POLITECNICO DI TORINO

Master's Degree in Management Engineering
Academic Year 2020/2021
Graduation Session October 2021

Politecnico
di Torino

MASTER'S THESIS

Location choices of Foreign Direct Investments in Europe: the role of innovation policies for the automotive sector

Supervisor
Prof. ssa Anna D'Ambrosio

Student
Daniele Torge (262490)

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1. INTRODUCTION

1.1 Overview on automotive industry in Europe and its future challenges

Nowadays the European automotive sector is constantly at the top of the global industry, due to its high volume of sales; moreover it represents a significant source of employment and for that reason it is an integral part of European society as a whole. The automotive industry is crucial for Europe prosperity ; indeed the automotive sector provides direct and indirect jobs to 13.8 millions Europeans, representing 6.1% of total EU employment (European Commission, Internal market, Entrepreneurhip and SMEs 2020).
Furthermore 2.6 million people work in direct manufacturing of motor vehicles, representing 8.5 % of EU employment in the manufacturing field. The EU represents the world's biggest producers of motor vehicles and the sector is the largest private investor in research and development (R&D). To strengthen the competitiveness of the EU automotive industry and preserve its global technological leadership, the European Commission supports global technological harmonization and provides funding for R&D (European Commission, Internal market, Entrepreneurhip and SMEs ,2020). The industry is not only involved in the business of personal mobility, but it plays also an important role in the field of services such as public transport, emergency services and distribution of goods. Moreover the automotive industry has an important multiplier effect in the economy, with many links toward other sectors. It is important for upstream industries such as steel, chemicals, and textiles, as well as downstream industries such as ICT, repair, and mobility services. In general terms the turnover generated by the automotive industry represents over 7 % of EU GDP (European Commission, 2020).
The entire European economic welfare is affected positively by the automotive sector: “Both the passenger cars, as a cornerstone of individual mobility, and the commercial vehicle, as a backbone of the European economy, contribute tremendously to society, environment, economic welfare and growth in Europe” (McKinsey & Company, January 2019, p. 8).

It is possible to summarize all that in three major contributions (3Ps) :

- **Social contribution (People) :** Nowadays, thanks the automotive industry, people perceive the mobility safer, more time efficient and affordable. Indeed a relevant portion of journeys (70%) are made by car, while 55% of public transport journeys are made by bus. In the same time the percentage of accidents involving passenger cars declined by 40% since 2005, and fatalities involving

commercial vehicles have been halved since 2001. Furthermore, during the last 40 years, the average costs per covered kilometer of cars decreased by 65% allowing to a larger part of European inhabitants to adopt individual mobility (McKinsey & Company, RACE 2050 - A vision for the European automotive industry, January 2019, p. 8).

- **Environmental contribution (Planet) :** Despite the number of cars in Europe increased by >50% over the last 20 years, the automotive industry gives a positive contribution to the environment too. A goal shared by the main companies of the sector is to maintain the harmful impact on the environment under control, acting in order to reduce the emissions in effective way. For that reason European new cars are more efficient than cars from 20 to 25 years ago, and this has led to a 36% decline in CO2 emissions since 1995. Furthermore, in the same period, CO2 emissions belong to commercial vehicles have decreased by 14%. In addition NOx emissions have been reduced by 90% since the early 1990s in the new cars , while regarding commercial vehicles the reduction was 95%. Despite the emissions for each commercial vehicle fell down drastically, the growth of the transport industry caused a higher share of transport sector emissions than 20 years ago. Indeed today, 24% of the EU's greenhouse gas emissions come from the transport field, in comparison to 17% in 1995 (McKinsey, January 2019, p. 8).

- **Economic contribution (Profit)** : The automotive sector is a consolidate and established industry, so that it is an engine for the growth of the European economy and a source of new and attractive job opportunities. The turnover generated by the sector account around 7% of the EU's GDP, and tax contributions related to the industry is 410 billion euros in the EU-15 countries alone, equaling roughly 6% of their total tax income. Moreover, due to the exportation of 5.4 million cars around the world, the European automotive industry represents over 40% of global automotive value share, and commercial vehicles are the backbone of Europe's economy, transporting 75% of all land-carried goods and 90% of value transported. Finally the average profitability of 7% makes the industry robust from an economic point of view, but there is an evident gap with the highly profitable industries, which achieve an average of 22% percent return on sales (McKinsey, January 2019, p. 8).

The entire EU industry is going through a considerable number of challenges, which affect also the automotive sector in a pronounced way. For that reason the main automotive companies need to take some tough decisions , in order to keep their leading position in this changing competitive landscape. The first thing to do is to have a shared vision regarding the future positioning of European automotive sector, considering that at the moment the industry is at a "turning point": the next challenges ahead are

the digital revolution, automated and connected driving, environmental issue (such as climate goals), societal changes and growing globalization. All this generated a phase of transition throughout the automotive field and manufactures, together with all the players along the value chain, are involved (European Commission, GEAR 2030 - High level group on the competitiveness and sustainable growth of the automotive indutry in the Europen Union, 2017, p. 3) .
The development of new and advanced digital technologies and the shift towards low and zero emission mobility will determine structural changes in the automotive value chain . For that reason is crucial for SMEs assessing and redefining their position in the value chain, with the objective to integrate digital technologies, alternative powertrains and circular economy concepts in their existing products portfolio and production processes.
Considering the complexity of all these challenges and the relevance of automotive industry for the European economy, the Commission and Member States have to support and stimulate this transition.
Europe is facing to a new industrial age where areas such as robotics, artificial intelligence, energy storage, electrification and the bio-economy are key drivers of innovation. Nowadays the global value chains integrate automation industries, because traditional manufacturing processes are increasingly automated . Furthermore the pace of change is accelerating and for that reason new opportunities can rise within those sectors which adapt in time.

Based on all was explained so far there are five key challenges ahead the automotive industry in the short and mid-term period (European Commission, GEAR 2030 - High level group on the competitiveness and sustainable growth of the automotive indutry in the Europen Union, 2017, p. 8-9) :

I. **New technologies and business model** will require high investments to guarantee a correct shift towards alternative powertrains, electrification, connected and automated driving. In addition, significant investments must be directed to the manufacturing and production activities (including the greater digitalization and robotization of the manufacturing process), handling of, and access to, vehicle data , 3D printing, new communications technologies and the use of new materials.
II. **Climate goals, environmental and health challenges** have as common objective to reduce greenhouse gas emissions from vehicles, so that is necessary to move toward alternative powertrains, with zero-emission and plug-in hybrid vehicles, characterized by greater range autonomy, more efficient batteries and improved charging infrastructure.
III. **Changes in the way consumer access, purchase and use cars** and other modes of transport, exploiting the increasing connectivity of our days.
IV. **Globalization and the rise of new players,** including technology suppliers, leads to the need to ensure a fair access to the market in order to allow firms to

produce the goods, satisfying the demand coming from the international markets.

V. **Structural change,** due to the move to low and zero emission vehicles and increasingly automated driving, affect the labor market in terms of potential restructuring, acquisition of new skills, retraining etc...

These challenges are tough but in the same time they represent a long term opportunities; indeed, in the case Europe is able to overcome them, is possible to create new and sustainable jobs for European citizens, going to improve livelihoods of people and restoring consumer confidence in EU's car manufacturers.
The necessity of a resolute transition towards more sustainable technologies and new business models, accompanied by an ambitious regulatory and policy framework must be recognized by the EU automotive industry. For that reason policy makers play a crucial role in order to establish a framework that will encourage and support innovation, enable production of competitive products and secure jobs in the long-term.

