figure in terms of tax planning or possibly tax evasion, the latter being deemed illegal.

BEPS initiative Action 5" Harmful Tax Practices" addresses the issue of aggressive tax planning, where patent boxes potentially may qualify. Concerns were expressed among the participating nations related to "…how to calculate qualifying R&D expenditure, transitional arrangements between regimes and time allowed for this through grandfathering provisions, and the tracking and tracing methodology for R&D expenditure that will determine whether it qualifies" (OECD, Action 5, 2015, p.3). This ought to have come as no surprise as implementing such a daunting collective tax project comes with complications even though the participant countries agree on the general outline of how to address the perceived problem of BEPS. These concerns later on lead to an agreement between the participating countries.

A study published by Stimmelmayr et al. (2016) scrutinizes the nexus approach showing that the integration of the nexus approach tends to lower profit shifting activities. In theory this can be the results of numerous factors. Increased overall costs of relocation of a subsidiary, lower potential pay-off as the nexus approach tends to raise the effective tax rate and increased costs for assessing different options can all intuitively affect an enterprise's decision of location of IP.

2.9 Harmful tax competition

Competition in an economic sense is often associated with positive effects. However, competition can also constitute something detrimental. The term" Race to the bottom" is generally accredited to Justice Louis Brandeis in case (Louis K. Liggett Co. v. Lee, 288 U.S. 517 (1933). The judgement addresses the issue of state relaxation of rules applying to enterprises in an attempt to incorporate them in their own jurisdiction. This pattern of race to the bottom persists to this day, though embodied in a different form, such as subsidies, lenient transparency regulation etcetera primarily on national level but to some extent also on regional level. In other words, even though tax competition looks somewhat different today than it did at the beginning the overall trend persists to this day. Stewart (1977) further advanced the use of the term to the point where the US Congress began using it in. Even to this day the term is widely used as it points out an economic phenomenon that carries substantial weight for economic activity. As capital becomes increasingly more mobile the race to the bottom becomes increasingly important to study as the modern economy can shift the location of assets more quickly than it used to. Therefore, the race to the bottom is crucial to comprehend as patent boxes may be a part of this overall trend.

3.0 Empirical studies

Early empirical studies such as Robinson (1961), Behrman (1962) and Wilkins (1970) examined what the reasons were for businesses to engage in foreign direct investment Faeth (2009). Among the factors looked at by the scholars were; marketing factors, trade barriers, cost factors and investment climate. Market size, market growth and maintaining market share were deemed to be dominant determinants of FDI (Faeth, 2009).

Later on, Blonigen (2014) carried out a review of the FDI determinants previously examined by other scholars in the field. The following determinants were deemed to be correlated with FDI:

I.   Exchange rate effects
II.   Changes in bilateral level of exchange rate
III.   Exchange rate volatility
IV.   Taxation

V.   Institutions (quality of)

VI.   Trade protection

VII.   Trade effects

Some of these determinants are notoriously difficult to quantify and assess though proxies may be used to capture some effects of these determinants. For instance, trade protection is deemed to belong to this category as stated in Blonigen (2014).

3.1 FDI tax elasticity

In Feld and Heckemeyer (2011) the estimated median semi tax-elasticity of FDI was approximately - 2.49 and that this figure has been egregiously overestimated in previous literature. This meta-analysis, consisting of 704 individual studies aggregated into one, forms a wide scope able to be generalized to a considerable extent. In previous literature, such as (De Mooij and Everdeen, 2008) the median tax-elasticity is estimated at - 3.3. In short, the scholars have found different estimated values for tax-elasticity though they are all somewhat similar and hold negative values as expected ex-ante.

3.2 Tax and tax elasticity

Dischinger and Riedel (2011) estimates the elasticity of tax in relation to IP to -1.6. For every percentage point in decreased tax rate in any affiliate by this estimation model would result in a 1.6% increase in IP. An interesting point that is made by Dischinger and Riedel (2011) is the heterogeneity in tax semi-elasticity, which the lowest being in Germany at 0.5 and highest in Luxembourg at 3.9.

Finally, there seems to be a clear difference in tax-responses in respect to types of IP, where the estimated tax semi-elasticity of trademarks is -6.2 which is significantly larger than the semi-elasticity of patents at -1.9 Dischinger and Riedel (2011). However, the size of tax elasticity is widely debated among scholars. Bieltvedt and Skeie et al (2017) estimated that a 5 % reduction in IP tax rate results in a 6% increase in patents. The number of patents may

arguably be viewed as a proxy for R&D activity and hence serves a central purpose in assessing how tax affects R&D activity.

3.3 Income shifting

In Hines & Rice (1994) the scholars point out the evident difference in how profits arise on paper in contrast to the presence of different markets. To illustrate this phenomenon, only a mere 4.3% of US firms' overseas employees work in tax haven affiliates, and these affiliates' assets account for roughly USD 359 billion, which is over one-quarter of the total. Additionally, 30.8 % of US firms' total foreign-sourced income arise in tax haven countries. (Hines & Rice, 1994). This study was carried out circus 25 years ago and today's figure is presumably higher than that of the above-mentioned study.