1.2 The role of European Union

In the precedent paragraph we explained that a major shift of technologies and new approaches to mobility will occur in the next decade. As a consequence EU must create and support a strong market for innovative technologies and, to ensure that innovation will be generated and developed within the European area, work on the framework conditions to ease their development and commercialization. The first goal of automotive players is to preserve and defend their leading role and current position in the global market, and to reach this objective investments in innovation to create new and cutting-edge technologies are key; in this way also European competitiveness as a whole will strength. For this reason the golden rule that EU will have to follow is : *Facilitating investments and innovation.*
As we said in precedence there is the need to increase the level of private and public investment so that new technologies are developed; this can be done through specific programs and by the commitment of each State Members to create innovation hubs, startup incubators and research centers focused on studying alternative powertrains, technologies for connected and automated vehicles, advanced manufacturing processes and new materials. In the same time EU must work on new policies and regulations to support the moving toward the digitalization of the entire automotive value chain (at the level of processes, products and services). This is very important because not only the vehicles themselves, but also the manufacturing processes and the sales, distribution, aftermarket and use activities are becoming more and more digital. Obviously to concretize the migration from traditional services to digital ones significant investments are needed, particularly for SMEs. At this point, thanks a Public Private Partnership (PPP) the synergies between European Commission, Member State and industry for the development of connected and automated driving

will be strengthened (European Commission, GEAR 2030 - High level group on the competitiveness and sustainable growth of the automotive indutry in the Europen Union, 2017, p. 47-52).
Furthermore, due to the incoming necessity to use resources in efficient way on the one hand and reduce energy consumption and mitigate climate change on the other, a valuable option is represented by the circular economy, which include practices to limit raw materials costs, promoting reuse and recycling. In the specific of the automotive sector the circular economy can be put into practice by reusing and recycling the batteries of cars; this can establish a new circular value chain, creating new competitive advantages. In addition EU needs to invest in new technologies and the European Commission, through the financing in research project, should support their development, going also to find a solution for the recycling and substitution of spare parts.
Of course, to sustain these investments, a collective effort by all Europeans authorities is fundamental. First of all the European Commission, together with Member States, regional authorities and the European Investment Bank (EIB) should evaluate the existing R&D programs which have as object of the study the development of low and zero emissions technologies, connected and automated vehicles and advanced manufacturing processes. In order to have a transformation of the transportation and mobility sector in a more sustainable one is necessary a constant financing in the area of R&D, and for that reason EIB plays an important role providing these investments. Moreover EIB should be increasingly active to support innovative SMEs, helping them to mitigate the possible risks (transition risks), and representing a source of financing for the digitalization of their technologies and services. Finally, for a general improvement of the transportation sector as a whole, the construction of strategic infrastructure across the EU is vital. (European Commission, GEAR 2030 - High level group on the competitiveness and sustainable growth of the automotive indutry in the Europen Union, 2017, p. 31).
This approach could be strengthened promoting collaborations and strategic alliances, so that R&D costs will be shared among the companies and complementary assets and competencies will be exploited. Last but not least these possible alliances could also help firms to avoid bankruptcies and destruction of capital.

As we argued so far the first and more urgent priority in the automotive sector is the big shift towards decarbonization and zero emissions vehicles, which on the one hand is a huge challenge, but on the other it represents an opportunity for the entire value chain. EU has to find a strategy which permits to reduce greenhouse gas and pollutant emissions, but in the same time ensures the growth and global competitiveness of European automotive industry. Due to the complex situation, to reach a proper transition toward ZEV (zero emissions vehicles), a several number of regulatory and non-regulatory incentives set by the European authorities are required.

In practice EU has the responsibility for :

- A common regulation on CO2 emissions
- Construction of new infrastructures for refueling and recharging
- Putting in place financial incentives to stimulate demand for ZEVs
- Adopting non financial incentives and public measures to encourage the purchase and use of ZEVS
- Working on a common EU vision on which to adapt the overall policy framework, in order to support the mass production of batteries cells in Europe

To reach all these points EIB and European Commission need to cooperate to develop new financing models , aiming to generate more leverage, reducing risks and easing investments from private sector.
Instead, for the issue regarding connectivity, the responsibilities are split among Member State and EU. In fact, both the Commission and Member states should work together on a common regulation to foster investments on connectivity in vehicles and infrastructure (e.g. road and telecoms) in a sustainable way across the EU, in line also with public policy priorities, implementing 5G Action Plan and carrying on the discussions on the European Electronic Communications Code (European Commission, GEAR 2030 - High level group on the competitiveness and sustainable growth of the automotive indutry in the Europen Union, 2017, p. 36-39).

Finally the last aspect to consider is about the skills and human dimension of the work, that is a necessary requirement in order to overcome these emerging challenges. Indeed, to help the automotive sector to adapt to new technologies there is the need to:

a) Support and allow the transferability of the skills
b) Encourage new learning certification
c) Build up an apprenticeship market regarding these last technologies

In addition the specific needs of SMEs must be taken into account and , for that reason, EU has to identify and develop digital skills, retrain the workforce and assess the impact that all these structural changes may have on employment within the automotive sector. Furthermore, through cooperation between industry, training providers and national authorities, under the coordination of EU, the development of a standard job framework is possible and the final result could be an increasement of opportunities and flexibility for the work force of the automotive industry (and reach the three points listed above) (European Commission, GEAR 2030 - High level group on the competitiveness and sustainable growth of the automotive indutry in the Europen Union, 2017, p. 30-33).
To sum up, the EU has to have the ambitious to become a global standards setter, not only ease the automotive sector to overcome its future challenges, but also to regain the trust in EU rules that was lost during the diesel scandal. This can only be done

effectively through a close cooperation among the Commission, Member States and the industry, working on a common action and strategy to ensure greater global certainty, prevent long-run declines in investment, restore consumer confidence and enhance the competitiveness of the European industry.

2. THEORETICAL FRAMEWORK

In an increasingly globalized economy, foreign direct investment (FDI) by transnational corporations (TNCs) is considered a major force in the economic growth of less developed economies.
Although location decisions of automotive firms are driven by complex factors and strategies, they are ultimately tied to profit-seeking behavior. Despite the difference in strategies adopted by automotive firms, all firms need to keep production costs under control in order to be profitable. Production costs include the costs of factors of production, costs of various material and non-materials inputs in production, R&D costs, administrative costs and transportation and logistics costs. Usually it is easier for firms to lower labor costs than the costs of other factors of production and for this reason, during the years, capitalist firms have controlled labor costs through technological and organizational innovations and the location of production in areas with surplus labor and low wages. One hundred years ago, transportation costs were considered the most important driver for the location choice of industries; however, as the cost of transport declined during the past century and the mobility of capital increased through deregulation, the relative importance of labor costs as a criteria for the location behavior of firms increased. Factors like large geographic differences in labor costs, labor availability and other labor characteristics, such as labor skills, productivity, motivation, militancy, the degree of unionization and national labor legislation, affect the location behavior of firms.
Thanks free market context characterized by the absence of trade barriers and with relatively low transportation costs, differences in labor costs, corporate taxes and other costs, such as land and infrastructure, affect the spatial distribution of production in the long run.
Historically, considering the automotive sector and focusing in the specific on Europe, one of the most relevant example is Central and Easter Europe (CEE). According the paper named "*Foreign direct investment and restructuring in the automotive industry in Central and East Europe"* (Slavo Radosevic and Andrew Rozeik), CEE automotive industry, which involves countries such as Poland, Hungary, Czech Republic, Romania, Slovakia and Slovenia, is driven and totally supported by FDI. Thanks FDI the automotive sector in CEE was entirely restructured and all these huge investments have permitted to upgraded equipment and reorganized production process. This has increased the capital intensity of assembly (top automotive investors are assemblers), improved management practices and has started the process of building a local supply base. Nevertheless the most positive mechanism to ensure positive spillover in the local economies is investing in human capital (Radosevic & Rozeik, March 2005, p. 4). A good example in this respect is Renault investments in training of labor in its Dacia plants in Romania; a total of over a million hours of training have been planned and

organized for manufacturing and support functions in production, management, IT and so on .