3.4 Patent boxes

In the previously mentioned work of Evers, Miller and Spengel (2015) the authors make an extensive effort to estimate the effective tax rate of patent boxes thus disentangling the seemingly complex tax effect of a patent box. They state that the effective average tax rate ranged from -26.95 In Belgium to a maximum of 7.50 in UK. Furthermore in a study carried out by Alstadæter, Barrios, Nicodeme, Skonieczna and Vezzani (2018) the authors argue that patent boxes do incentivize MNCs to shift the location of patent but this shift does not equate to increased local R&D, which suggests that the effect of patent boxes is mainly of tax nature. Lastly Falk and Peng (2018) show evidence of patent boxes having a positive effect on FDI for a set of countries in Europe, though to a varying extent. The effect of patent boxes is measured in terms of number of FDI projects initiated in the studied countries through aggregated data on cities. The countries that were studied are: Netherlands, Belgium and Spain.

In the ensuing paragraph the method for my own study will be stated and explained.

4.0 Method

The general equation used for the regressions performed in the study was constructed in the following manner:

$$y_{it} = \beta_0 + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \cdots + \beta_k X_{k,it} + D_{,it} + \beta_i \alpha_i + \varepsilon_{it}$$

where $i = 1, \ldots n; \; t = 1, \ldots, T$

y_i = Dependent Variable

β_0 = Intercept

D_i = Dummy Variable

α_i = Entity-specific intercepts capturing heterogeneities across the entities

$\beta_{1\text{-}k} = \beta$

$X_{1\text{-}k}$ = Independent Variables

ε = Residual

In order to test my hypothesis, I used the following independent variables:

I. Combined corporate income tax on national and regional level

II. Economic freedom

III. GDP per capita

IV. FDI

V. Exchange rate, benchmarked to USD $

VI. GDP market size

VII. Education index

VIII. Patent box dummy

IX. IP protection

X. Patent box tax

Moreover, the following variables were logged in order to form a more normally distributed data as these variables differed greatly in relation to one another.

I. GDP market size

II. GDP per capita

III.   FDI

IV.   Exchange rate

The logging of these above-mentioned variables is also commonly used among other scholars. Furthermore, in some of the regression, variables were used in lagged format as the market and its actors' responsiveness to change is uncertain timewise. Hence the possible need for lagged values in order to take into account that reaction-time may not be quick enough to be translated into action the same year but rather ensuing year or spread over time.

In order to divide the sample into sub-samples a binary variable was engendered. The wealth variable was generated as a binary variable defined by whether the specific country at a particular point in time was wealthier or not than the average income per capita in Europe for that specific year. This means that a country can be classified as wealthy in one period and not in the next if the country is right at the threshold or if any major external or internal developments have occurred. To clarify this benchmark of wealthy is not constructed by an average of the sample itself since that would distort the threshold value greatly depending on the sample selection but rather on Europe as a whole.

In this section the independent variables will be described and explained, some of which are proxies. The IP score used in the calculations are derived from data from the Property Rights Alliance. IP protection is assessed as a scored mean of i) Perception of IP protection, ii) Patent protection and iii) Copyright piracy. Another proxy present as independent variable is the economic freedom index. Economic freedom index is a proxy for how well the institutional framework functions and the score is made up by a multitude of factors. This index gives both in-depth details to subcategory scores for nations as well as an overall score and its relation to the scores of other nations. How these factors are assessed and scored can be viewed in Appendix 1. Furthermore, the combined corporate tax is used rather than the statutory corporate tax level as this does not capture the province and or state tax imposed by some nations and would thus give inaccurate information. FDI is measured in net inflow in current USD where a negative value corresponds to a net outflow. Education index is developed by the UN development program where the score is derived from both mean years of schooling for citizens and the expected years of schooling. In other words, the proxy captures changes in the forecasted amount of schooling individuals obtain. These two factors are weighted equally at 50/50 thus emphasizing the present equal to future. GDP

market size is the gross domestic product measured yearly and GDP per capita is this previously mentioned value divided by the number of citizens of that country. The patent box dummy is a dummy variable representing the presence or absence of a patent box, regardless of scope, shape or form.

The regression was run in cluster in order to group the standard errors in groups of the specific country. In other words, multivariate regressions were performed for each and every one of the clusters. In this study the clusters comprise the different countries present in the dataset. Additionally, a Hausman test was performed to check for random or fixed effects.