2.1 The effects of FDI on national competitiveness

The relevance of foreign direct investment (FDI) has increased rapidly over the last decade, considered a source of economic activity. Nowadays merger and acquisitions (M&A) represents the most dynamic component of FDI. The intensification of FDI activity affects positively both origin and destination countries in terms of, for example, economic growth, productivity, wages and employment. Moreover, the expansion of multinational enterprises (MNEs) has been accompanied by the creation of complex cross-border production chains, which also has important implications. The arrival of MNEs in a country increases competition first of all, fostering in this way the necessity to improve the efficiency. Considering also that MNEs integrate domestic firms into their production processes through forward and backward linkages, this can also produce positive productivity spillovers. In addition, MNEs tend to make new technology available and provide access to new markets, improving the training and qualifications of the local workforce and increasing wages and employment. In general terms FDI has the potential to bring several benefits for the host country's competitiveness, but obviously the extent of these positive outcomes will depend partly on the host country's absorptive capacity.
An international success of a nation in a particular industry is determined by four broad national attributes, which can promote or impede the creation of competitive advantage (Gugler & Blunner, April 2007) ; these attributes are :

1. **Factor conditions :** the nation's position in factors of production such as skilled labor, infrastructures, physical resources and technologies, all necessary to successfully compete in a given industry
2. **Firm strategy, structure and rivalry:** the national conditions determine the way in which companies' business is organized and carried on, as well as the nature of domestic rivalry
3. **Related and supporting industries:** the presence or the absence in the nation of supplier industries and research and education institutions that are internationally competitive
4. **Demand conditions:** the specific type of home demand for the industry's product and services , both from the qualitative and quantitative point of view

A nation can benefit of FDIs because they bring new resources and technologies; indeed a foreign investor might import ownership specific advantages contained in his assets from his home base. At the end firms create wealth and, particularly MNEs, have an important role to shape the competitive scenario.

During the years the theory and opinions about FDI have changed. Indeed , during the 1970s, many host country governments and some scholars believed that FDI could represent a damage for the welfare and development of the local economy. However, since1990s, the arriving of foreign MNEs were perceived in positive way due to their important complementarities with local industry and thanks the access of new technologies and skills which can be a relevant stimulus for the development of the host economies. Furthermore it is argued that dealings with domestic suppliers and through the movement of skilled staff are all possible ways in which new ideas, technologies and working practices are diffused in the destination country. In this way the foreign companies introduce new know-how, transferring production techniques and management skills, stimulating the competition in the same time.
Therefore also policy-makers started to see positively MNEs, recognizing that they can improve and promote the local economic development, going to increase not only the nation's productivity directly, but also indirectly through spillovers. For that reason this process can be seen as a self-reinforcing virtuous cycle.
Following the international business theory explained in the OLI paradigm, a firm will invest abroad only if it can exploit its ownership advantage over the domestic firms, which instead have superior knowledge of local markets, consumer preferences and business practices. The MNEs' competitive assets include new products and process but also, especially for well established multinational, marketing skills and organizational advantages. A MNE is not an unique entity but it should be seen as global networks of firms, and one of the main characteristics of these networks is the creation, diffusion and commercialization of technological innovations.
In theoretical terms the potential advantages of FDI are clear, but in practical the level and extent of the benefits change a lot based on the specific case. Indeed the real impact of FDI depends mainly on two interdependent factors: the type of MNE activity and the absorptive capacity of other domestic firms.
First, the activities of the MNE needs to be considered. These are strictly related to the internal organization of the company and the strategy adopted; multi national strategies implies more autonomy for the subsidiaries, whereas in the global strategies there is a greater influence by the headquarter. In the latter case the subsidiaries have little autonomy and their activities have principally limited value added. This case is typical of resource – seeking FDI (investments made in order to have access to cheap raw , pool of labor, infrastructure …) where the overall benefit to the host country's economy is limited. Secondly the absorptive capacity of domestic firms is another issue, which allow local economy benefiting the spillover effect. Obviously MNEs do not want that their proprietary technology are diffused or having their business strategies copied so, in order to have a good absorptive capacity, the host country has to have already a minimum of technological knowhow and competence; in this way the local firms can become part of the network of the MNE. The absorptive capacity of the domestic firms depends on their technology gap. On the one hand a large gap of technological capabilities and competencies between the foreign firm and the country permits a larger potential for spillovers; however, if the gap is too large, the foreign technology can be useless and difficult to diffuse. For that reason according many

academic studies positive spillovers occurred in developed countries (Gugler & Blunner, April 2007, p. 271 - 273).
FDI is generally considered a source of modern technology, including product, process and distribution expertise, as well as management and marketing skills. Technology transfer can take place in direct way or through spillovers. In the first case foreign firms can improve the local average productivity of the host economy through capital, advanced assets and proprietary technology. Moreover MNE can transfer technology directly thanks the adoption of licenses and through supplier networks. However transaction cost can be a barrier to direct technology transfer; moreover some technologies are very firm – specific an so, as a consequence, hardly transferable. Furthermore, in order to hold control of its resources, many MNCs are not willing to share their core technologies so that they tend to keep them secret and just transfer its second-class or non-critical technologies to host countries, instead (Gugler & Brunner, April 2007, p. 273).
In the second case FDI may create also positive spillovers, exploiting different channels such as demonstration effect, increased competition and mobility of human resources.
Indeed domestic firms have the opportunity to learn superior production technologies thanks the demonstration of superior practices by foreign affiliates. The direct consequence is that domestic firms will imitate the MNEs' advanced technologies, creating an overall improvement in the local industry; for instance the construction of some high-class R&D centers from a foreign company will provide good opportunities for local businesses to learn and develop their innovation ability or experiences.
Another productivity spillover is the result of the entering into the market of foreign competitors, so that local firms are forced to innovate to tackle the increased competition level. This may lead to a rise of general productivity in the local industry. An increase of competition results in a stronger price pressure, so that domestic (and foreign) firms feel the need to differentiate their products offer. As consequence consumers from the host country can benefit of a larger variety of products at a lower price. The opening of the domestic market to foreign competitors will not only increase competition between the direct rivals of the MNEs, but also involve the competitive context of local suppliers, so that the effects explained previously spread along the whole supply chain too (Gugler & Brunner, April 2007, p. 274).
Finally an important channel for technology spillover is the employee training and turnover. Multinational companies generally give vast importance to training and staff orientation. In case these highly-skilled employees decide to leave foreign companies and enter in the local competitor firms, it is inevitable that technology transfer and extension will occur, enhancing domestic enterprises' managerial and innovative ability. Some technical knowledge, capabilities and firm know-how are not codified, but are embedded in the human resources of the company. For that reason the upgrading of human capital is a consequence of and a complement to technology transfer; indeed the availability of human capital is a necessary resource both for MNEs in order to implement and manage new technologies, both for host countries to absorb the foreign knowledge. Of course the need for skilled workers goes up when firms use

superior technology, because the development and effective use of technology requires human capital. This is the reason why a lack of skilled human resources can slow down the new technology adoption. For that reason is crucial for the companies to upgrade the human capital, and this can happen directly and indirectly : in the former case the quality of the local workforce can improve in practical terms through training courses organized by the foreign company and through learning-by doing, in the latter case positive productivity spillovers can occur in indirect way due to the movement of highly skilled staff from the foreign company to domestic firms (Gugler & Brunner, April 2007, p. 274 - 275).
In summary MNEs bring a positive impact on the host country, as they represent a source of innovative technology and they can determine an improvement of the local human capital. However, as we argued in precedence, to assess the effective impact of FDI on the host economy the type of activity undertaken and the absorptive capacity of domestic firms must be evaluated. Obviously all that has to be assessed by policy-makers, who have as objective the attraction of FDIs in order to generate maximum possible benefit for the domestic economy. The national competitiveness is affected and shaped by liberalization policies and legal investments protection guarantees, but anyway they are not sufficient. Indeed policy-makers must understand how well FDI and foreign companies' business is fitted with their economy, by asking : "What kind of investment is attracted and how can our economy enhance its competitiveness through technology transfer and the upgrading of human skills ? "
FDI-related policy should have as primary objective to attract the most value added activities; to reach this goal the local government can provide incentives to foreign firm providing incentives to firms to locate more elements of their value chain in its country. In other words FDI-related policies must become more selective and more targeted, in order to guarantee a good match between the foreign firm business and the local economy. In conclusion, instead of focusing on short-term objectives, such as the number of jobs created or the total value of the investment attracted, governments should work on policies to exploit and create synergies and combine the ownership advantages of the MNE with the competitive advantage connected to the location (following the OLI international business theory) (Gugler & Brunner, April 2007, p. 281 - 282).

2.2 FDI location determinants

Foreign direct investment is one of the most effective ways by which transition and developing countries become integrated to the global economy; that because FDI provides the host economy not only capital but also technology and new know-how which will be embedded in the local workforce (Kinoshita, July 2002, p. 2). A transition economy is characterized for the changing from a central planned economy to a market economy; this means that a series of structural transformations occur like

economic liberalization, where prices are set by market forces and not by a central planning organization, remove of trade barriers, push to privatize state-owned enterprises and resources and the creation of a financial sector aiming the movement of private capital. The most relevant examples of this type of the economy are China and central and eastern European countries (CEE) which were part of Soviet Union.
As explained in the previous paragraph the spillover effect of foreign advanced technologies is the final result of a positive interaction between FDI inflow and the hot economy. An important question for policy makers is what the host government can do to attract FDI. Trade theory argues that the location choices by investing firms are influenced by the classical factors of competitive advantages specific to the country: market size, low wages, skilled labor force, and infrastructure. Others argued that investments location choices can be explained by agglomeration economies (for example positive externalities).
Many policy makers, especially in the transition countries, are aware about the relevance that FDI have for a good transition toward a globalized economy, and for that reason is important offering various incentives to attract FDI.
Now let's focus on the theoretical framework of the location determinants of FDI.
A firm decide to invest abroad, becoming a multinational, mainly for three reasons, which are explained with the OLI paradigm; these reasons are ownership advantages, location specific advantages and internalization. Firms decide to expand their business abroad to "internalize" the benefits arising from ownership advantages and to exploit their strengths with location-specific factors. National characteristics such as market size, proximity to home market, low-cost labor and favorable tax treatment are all possible location advantages useful for the attraction of a foreign company.
Moreover FDI can be classified based on the location specific advantages that a firm wants to reach. First, market-seeking investment take place aiming is to serve an existing markets or to exploit potential new markets. For example, a company can be subjected to high exporting cost in a specific country, due to local tariffs and other forms of barriers; so that the company may decide to locate there its production in order to serve better the local market of that country. What stands out is that the main factors that drive the market-seeking FDI are obviously the market size and market growth of the host economy, but also that this type of FDI is particularly useful in serving markets characterized by particular disadvantages like tariffs and high transport costs.
Secondly, when firms invest abroad to acquire resources not available in the home country, the investment is called resource or asset-seeking. Resources may be natural resources, raw materials, or low-cost resource such as labor. In contrast with market-seeking FDI, this type of investment is not based only to serve the local market but also the home and other markets. Indeed in this case the investment is driven by the presence of key resources, cheap and skilled labor, and physical and strategic infrastructure. Third, an investment can be efficiency-seeking when the firm looks for common governance of geographically dispersed activities in order to exploit economies of scale and scope. In other words this type of investment comes into a country in order to benefit from factors which allow company to compete in international markets.

There are also other factors that could affect the location choice of investment in a specific destination country, like for instance the favorable macroeconomic conditions. In this case, what a foreign firm analyzes is the economic situation of the host country, which can be evaluated through the stability of the prices, the level of public debt and the sustainability of the deficit. Instead, other non-economic factors, which reflect better the political condition of the country, are the degree of corruption, legal enforcement, and administrative efficiency; all these indicators must be evaluated because they can facilitate the business operating context (Ease of Doing Business index).
In this way a company can identify the set of economic, political and institutional variables to study as determinants for the location choice of the investment (kinoshita, July 2002, p. 3 - 5).
Another characteristic of FDI is that they are typically spatially clustered; this means that there is an agglomeration of FDI which can be explained just in part from the factors described in precedence. Indeed, sometimes, agglomeration is generated by the tendency of investors to follow the others behavior; this happens very often when the available information about the host country conditions are scarce, so that an indicator to assess the goodness of a location is the number of foreign investment made by other firms. In this case we are talking about the agglomeration economies, which are generated when a company collocate its business near others competitors in order to exploit positive externalities such as knowledge spillovers, specialized labor markets and supplier network (Kinoshita, July 2002, p. 5).

Considering that profitability is affected by several country specific factors, investors choose a location according to the expected profitability associated with it. For example, market-seeking investors will be attracted to a country where a large local and/or fast growing market is present. In contrast resource-seeking investors will look for a country with abundant natural resources, while efficiency-seeking investors will give more importance to the geographical proximity to the home country aiming to minimize the transportation cost. Thus, the location of FDI is closely linked to the competitive advantages that a firm can achieve in a specific country, which in turns affect the expected profitability of investment.
The classic sources of competitive advantages are input prices, market size, growth of the market, and relative abundance of natural resources. For market-seeking FDI, the determining factor is the size of the host country market, which is measured by GDP per capita.
Another crucial issue is the availability of cheap labor which often drives the choice of the company to locate some of its production plants in countries where the cost of labor is favorable. In this case the typic measure adopted is the nominal wage rate , used as an approximation for labor cost. It is important to notice that nominal wage is not adjusted for inflation, so it doesn't reflect the real purchasing power that a wage provides to a person in a specific country.

However investing firms should be focused not only on the labor cost but also on the quality of workforce. Indeed a skilled labor force usually can learn and adopt new technology faster and, as a consequence, the cost of training local workers is lower.
Another factor which play a key role for the FDI location choice is the presence of natural resources (for instance those countries rich of oil and natural gas), following the logic of resource-seeking approach.
Basically the proximity to the home country of the investing firm is an important factor because it allows a higher volume of trade flows between the origin and the host country. The analogous argument may apply for FDI, because investments flows are closely related to trade flows. In brief if goods are produced abroad but are sold in the home or to the third country markets, then the closer the production site is to the home or the third country, the more efficient it is for MNCs.
In addition availability of good infrastructure is a necessary condition for the investing firm to carry on business locally. Some infrastructure variables are the percentage of paved roads in the country and the number of telephone lines. Obviously the factors used to assess the level of infrastructure in a country are strictly related to the specific industry. For example, considering automotive industry, road quality, number of parking spaces, electric car charging stations and petrol stations can be indicative. Nevertheless the presence of infrastructure like highways and railway network play a key role regardless the company core business (Kinoshita, July 2002, p. 5 - 7).
Especially in emerging markets investment decisions are driven by factors connected to economic and political risks. A host government which put in place important economic reforms is a good signal for investors because a stable macroeconomic context declines the risk of an investment. To assess the performance of the local macroeconomic policies the price stability is the primary indicator to see. For example, a history of low inflation and manageable fiscal deficits gives investors an indication about the credibility and reliability of the government. In fact, as the countries proceeded with structural reforms and stabilization policies, the price level also slow down. The sustainability of moderate or low inflation tells investors how successful the host government is and thus the prospect of further growth. Thus, the lower the average inflation rate is in the host country, the more foreign investment will be attracted to the country.
Removal of trade barriers, decrease tariff rates and regulation on foreign exchange rate are all measures linked to liberalization process. More the State is liberalized more the foreign investment flows inside the country. Nevertheless under some circumstances the more restrictive external regime may also induce FDI, because higher taxation means also an higher protection for the entrance of new potential competitors.
The returns to investment is affected also by non-economic factors. The cost of investment groups together not only the actual costs of inputs but also non-economic costs such as level of corruption and bureaucracy (quantified in time lost in dealing with local authorities). To assess business operation conditions of the host country MNC tend to study two variables : “Rule of laws” and “Quality of bureaucracy”.
The former variable consists in three indicators:

I. A strong court system (reflected by length time of justice)
II. The fairness of the juridical system over property right
III. Substance of the law itself

The latter variable is based on two indicators instead :

I. The autonomy of national bureaucracy from political pressures
II. The ease of regulations connected to license requirements and labor, environmental, consumer safety and worker health

Finally agglomeration economies are another factor to consider. These type of economies occur when there are some positive externalities such as knowledge spillovers, a specialized labor markets and a consistent network of potential suppliers (Kinoshita, July 2002, p. 7 - 8).