4.1 Data

The data was derived from subsets of data from OECD, Economic Freedom Index, and the World Bank. The time span for the data is 2005-2019, which both captures the financial crisis of 2009 and the implementation of BEPS and BEPS Article 5 in 2015.
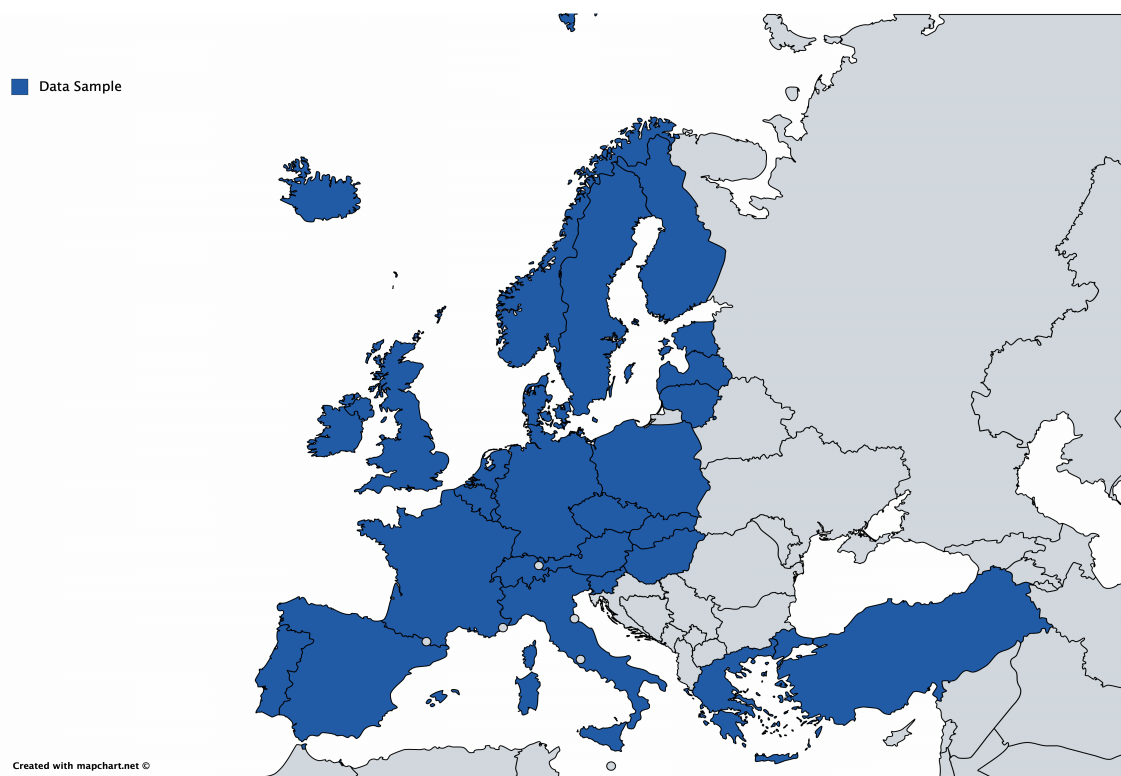

Figure 1 - Spatial distribution of data sample

Figure 1 shows which countries that are represented in the data sample. The dots are constructed to enlarge and clarify where small countries are situated, such as San Marino or Andorra. The countries present in the data set are: 1) Austria, 2) Belgium, 3) Czech Republic, 4) Denmark, 5) Estonia, 6) Finland, 7) France, 8) Germany, 9) Greece, 10) Hungary, 11) Iceland, 12) Ireland, 13) Italy, 14) Latvia, 15) Lithuania, 16) Luxembourg, 17) Netherlands, 18) Norway, 19) Poland 20) Portugal, 21) Slovak Republic, 22) Slovenia, 23) Spain, 24) Sweden, 25) Switzerland, 26) Turkey and 27) United Kingdom.

4.2 Data Description

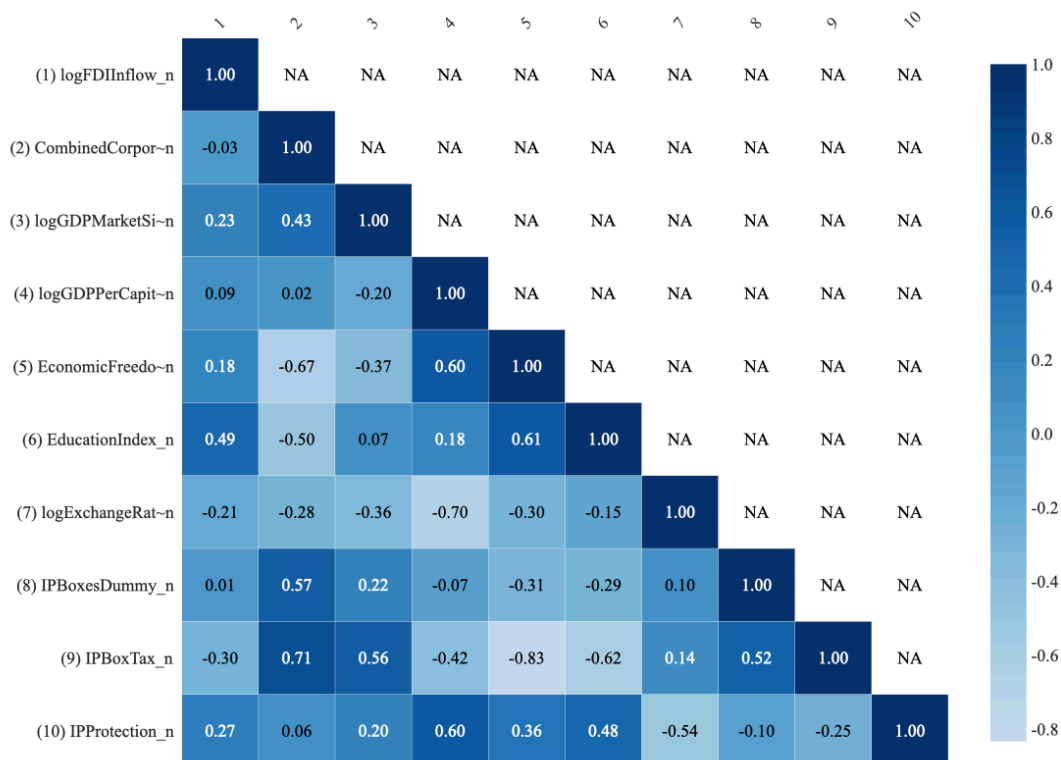|	1	2	3	4	5	6	7	8	9	10
(1) logFDIInflow_n	1.00	NA	NA	NA	NA	NA	NA	NA	NA	NA
(2) CombinedCorpor~n	-0.03	1.00	NA	NA	NA	NA	NA	NA	NA	NA
(3) logGDPMarketSi~n	0.23	0.43	1.00	NA	NA	NA	NA	NA	NA	NA
(4) logGDPPerCapit~n	0.09	0.02	-0.20	1.00	NA	NA	NA	NA	NA	NA
(5) EconomicFreedo~n	0.18	-0.67	-0.37	0.60	1.00	NA	NA	NA	NA	NA
(6) EducationIndex_n	0.49	-0.50	0.07	0.18	0.61	1.00	NA	NA	NA	NA
(7) logExchangeRat~n	-0.21	-0.28	-0.36	-0.70	-0.30	-0.15	1.00	NA	NA	NA
(8) IPBoxesDummy_n	0.01	0.57	0.22	-0.07	-0.31	-0.29	0.10	1.00	NA	NA
(9) IPBoxTax_n	-0.30	0.71	0.56	-0.42	-0.83	-0.62	0.14	0.52	1.00	NA
(10) IPProtection_n	0.27	0.06	0.20	0.60	0.36	0.48	-0.54	-0.10	-0.25	1.00

Table 1 – Correlation table with color intensity based on the Pearson correlation coefficient

The derived results from the correlation table are in line with results from other scholars, see Blonigen (2014). Taxes, both the effective corporate tax rate and the patent box tax show a negative correlation with FDI as assumed and a priori expected. Economic Freedom, Education Index, GDP and GDP per capita along with IP Protection all show a positive correlation with FDI. The correlation table is run with all of the data in its entirety

and not along subsets. In addition, the commands for formatting the data and for all of the calculations performed can be viewed in Appendix 3(Do File).

The data at hand showed a major discrepancy concerning several factors among the countries present. Corporate tax rate, indicated by combined corporate tax rate had a minimum of 9 % (Hungary from 2017 and onwards) and a maximum of 44.43% (France, for the sole year of 2017). A total of 405 observations were present in the dataset with some missing values, especially for the variable patent box tax due to absence of such a taxation rate if there is no such patent box in place. FDI measured in absolute value ranged from -239.34 USD Bn. to 733.83 USD Bn., where a negative value represents a new outflow of FDI. At 2018 the low point of -239.34 occurred in Netherlands and at 2007 the same country had the single highest obtained value for FDI at 733.83. GDP market size ranged from 13.16 USD Bn. (Iceland 2009, year of the financial crisis) to 3947.62 USD Bn. (Germany 2018).

5.0 Results

The primary regression yielded the following result.

logFDIInflow	Coef.	St.Err.	t-value	p-value	[95% Conf.	Interval]	Sig
CombinedCorporateTax	0.050	0.021	2.35	0.026	0.006	0.093	**
logGDPMarketSize	-0.447	2.189	-0.20	0.840	-4.947	4.053	
logGDPPerCapita	1.331	2.465	0.54	0.594	-3.735	6.396	
EconomicFreedom	-0.005	0.003	-1.37	0.183	-0.012	0.002	
EducationIndex	0.002	0.003	0.66	0.516	-0.004	0.007	
logExchangeRate	0.060	0.514	0.12	0.908	-0.997	1.117	
IPBoxesDummy	0.252	0.264	0.95	0.349	-0.290	0.794	
IPProtection	-0.348	0.139	-2.51	0.019	-0.633	-0.063	**
Constant	-6.284	14.795	-0.42	0.675	-36.695	24.127	

Mean dependent var		2.371	SD dependent var		1.772
R-squared		0.050	Number of obs		271
F-test		3.283	Prob > F		0.012
Akaike crit. (AIC)		687.708	Bayesian crit. (BIC)		716.525

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 2 – The primary regression result

Two significant results were yielded, namely combined corporate tax and IP protection. These variables were both significant at the $p > 0.05$, albeit with correlation not consistent

with previous studies but instead showed inverse relationship of these. FDI was positively correlated with corporate tax rate and negatively correlated with IP protection.

The examination of subsets within the data sample netted the results below after running regression for the not wealthy group.

logFDIInflow	Coef.	St.Err.	t-value	p-value	[95%Conf.	Interval]	Sig
CombinedCorporateTax	0.035	0.040	0.88	0.399	-0.052	0.122	
logGDPMarketSize	-0.537	2.531	-0.21	0.836	-6.108	5.034	
logGDPPerCapita	1.733	2.993	0.58	0.574	-4.855	8.321	
EconomicFreedom	-0.009	0.004	-2.19	0.051	-0.019	0.000	*
EducationIndex	0.005	0.004	1.13	0.282	-0.004	0.014	
logExchangeRate	0.798	0.544	1.47	0.171	-0.400	1.996	
IPBoxesDummy	-0.569	0.320	-1.78	0.102	-1.273	0.134	
IPProtection	-0.401	0.242	-1.66	0.126	-0.934	0.131	
Constant	-14.723	19.529	-0.75	0.467	-57.706	28.260	

Mean dependent var	1.378		SD dependent var	1.421
R-squared	0.118		Number of obs	107
F-test	18.331		Prob > F	0.000
Akaike crit. (AIC)	223.696		Bayesian crit. (BIC)	245.078

*** p<0.01, ** p<0.05, * p<0.1

Table 3 – Regression result for the not wealthy subset group

In the regression one variable was significant at p > 0.051 three independent variables slightly above the p > 0.10 threshold. The IV 0.001 point from reaching significance at the 5% level was economic freedom with a β-value of -0.0093. The two IVs just above the 10% level were: i) patent boxes (Dummy) and ii) IP protection, both with negative correlations.