2.2.1 Tax effect on FDI

We have explained so far that all governments are determined to attract FDI; the results can be the generation of new jobs, adoption of new technologies and more in general the growth and employment of the country. Consequently the resulting net increase in domestic income is shared with government through taxation of wages and profits of foreign-owned companies.
Given these potential benefits, policy makers continually re-examine their tax rules to ensure they are attractive to inbound investment. Moreover tax policies may also support direct investment abroad, as outbound investment may provide efficient access to foreign markets and production scale economies, leading to increase the net domestic income. At the same time, governments have to balance constantly the intention to create a competitive tax environment for FDI, with the need to ensure that an appropriate share of domestic tax is collected from multinationals (Tax effects on Foreign Direct Investment, February 2008, p. 1).
Surely tax is an important factor involved in the decision process on where to invest, but it is not the main determinant (see the other factors listed in precedence), so policy makers continuously wonder how sensitive is FDI on taxation.
In today's global environment investors, as policy makers do, routinely compare tax burdens in different locations. These comparisons generally are made across countries that are similar in terms of location and market size. However a tax reduction is not always enough (or required) to attract FDI. In fact it is necessary the match with a well-developed infrastructure, public services and other host country attributes which are attractive to business, including market size. Tax competition from relatively low-

tax countries not offering similar advantages may not seriously affect location choice while a number of countries with relatively high tax rates are very successful in attracting FDI. What stands out is that a low tax burden cannot be the only indicator to be taken into account . Indeed tax is only one element and cannot compensate for poor infrastructure, limited access to markets, or other weak investment conditions that make the environment unattractive for FDI. Furthermore the importance of other taxes, and not only corporate income tax, has to be recognized. Energy taxes, payroll taxes and non-profit-related business taxes are increasingly under the spotlight by investors and policy makers (Tax effects on Foreign Direct Investment, Febraury 2008, p. 2 - 4). Another factor is how business-friendly the tax administration is perceived to be. Investors look for certainty, predictability, consistency and timeliness in the application of tax rules, and in many cases these considerations are as important as the effective tax rate paid.

Typically governments respond to these competitive pressures reducing the corporate income tax rate. However this reductions tend to be expensive and it may be seen unfair from the public opinion and create pressures to reduce personal income tax rates as well. Rather than reducing the weight of general taxes, some countries prefer to explicitly apply tax relief in certain sectors or activities, to encourage investment in those areas.

Governments are trying to improve the business friendliness of their tax administration by improving the transparency and certainty of tax treatment. Many countries have introduced advance ruling procedures where tax authorities will respond in advance to questions about the tax status of a particular type of investment. In addition tax treaties and mutual agreement are also considered key procedures for the certainty and stability of the treatment during a cross-border investment process. Finally increased vigilance by countries may also be exercised to limit artificial shifting of tax base to no/low tax havens, to avoid imbalances in the global tax system (Tax effects on Foreign Direct Investments, Febraury 2008, p. 6 - 7).

Studies examining cross-border flows suggest that on average, FDI decreases by 3.7% as a result of 1% point increase in the tax rate on FDI, but it’s also true that the range of estimates is very wide depending on differences between the industries and countries being examined, or the time periods analyzed . However as we discussed in precedence low tax rate alone can’t compensate the lack of a profitable business environment in the host country. In fact host country benefits permit that profits can be taxed up to some point without discouraging investment, and this is confirmed by the observation that a number of OECD economies whit large domestic output markets and strong FDI inflows (US, Japan and Germany) have in the same time relatively high

corporate tax rates (Tax effects on Foreign Direct Investments, Febraury 2008, p. 2 - 3).

2.3 Knowledge seeking of FDI

As we explained in precedence firms may decide to expand abroad for different reasons such as exploiting low cost conditions, decrease or avoid corporate taxes, market purposes and exploiting agglomeration economies by following competitors. Recently, another prominent motive has emerged; instead of utilizing capabilities already on hand, firms may decide to expand abroad in search of capabilities that are not available in their home markets. This motive has been termed "technology seeking" or "knowledge seeking".
An important question which is fundamental to understand is what types of firms are more likely to invest abroad to acquire technology. Usually knowledge seeking occurs among technical laggards, which are companies that want to reduce their gap by investing abroad to acquire the needed technology and competencies, but this is not always the case. In fact also firms which are leader in a sector may decide to go in a foreign market which has leading technical centers in order to increase and differentiate their current capabilities.
For these reasons understanding knowledge seeking investment strategies and the motivations that drive them is critical for managers and policy makers too. Indeed managers should improve their existing safeguard protocols to protect better the company proprietary knowledge in the scenario that foreign firms want to acquire local technology. Inward FDI is beneficial for a country because increases competition and productivity but, in the same time, can represents also a threat; the case is when many foreign firms enter aiming to seek new knowledge, so that the nation's technological uniqueness can be quickly replicated . For this reason a possible action implemented by policy makers can be to reconsider forming certain alliances or give incentives to retain key employees.
In general, considering FDI based on knowledge seeking, firms are attracted by countries which offer more technical activity, where there are many scientist and researchers and where there is an high intensity of patents generation. Moreover firm traits and the specific industry within it operates is another factor to consider; usually knowledge seeking can be a proper motivation for an investment if the firm is in an R&D intensive industry like pharmaceuticals, electronics and automotive one (Chung & Alcàcer , December 2002, p. 1535).

We have seen in the previous paragraphs that the most recognized reason for firms to conduct FDI is that they have unique capabilities that can be implemented abroad, taking advantage from the favorable host country environment. Indeed firms obtain the highest value when they are able to expand their business abroad, keeping in the same

time their useful capabilities internal. An opposite logic which justifies FDI knowledge/technology seeking FDI is that, instead of utilizing capabilities already on hand, firms may decide to expand abroad in search of innovative knowledge and skills. Technology differs across locations because it depends on location–specific factors, such as innovations previously established, the education system, and the linkages between educational institutions and firms (Chung & Alcàcer, December 2002, p. 1536). For this reason firms may supplement their existing technologies by investing in innovative countries to access new and complementary knowledge.

There are a type of knowledge which is partially tacit so, in order to exploit it, physical proximity is needed because transfer requires frequent interaction.

The most important example of knowledge seeking investment comes from the internationalization of R&D activities in countries rich of research centers; however firms may also seek technology used for manufacturing operations. In this case investments aim to develop new skills and to generate new technological capacity ready to be exploited in new plants and equipment.

As described in precedence is important to differentiate between investing firms coming from leading versus lagging technological countries. In the latter case firms from lagging technical locations decide to invest abroad for the construction of new labs aiming to improve their existing technology. In contrast, although firms from leading locations have already advanced technology, they still may locate labs abroad to collect different types of knowledge and improve their diversity level. For that reason knowledge seeking investments might also take place in conditions where differences in R&D between the origin and the destination country are small.

In general terms knowledge-seeking firms tend to locate close to sources of knowledge; now considering that knowledge is tacit it is embedded with engineers in local labor markets. This means that the sources of knowledge can be identified from data showing the mobility of engineers for example. (Chung & Alcàcer, December 2002, p. 1536 - 1537).

Definitely the location choice of the investing firms is based on the maximization of the utility gained. Because, as we have argued so far, firms can expand abroad for several reasons, this utility depends on different parameters, but they don't have the same value for all firms indistinctly but are connected to the specific industry. Clearly, the presence of technical activity, market size, market access, and low cost factors are not going to be equally attractive. To account for this heterogeneity in the evaluation of location attributes, it is important to take into account firm traits, which will strongly affect the value and the weight of categories in the utility function.

An important characteristic associated to the firm trait is the technical capabilities of its home country industry, which can be leading or lagging technically. The firms' technical capabilities tends to be similar to the one of their home country industry, due to the fact that knowledge is localized; in conclusion firms do not deviate so much from their origin country knowledge. As consequence a firm originating from a country industry with leading technical knowledge may have such unique capabilities, while a firm originating from a country-industry with lagging technical knowledge is likely to be less advanced. Obviously this does not means that firms coming from less

technically capable country-industries cannot have unique capabilities. As result firms from country-industries that are technical laggards are more likely to invest abroad seeking new knowledge, and in this case the favorite locations are the ones where R&D level is significant. "This is not to say that firms from leading technical country-industries will never knowledge seek abroad, but on average firms from lagging country-industries are more likely to do so" (Chung & Alcàcer, December 2002, p. 1537).