The regression for the wealthy subset yielded the following results

logFDIInflow	Coef.	St.Err.	t-value	p-value	[95% Conf.	Interval]	Sig
CombinedCorporateTax	0.066	0.039	1.67	0.115	-0.018	0.149	
logGDPMarketSize	-4.108	3.789	-1.08	0.294	-12.141	3.925	
logGDPPerCapita	5.469	4.579	1.19	0.250	-4.237	15.175	
EconomicFreedom	-0.003	0.006	-0.53	0.602	-0.015	0.009	
EducationIndex	0.002	0.005	0.34	0.737	-0.009	0.012	
logExchangeRate	0.741	0.984	0.75	0.462	-1.345	2.827	
IPBoxesDummy	0.630	0.260	2.42	0.028	0.078	1.181	**
IPProtection	-0.283	0.231	-1.23	0.237	-0.772	0.206	
Constant	-34.178	31.957	-1.07	0.301	-101.925	33.569	

Mean dependent var	3.019	SD dependent var	1.678	
R-squared	0.061	Number of obs	164	
F-test	2.827	Prob > F	0.040	
Akaike crit. (AIC)	455.689	Bayesian crit. (BIC)	480.488	

*** p<0.01, ** p<0.05, * p<0.1

Table 4 - Regression result for the wealthy subset group

In this regression illustrated above there was one significant result. That variable was patent boxes (dummy) with a p -value of 0.028 and a with a β-value of 0.629.

logFDIInflow	Coef.	St.Err.	t-value	p-value	[95% Conf.	Interval]	Sig
L.CombinedCorporateTax	-0.096	0.053	-1.82	0.095	-0.212	0.020	*
L.logGDPMarketSize	-3.671	3.333	-1.10	0.294	-11.008	3.666	
L.logGDPPerCapita	2.174	3.246	0.67	0.517	-4.971	9.320	
L.EconomicFreedom	-0.010	0.005	-1.90	0.084	-0.021	0.002	*
L.EducationIndex	0.011	0.008	1.32	0.214	-0.007	0.030	
L.logExchangeRate	1.533	0.767	2.00	0.071	-0.155	3.220	*
L.IPBoxesDummy	-1.365	0.273	-5.00	0.000	-1.965	-0.764	***
L.IPProtection	-0.567	0.276	-2.05	0.064	-1.175	0.040	*
Constant	-10.511	16.719	-0.63	0.542	-47.309	26.286	

|				
Mean dependent var	1.307	SD dependent var	1.409	
R-squared	0.259	Number of obs	100	
F-test	57.336	Prob > F	0.000	
Akaike crit. (AIC)	190.198	Bayesian crit. (BIC)	211.039	

*** p<0.01, ** p<0.05, * p<0.1

Table 5 – Regression for lagged independent variables for not wealthy subset group

The above regression netted results for patent box at 0.000 with a β-value of -1.364, IP

Protection at -0.567 at p > 0.064, logexhangerate p > 0.071 with β-value 1.532 and combined corporate tax at p > 0.095 and β-value at -0.096. For the wealthy subset group no significant results were yielded.

In the next section I will illustrate the correlational relationship between FDI and exchange rate benchmarked to USD along with the super-trend for FDI for the entire period of time.
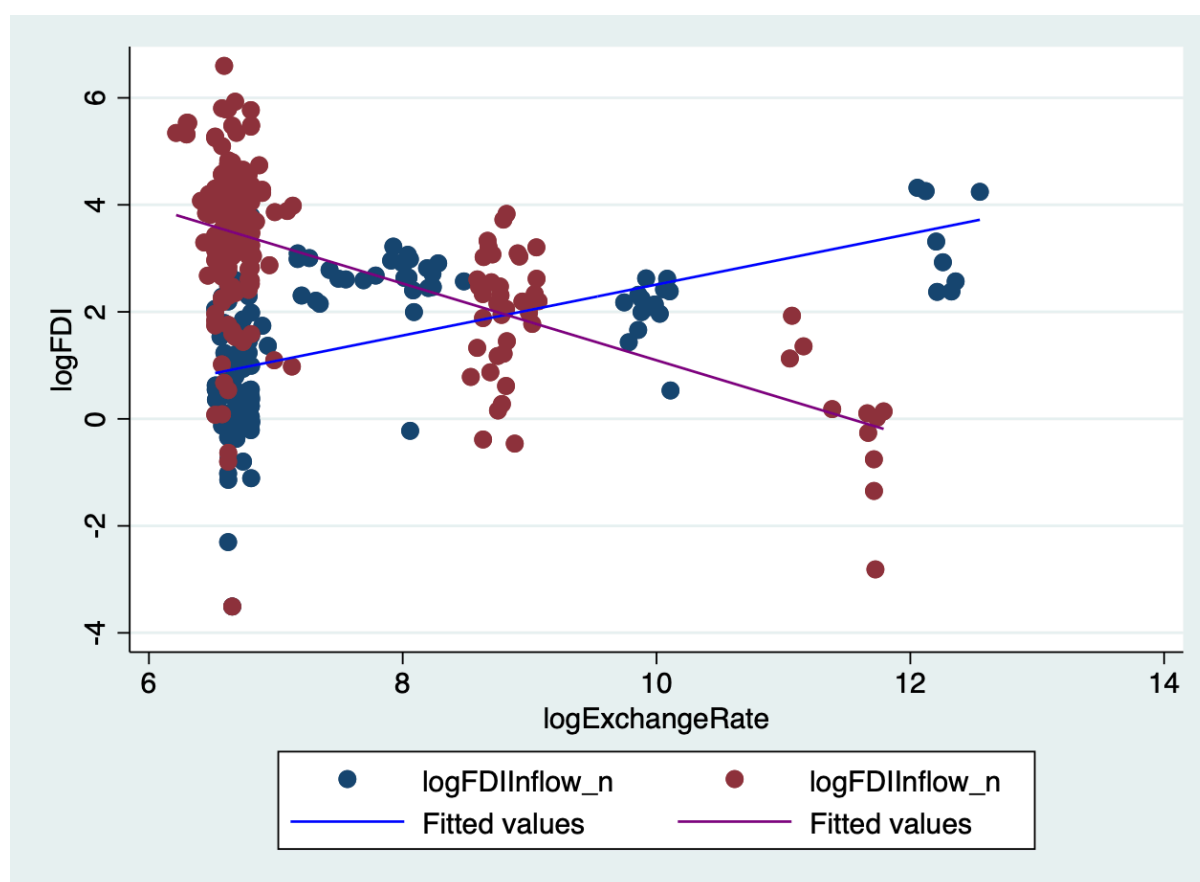