A second important trait will be the overall knowledge intensity of an industry. Knowledge seeking is not always a crucial business element; indeed in some industries advanced technology is not necessary and the technical knowledge account just for a small part in the value added process. In this case a technological lag is not so much a problematic issue for the company. In contrast, there are other industries where knowledge is crucial and where the competition is completely based on the last cutting-edge technology, in order to compete on quality, services and other technical dimensions. Under these conditions, not only laggards, but all participants will need to be aware of competitors' technical activities. In conclusion also firms coming from leading technical centers and which are technical leaders have the necessity to invest abroad in other leading technical centers in order to increase their knowledge diversity and preserve their competitive position. To sum up we expect that "firms in certain industries, where technical progress is critical, will be attracted to locations of greater technical activity, regardless of their current technical capabilities" (Chung & Alcàcer, December 2002, p. 1537 - 1538).
In order to give some practical example about what we have described so far we can quote the paper of Wilbur Chung and Juan Alcácer, in which they study the knowledge seeking and location choice of FDI in the United States. In details they analyzed how 1784 inward FDI transactions locate among the American States; they conducted a state-level analysis considering that some data like tax rates, labor laws, and other traits are different from one state to another. To quantify the innovation level of a State they used as indicator R&D intensity, number of doctorates in science and engineering field and patents awarded residents. Moreover they didn't study only state characteristics but also firm traits which determine where inward FDI locate within USA.
First of all, as was easily expected, the final results confirm that States with greater market size, lower factor costs, and better access to surrounding States attract more FDI. Nevertheless their analysis gave also new outcomes that contribute to understand how knowledge seeking affect FDI. Contrary to expectations State R&D intensity and the number of patents generated for each State residents affect negatively the inward FDI, suggesting that knowledge seeking is not prevalent across industries. However this phenomenon can be explained by firm traits; indeed results show that the majority of knowledge seeking investments are referred to those industries in which R&D is an important element, such as pharmaceuticals, semiconductors, and electronics. Furthermore they discovered that knowledge intensive industries seek knowledge not only in laboratories and research centers but also in manufacturing plants; this is confirmed by the fact that many patents bought by foreign firms are for operational

processes and machinery. Another important finding underlined from this paper is that knowledge seeking occurs not only among technical laggards, but also among technically leading firms (as we described in precedence). Indeed corporations belong to pharmaceutical industry are likely to invest in other State with an high R&D intensity, despite they come from technically leading location, considering the pronounced technical competition which characterizes this specific sector.

2.4 The importance of government in the innovation context

Innovation is certainly one of the key factors that are responsible for the success of a company, and for this reason the attention that managers pay to it is quite high. At a broader level what is argued by many economists is that economic growth and innovation are strictly correlated; in fact GDP growth can be explained by an improvement of production factors, but what also matter is productivity growth (the economic value created by the same units of production factors), and progress in knowledge and technology is responsible for this. Therefore policy makers are aware of the important role of innovation and for this reason they work to find ways to foster it in the countries and regions they are called to administrate.
In general terms the role of government and all its public institutions is to promote competition and international trade, facilitate business and do not have a claim to direct or co-manage it and place incentives for long term value creation against short term opportunistic behavior.
Innovation process is not only quite lengthy, but also highly risky, especially in its earlier phases, which are the basic and applied research. These phases are riskier and they don't provide economic return, so it's quite obvious that private sector cannot be the only one type of actor involved in the context of innovation.
As a consequence the public sector, through funding in research (direct financing in universities, research center and also companies), has a key role because it brings the knowledge generated in the public domain, allowing companies to freely use the results for the purpose of inventing and innovating (Istituto di ricerca sull'impresa e lo sviluppo, La politica per l'innovazione nell'Unione Europea, December 2010, p. 6). In contrast, if the research were funded exclusively by private sector, firms would make very strong attempt to keep the knowledge generated confidential, slowing down the whole innovation process.
If the government act directly in the research phase, the same cannot be said for the product development (competitive) phase, which remain a private sector issue. Indeed direct government financing is not possible in this step, because it would lead to a distortion of competition (both within the country and at the level of international

trade). Anyway the government can act indirectly in the market in many ways, promoting the innovation environment and attracting foreign direct investments (Cantamessa & Montagna, August 2015, p. 8 - 10).

- **Regulators at large :** In general government can build an economic and institutional environment that support innovation. Taxation, labor, bankruptcy laws and access to justice have an impact to all firms operating in the market, but especially are crucial for the companies which invest in innovation. In addition demand for the products and the services offered by innovative firms is pushed up thanks a dynamic and highly competitive economy . Finally government can provide infrastructure, like highways and telecommunication network, that decrease the cost and increase the effectiveness of business activities, making easier for private firms to invest in innovative projects
- **Specific infrastructure :** The diffusion innovative new products is based on infrastructure that is complementary and specific for it. The government may consider the infrastructure as a public good, and so decide to invest resources for its development (for instance the charging columns for the electric cars). A possible drawback is that this action would favor some firms at the expenses of other ones and force the adoption of a technology which is not the best one, distorting the competition (a government funding plan for a network of recharging stations for electric cars may stop the diffusion of hydrogen-powered vehicles)
- **Regulators with respect to standard :** Government can dictate to industry the required characteristics that the products must have, in order to improve the social welfare. The presence of a standard can speed up the diffusion of an innovative technology, enabling the formation of positive network externalities, guaranteeing the complementary with other goods and exploiting the economies of scales. Considering that the spontaneous agreement by industry players on a common standard is very difficult to reach and that an eventually standard war could create a damage to the whole market since it would slow down the diffusion of an innovative technology and lead to a monopoly condition for the winning company, standards may be imposed by the government (de iure). In this way public authorities set the standards, usually through a technical cooperation with the industry, and finds a way to block the diffusion of the product until the standard is clearly defined
- **Customers :** In some countries there are policies, generally called Public Technology Procurement (PTP), with which a part of public financial resources are reserved for the purchasing of innovative goods and services. Besides providing citizen with better public services, this create also a strong demand-side incentive to innovate. In fact the government can easily generate a sufficiently large demand in order to encourage firms to develop innovative products and attracting investments in the market.

2.5 Innovation strategies

In precedence we analyzed that sometimes firms may decide to expand abroad, making investments knowledge/technology seeking, in order to develop new capabilities which are not present within the company and access technology available in other countries.
When the firm identifies the desired competencies, is fundamental to draw an appropriate strategy in order to develop and retain them. In general firms, in order to take a proper decision, has to evaluate two aspects that must be balanced : the time required to develop the innovative technology and the economic appropriability of the economic benefit (if the economic benefit referred to that innovative technology is shared or not with other parties).

2.5.1 Internal R&D

The traditional and most typical way to gain a specific capability was to develop it internally by allocating human, material, and financial resources in research projects.
In general terms R&D expenditure is used to measure the will and the commitment of a company or an economy to improve its knowledge base. In fact the ratio between R&D expenditure and the sales and the ratio between R&D expenditure and the GDP are both used as indicators to quantify respectively the level of innovation of a company and a nation.
Thanks internal R&D a firm can exploit innovative technologies and products and gain competitive advantages. Nevertheless R&D projects are able to generate positive results only if projects are supported by a constant financing; for this reason highly indebted firms are reluctant to follow this strategy.
The main advantage of internal R&D is the high level of appropriability of the competences generated, but to ensure it is crucial to retain the personnel involved in R&D activities. For this reason incentives, financial rewards and career opportunities are very relevant to avoid the high and constant risk to loose personnel who can join to a competitor or start their own business. In addition to this, the main drawback of this strategy is the slow implementation; indeed for the success of internal R&D what really matter is to have an healthy financial situation, in order to ensure a constant and continuous investment over time .
Finally the internal R&D can be centralized or decentralized.
The main benefit of centralized R&D concerns the economies of scale, making a better use of costly resources and creating stronger link with the scientific community. Moreover centralized R&D permits sharing of results among all the business units of the company, avoiding duplication of effort. Last but not least in this case strategic roadmap and budget is decide by top management (top down approach), ensuring in

this way a better financial stability, a longer-term time horizon, and an alignment of all departments with the central corporate strategy.
In contrast a possible disadvantage is the lost of connection with BUs needs and their specific market characteristics.
At the opposite, decentralized R&D permits to be closer to the market needs and development activities, but as drawbacks financing is less stable, there is a short term prospective, risk of duplication of and an undefined career for employees involved in the projects (Cantamessa & Montagna, August 2015, p. 140 - 146).