Graph 2 – Scatter plot with fitted values for the subset groups wealthy and not wealthy, showing an inverse relationship.

As illustrated above the relationship between logFDI and logexchangerate takes a positive relationship for the group not wealthy and an inverse (negative) for wealthy. Put in another way, when a country's currency depreciates it correlates to a lower volume of FDI if the country is defined as wealthy and the inverse if it is defined as not wealthy.
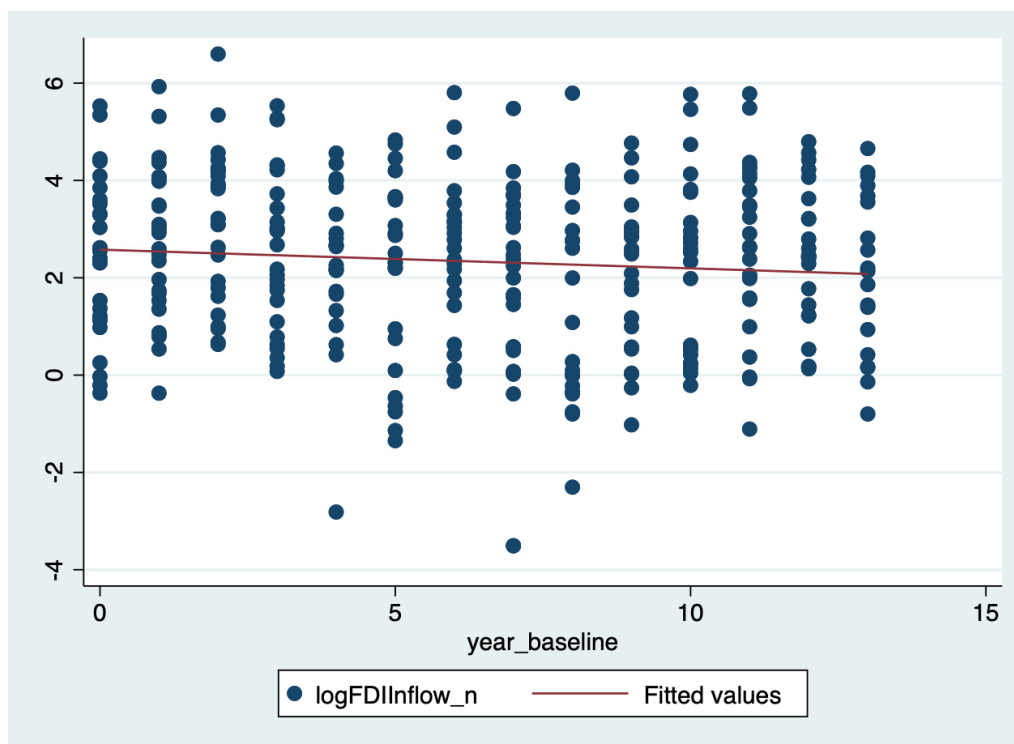
Graph 3 - Scatter plot with fitted value, indicating a super-trend of decline of FDI from 2005-2019 in absolute values.

The Graph above illustrates the mega-trend of FDI for the data sample where it is negative across the entire time spectrum. The year_baseline is constructed in a way that represents how many years from 2005 the data-point represents. The β is - 0.030 measured in logFDIInflow.
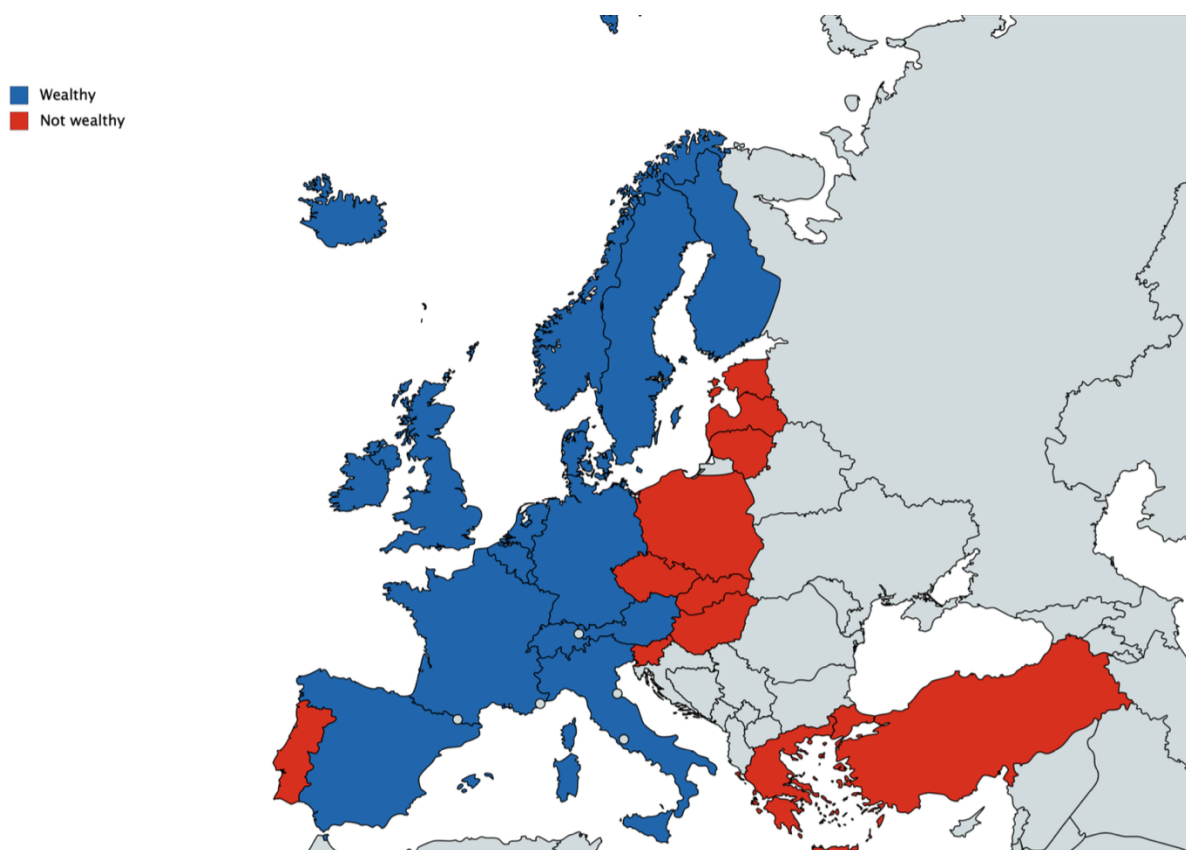
Graph 4 – Map of subset groups. The wealthy subset group is marked by blue and the not wealthy subset group is marked by red.

The graph depicts categorization of wealthy and not wealthy. The groups remain constant for 2005 and 2018 though with some minor fluctuations across time which was subsequentially reverted back to their original classifications. All of the regression performed were all adjusted for this by the implementation of the wealthy variable with floating threshold values across the time spectrum. To further clarify matters, the wealthy threshold is calculated through the European mean of GDP per capita for each and every year.

In addition to the regressions performed a number of other tests were carried out to further examine the data. A Hausman test was carried in order to check if random effects or fixed effects present. The p-value for this test was significant at 0.000, meaning fixed effects are significant and therefore are controlled for in all of the regressions performed. Moreover, a VIF-test was performed, with a value of 2.52 constituted no issues in the data in regard to multicollinearity.

Finally, an ARCH (Autoregressive Conditional Heteroskedasticity) test were performed for all of the variables in the dataset. With a p-value of 0.000 the null hypothesis is rejected, and the alternative hypothesis adopted. This means that the volatility is clustered in regard to FDI in the dataset.

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 u_{t-2}^2 + \cdots + \alpha_p u_{t-p}^2,$$

Figure 2 - ARCH equation. Source: (Diebold & Nerlove, 1989)

6.0 Discussion

The derived results in this study demonstrates just how crucial it may be to delve into differences within the data to look for differences in subsamples. The work by Riedel (2001) shed some light on the topic of my study which ultimately resulted in generating the wealthy variable for my own study as the author argues for considerable heterogeneity among countries. This new engendered variable made it possible to examine subsets of the data as they might fundamentally differ in characteristics. Even though it merely divides the sample into two, it still may capture some major differences in characteristics of the countries associated with being classified as wealthy or not. The whole idea is to examine whether the effect of a variable is constant regardless of what type of country it is. In my own study the wealthy variable generated new patterns and effects among the countries studied. As Riedel (2001) pointed out in his own study subsets did differ substantially in my study as well on numerous factors which can all be viewed in results. Therefore, I conclude that this division of data served its purpose and enhanced the legitimacy of this study's result.

6.1 Analyzing the results

The results indicated a significant positive correlation between the presence of a patent box and FDI for the wealthy subset group. This is by all means the culmination of the yielded

results in this study as it confirms the hypothesis and is central to the question asked. The not wealthy subset was indicative of the inverse of this relationship though with non-significant result. The above-mentioned result begs the question whether the patent box in developing countries might be indicative of underlying economic difficulties resulting in efforts trying to compensate for these. In other words, the presence of a patent box in wealthy nations might signal a generous and lenient tax-code while a patent box in relatively less wealthy countries might signal the presence of economic dilemmas. Naturally this is pure speculation and won't even qualify as a guesstimate though it intuitively bears some weight. To further clarify, in nations with struggling economic development with poor infrastructure, low levels of human capital, rampant corruption and weak protection of private property a patent box may be seen as an effort to attract capital rather than dealing with the fundamental problems themselves and does not compensate for these above-mentioned factors.