2.5.2 Acquisition

Acquisitions are not a rare along a corporate history and they can occur for different reasons, like when for example a company wants to access to a new market or to collect the customer portfolio of the acquired firm, secure physical assets (for example plants and machinery), or obtain desired competencies. This latter motivation describes the case of a technology acquisition.
Acquiring an existing firm represents a very quick way for an innovation-oriented firm to obtain desired capabilities, guaranteeing in the same time a high degree of appropriability. In general, acquisitions can create value in cases the acquiring and the target firm have similar knowledge assets (pursue incremental innovation), different (pursue radical innovation) or complementary ones.

Acquisition is a complex process, characterized by high transaction cost :

- Scout cost to find out target firms which might have the desired competencies
- Due diligence cost to quantify the true value of the target firm
- Integration cost to join together the two companies (buyer and acquired firm) in a single one

The integration process is the most critical aspect but is fundamental to allow acquiring company to exploit competences and knowledge of target firm. Sometimes the integration process can fail if “resource retention” strategy is not correctly organized and put in place and key employees of the acquired firm may decide to leave. Furthermore the target firm can take advantage of the popularity of the acquisition as a way to gain competencies and technological assets quickly to raise the valuation at which the transaction occur (trying to create also an auction with competitors of the acquiring company).
In summary acquisitions are a powerful, fast , but somewhat risky way to gain access to desired competencies, requiring a well defined strategy which has to be executed correctly and profitably to have a proper integration of the acquired firm (Cantamessa & Montagna, August 2015, p. 146 - 149).

2.5.3 Hiring human resources

A firm that need specific competencies in a given area may decide to hire new employees who have that knowledge, or fresh graduates with a relevant academic curriculum, or also professionals who already have some previous work experience in the field and developed the required know-how procedures during their career. The hiring process includes the following step: searching for candidates, interviewing them and negotiating employment contracts. Moreover, as we explained in the case of acquiring firm where a complex integration process of the target company had to be implemented, also for the hiring of human resources the company must conduct multiple and small integration processes to fully exploit the knowledge of each one of the new employees. The main difference compared the acquisition strategy is that, while an acquired firm generally can continue its operations during the integration process, the productivity of new hires is usually low, until their integration is totally completed.
The price linked to the hire of a new human resource depends on the particular competencies that company is looking for in the candidates; in the case of emerging competencies the scarcity of experts in the market will force the firm to pay higher salaries the new hired people.
In any case the hiring process is always quite risky, since practically it is difficult for a company to assess the true value of a candidate, considering also that a person may have been an excellent performer in a previous firm but the same value will not necessarily be replaced when joining in a new firm, due to a new working context characterized by different working routines and corporate culture (Cantamessa & Montagna, August 2015, p. 150 - 151).

2.5.4 Non equity strategic alliances

Another methods to obtain access to new and innovative competencies is creating links with external entities, choosing to renounce to a part of the appropriability of the related economic value. The basic way to implement this action is to create a strategic alliance with another firm, agreeing on a joint program of activities, where research and product development are included. Alliances can create value in the circumstances that the two firms have complementary competencies, in order to reach together common standards and develop economies of scales.
Successful alliances are based on the exploitation of existing knowledge assets and exploring their potential synergies.
When we use the term “non-equity alliances” we are considering those relationships which are based on a contract that does not imply the exchange of shareholdings and/or the starting of a joint venture. Indeed in this case firm are bound together by a contractual link but not by an institutional one; in details the governance of the two companies remain separated and the value of the final outcome coming from the

alliance will depend on how detailed the contract is for the specification and direction of actions of each part involved.
Unfortunately, contracts can be incomplete and difficult to enforce in front of a court, and this can lead to opportunistic behavior by both parties, resulting in poor results at the end. For instance a company may decide not to allocate their strategic resources on the common project, or in other cases top management fail to motivate middle manager and employees involved in the alliances. Finally, in the case of usage of intellectual property assets, a company can be reluctant to share them with the allied firm (Cantamessa & Montagna, August 2015, p. 151 - 152).

2.5.5 Joint venture

Joint ventures, called also equity based alliances, have similar objectives of non-equity alliances, but this time are based on an institutional relationship between the involved players. In this case a completely new and independent business entity is created, and this generate less ambiguity. Now, due to the co-ownership of the joint venture, the parts involved are more committed and have an higher incentive to pursue the success of the common project. Moreover, in case issues about the parties' duties arise, the governance structure of the joint venture can become an important mediator, trying to solve disputes before taking a legal action (which is money and time spending).
However these advantages risk not to be achieved if the partnering companies are very different in size, so that the bigger one tend to have an intrusive behavior influencing the joint venture's governance (which must be independent).
Besides this there are some drawbacks. First of all at the end of the joint venture process a new legal entity is born and the cost to establish and maintain it are relevant, considering it is required a separate accounting, a board of directors and dedicated management. Furthermore, from the organizational perspective, the employees that are assigned to the joint venture or are directly hired by it are no longer members of the parent organizations; this means that transfer of information from the participating firms to the joint venture and vice versa is a very tricky operation and the sharing of the knowledge generated can be difficult. As a consequence, the joint venture risk to lose access to potentially valuable competencies that reside in its parent companies, while to the same way it will not be easy for the parent companies to exploit competencies generated by the joint venture (Cantamessa & Montagna, August 2015, p. 152 - 153).

2.5.6 Co-development

Co-development occurs when a company, in order to develop some particular components, require highly specific competencies which are not present in-house, and therefore it has to ask supplier.

A basic solution to this problem is to ask supplier to make an investment in R&D, and then to pay him a price based on the expected volume required, variable production cost and the initial investment, plus obviously an acceptable contribution margin. This is called co-development *revenue sharing*. Nevertheless it is possible that this solution can be rejected by supplier, since multiple risks are under his responsibilities. Precisely the main sources of uncertainty are technological risk and the market risk; it is the latter case the most critical one, because sales volume of the final product may be less than the amount forecasted at the beginning, so that also the volume of components required are wrongly estimated. The supplier has no control on the final product volume demanded by the market and he hasn't information to assess if the estimated amount is reasonable or is an optimistic forecast.
Since the new competencies are specific for a determined component asked by the customer and cannot be used to supply other firms, the initial investment is a sunk cost for the supplier. In this way the customer company is incentivized to wait as much possible, and when the project is completed and the actual demand of the final product defined, renegotiate the terms of the contract and asking supplier to decrease the price of its components in case of an overestimation of the quantity; at this point the only alternatives of supplier is to accept or to go to court (which is a time spending action with the added risk to lose forever an important client).
To solve this situation a possible approach is co-development *investment sharing.* In this way the customer will finance the initial investment in R&D, so that the supplier bears no more risk. Typically this agreement allow customer to gain exclusive licensing rights on the competencies generated and any other intellectual property developed during the project it has financed. As consequence, under this agreement, the supplier is prevented to use these competencies to serve the customer competitors. Obviously in this case the customer has to monitor the supplier, in order to verify that the financing is used exclusively for the commissioned project. The principle drawback of this strategy is that the appropriability of the competencies is weak, because at the end the supplier is the effective owner and, in case the exclusivity clauses of the contract are not written properly and are difficult to enforce ahead a court, he will have higher bargaining power.
For this reason is more convenient for the customer opting for the co-development *innovation sharing*, where also part of R&D supplier work is shared. In this way the customer monitoring action is stronger and the exclusivity of competencies and intellectual properties generated is easier to manage (Cantamessa & Montagna, August 2015, p. 153 - 155).