In general, the exchange-rate effect seemed to be of higher importance than the corporate tax rate given the different calculations carried out. The central question is how MNCs capitalize on changes in the exchange-rate? One answer to this might be the previously mentioned study by Blonigen (1997). He argues that FDI is made with the purpose of acquiring assets, in any way shape or form, that can be transferred and used within the conglomerate. Therefore, the FDI is not a product necessarily of aiming to access new markets through expansion but rather a way of cutting costs for investments made. This might very well be the case in my own study but cannot be verified given the present data examined.

6.2 Limitations

There are several limitations to this study. Among these are the limitation of how FDI is measured. FDI represents a financing flow, not necessary an investment, which is a crucial aspect often overlooked according to some scholars. Among these scholars are Calderón, Loayza and Servén (2004) who describes the matter in the following manner "…Greenfield investment includes all financial transfers from a multinational's headquarter to its subsidiary (and back, in the case of outflows). These could take the form of equity or loan financing" (Loayza and Servén, 2004, p.5). Thus, making greenfield FDI somewhat blurry to quantify if one means to capture real investments and not just movement financing flow movement. This

means that even if FDI is differentiated into greenfield and brownfield FDI it may not yield reliable results.

The difference between wealthy and not wealthy countries could have been further studies through an interaction-term. This engendered variable would in turn be able to further analyze the relationship between the two subgroups of wealthy and not wealthy countries to examine them for further differences among them. If this interaction-term would have been put in place different results may have been yielded.

There are more limitations to this study as there is arguably a major concern for scholars attempting to fully assess the fundamentals and effects of patent boxes as they might differ in scope, form of legislation, rule of application and effective tax rate. In theory assessing these aspects of Patent Boxes might be achieved through rigorous examination by economists and tax lawyers of the different Patent Boxes across countries and time periods.

Moreover, assessing the legality of how a MNC may classify assets is also a puzzling question that arguably requires extensive work from tax lawyers in order to be properly assessed. How can one construct a general model applicable across the spectra of how assets are allowed to be classified as? To further complicate matters, since 2015, as the implementation of the nexus-approach materialized, calculating the effective tax rate is arguably difficult at best. This is due to the fact that the MNC has to have adjacent business activity (Stimmelmayr et al., 2016). He also argues that the overall effective tax rate will increase as a result of this implementation as a smaller fraction of the overall income will be taxed at the lower tax-rate offered by the country's patent box.

Lastly, FDI may also be the result of an endogenous process where earlier year's FDI may impact the future value of FDI. This is not checked for in this study and therefore it is inconclusive whether this has an impact or not. In theory this might very well affect FDI.

6.3 Making sense of the results in holistic approach

By constructing the variable year_baseline it was possible to examine the overall trend in the data sample. This enabled the opportunity to view the potential underlying mega-trend in the data, which the scatter plot confirmed with the best line of fit. The results can possibly

be attributed to outsourcing. Outsourcing is the name of the game according to numerous scholars who have studied this effect for some time now. This ought to show that FDI in Europe is decreasing every year adjusted for inflation and thus represents a trend of net outflow towards countries outside of Europe. In order to confirm this hypothesis, one needs to benchmark this result to that of the global economy to see if there are any regional differences in FDI.

6.4 Further studies

An important matter to address is the topic for this study and its relation to patent boxes. A patent box may have been put in place in order to raise tax revenue, incentivize economic activity that results in positive external effects or spillover effects and not FDI in particular. To illustrate this study therefore looks at the effects of FDI rather than these previously mentioned factors. In other words, it might be meaningful at looking at these factors in future studies.

Even though it might be an arduous task to assess all of the major effects of a patent box one might incorporate variables for tax revenue, external effects, spillover-effects and R&D into a collective study in order to further examine the effect of patent boxes. This future study could potentially look at different types of outcomes all pertaining to the implementation, continuation and possibly even the scenario of abolishment of patent boxes. This study would require immense data collection over time and as stated above has to score patent boxes according to their potential tax-decreasing effect and efficiency at doing so. Furthermore, one has to adjust for transaction costs, data over which is hard to come by. In summary I find the possibility for such as study slim due to these above-mentioned reasons. On the other hand, all studies come with limitations in a theoretical sense and does not prevent future studies to attain more accurate information on the matter.

7.0 Conclusion

The longevity of patent boxes is yet to be determined. If global, or regional harmonization of tax policies such as the patent box is achieved this kind of tax-structure may

persist for a considerable amount of time. If patent boxes are harmonized it might merely serve as a hygiene factor rather than an incentive. In that case other variables will gain importance as patent boxes lose their competitive edge concerning spurring investments and capital. Moreover, if the nexus approach endures, the overall tax climate of a country may have to be changed as a whole to further future investments.

In conclusion the patent boxes do seem to have a positive effect on FDI, though not across the entire spectrum of countries due to underlying heterogeneity concerning economic, social and possibly cultural factors. The overall correlation between FDI and the independent variables were all consistent with previous literature showing positive correlation with GDP market size, GDP per capita, economic freedom, education index and IP protection. FDI had a negative correlation with combined corporate tax, exchange rate and patent box tax. These correlations add to the validity of this study as it indicates similar results obtain by prominent scholars within the field of economics. Furthermore, the correlational results of exchange rate points to how this factor might carry more weight than previously expected.

8.0 References

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9.0 Appendix

Appendix 1 - https://www.heritage.org/index/pdf/2020/book/methodology.pdf

Appendix 2 - https://read.oecd-ilibrary.org/taxation/oecd-transfer-pricing-guidelines-for-multinational-enterprises-and-tax-administrations-2017_tpg-2017-en#page8

Appendix 3: Do File