2.5.7 Open innovation

A company that decide to follow an open innovation strategy develops innovative competencies by looking outside the boundaries of the firm, and outsourcing R&D. This approach requires adequate business intelligence tools to look for external entities

able to develop these new capabilities and innovative technologies useful for the particular situation of the firm.
There are several possible candidate entities which can be considered by the firm:

- **Competitors' R&D units :** Competitors can decide to accept an offer to cooperate on specific projects for different reason; one of these is to gain profit from free capacity and/or to have returns from competencies they have developed. However a competitor can accept to provide technical results for another firm, but obviously it will be reluctant to transfer its competencies and know-how methodologies
- **For profit R&D firms :** The core business of this type of firms is to perform R&D activities for other companies. In the R&D firm works for too customer companies the exclusivity of determined competences and knowledge will be more problematic and there will be also more limits to deliver contractually specified results
- **Universities and non profit R&D centers :** Academic entities are the most important knowledge-generating source in the innovation process, especially regarding the basic research; hence they are the most interesting candidates to be chosen by firms which decided to follow open innovation strategy. Thanks this process, generally called *technology transfer*, is possible for universities to cooperate with the industry (going licensing intellectual properties), operating on contract-based researches and use public research funding to carry on projects jointly with firms. Cooperation with universities can be an attractive option for corporations because academic organizations are not used to preserve their proprietary know-how and competences. In fact in case a contract-based research generate a patent, the firm that financed the project will obtain the ownership (or at least exclusive licensing rights). Moreover the company can transfer tacit knowledge hiring junior academic staff, as Ph.D. students that have been involved in the research project.
  Anyway there are also some drawbacks. First of all corporate problems tend to have a multidisciplinary nature, and so are difficult to be tackled by university that is organized in fragmented departments. Secondly academic research used to disseminate the knowledge they generate through publishing, while the company wants to keep all the results confidential. This situation may be solved by cooperation contracts, which specify that before of submission of any publishing about the research findings, the firm signature is necessary.
- **Small firms and individual inventors :** Many inventions and technologies are developed by small firms which are not able and/or don't have enough resources to fully exploit them and capture their value. The same is true for individuals who can boast specific competencies or inventions but are not in the position to create business around them for a lack of financing. For that reason a firm may decide to cooperate with the inventor of a technology of interest, because it is cheaper rather than trying to replicate the exact invention.

Open innovation is a very attractive concept, allowing the company to exploit unlimited richness of talent presents outside its borders.
Finally, within the context of Open Innovation, firms can decide to license other firms' intellectual property firstly, in order to penetrate in the technological area of their interest, and later starting developing own competencies around it (Cantamessa & Montagna, August 2015, p. 155 - 159).

2.6 Innovation in the automotive sector

As described in the last paragraph open innovation is based on searching for ideas and knowledge from external players, and then bring and integrate these new competencies into the firm, trying to build on them an innovation process. The process of opening knowledge boundaries could be particularly challenging for firms that operate in mature and asset-intensive industries like automotive and that have been shown to be more rigid in changing their internal operational processes (Wilhelm & Dolfsma, 2018, p. 3 - 4).
In the last years automotive industry faced on many relevant changes such as the way in which the production is organized among firms and their suppliers and the distribution of manufacturing plants and facilities around the world. The high dispersion of production activities is due to the increase of technological complexity of the automotive products that forced many car makers outsourcing manufacturing and service activities toward their suppliers. Furthermore, globalization opened new potential markets in developing countries and ICT (Information and Communication Technology) revolution allowed to unbundle production processes globally.
To support the technological advancement of the final product (the car) required by the market, a very deep functional reorganization of the whole automotive sector is necessary, and for this reason carmakers started to focus their effort just on activities which generate the higher value added (such as design, engineering, R&D, sale and after-sale services).
Nowadays consumers are demanding vehicles increasingly complex and with higher technology components' systems, so that many car makers needed to outsource many tasks. As a consequence, established suppliers of automotive systems have been involved not only into the production processes, but they started to play an active role also in the innovative activities. This resulted a hierarchical reorganization of the labor among firms, considering that suppliers are no longer just components providers but they have become the main responsible for the development of innovative and cutting-edge technologies (Cullino, Fabrizi, Linarello, & Orame, 2012, p. 3).
The automotive supply chain is structured in hierarchical levels: at the top of the hierarchy there are the tier-1 suppliers, who are involved in the large scale processes. They are very important for the automotive car makers' business because they make

huge investments into R&D in order to deliver the best advanced technology. Moreover they coordinate the smaller suppliers of single components. The smaller suppliers can be divided into different levels (tier-2, tier-3, etc.) based on the decreasing complexity of their products. As is possible to notice systems and components' suppliers are key players for the technology development of the final vehicle, so that they are becoming years by years central actors for the innovation process within the automotive sector.
Automotive innovation is characterized by a large range of potential application due to the complexity of its products architecture, which join together knowledge from several scientific disciplines and fields such as chemistry (e.g. batteries), materials science (e.g. lightweight materials), and consumer electronics (e.g. infotainment); obviously it is very difficult and expensive for traditional carmakers to "go deep" across all these technologies, even because they do not have all the required capabilities . The pressure to innovate and integrate new functionalities in the vehicle forced carmakers to find innovation outside the traditional firm and supply chain boundaries, enlarging their established network in order to obtain new competencies. For that reason nowadays carmakers are no longer just interested to sign alliances with traditional automotive systems or parts suppliers, which are already well integrated in their network, but also go into business with other external actors such as private inventors, research institutes, engineering firms and other service providers, aiming to obtain from them new knowledge and useful capabilities for innovations (Wilhem & Dolfsma, 2018, p. 4).
Historically automotive industry has always been a scale-intensive sector where innovative technologies were developed in R&D departments of a few large and well established firms. Nowadays consumers are more concern on environmental issue, and for that reason they are demanding for lighter and fuel-efficient cars to decline the level of pollutants in the air. At the same time, due to the digital revolution, more active and passive safety features, driving assistance and infotainment equipment are required by the market; however financing and developing all these innovations internally has become less feasible for the automotive companies, regardless their size. As a result, the prevailing mindset in the automotive industry is changing, and all the major firms in the sector started to realize that not all ideas and innovative technologies can be generated by their own capacities. In order to reacted to these trends carmakers have decided to consolidate collaboration with their first tier suppliers, aiming to develop new products and technologies. For that reason the importance of automotive suppliers in the product development process is expected to go up, and indeed more and more activities are either fully or partially carried out by established first tier suppliers such as Denso, Bosch and Valeo.
Suppliers, playing a critical role in electric vehicle development and assembly, since special capabilities are required, are considered the main source of product and process innovation for the environmental improvement of the cars. Nevertheless, especially

regarding fields that lie outside traditional technological domains, the integration of suppliers in new product development could be particularly critical.
Indeed, while the automotive industry has a great experience and tradition in dealing with automotive parts suppliers, integrating other external actors outside the industry is at a very nascent stage. This might be problematic in the long run because functional innovation requires the integration of knowledge from distant disciplines that traditional automotive suppliers do not offer, and that can be found only outside the traditional boundaries of the industry. Knowledge about psychophysiology (e.g. monitoring driver's fatigue) or specific information technology applications are just some example of possible disruptive innovation applications. However integrating outside-industry knowledge shows some drawbacks; for example knowledge from universities was often considered far from the market. Furthermore problems of sharing outside innovation inside the automotive industry can raise especially when there is a lack of common knowledge to assess a specific technology. "More distant and novel the knowledge is, more these problems will be acute" (Wilhelm & Dolfsma, 2018, p. 5 - 7).
Despite the complexity of the integration process described so far, more and more firms try to collect knowledge belongs to industries different from the automotive one; nevertheless open innovation must not be interpreted as the disappearance of the boundaries between an organization and its environment.
In the last years the automotive industry has shown an increase of product development outsourcing and a shift of knowledge from carmakers to suppliers. The integration of external sources of innovation has become a problem that more and more firms need to address; in this respect product modularity has received much attention and has been credited of many advantages as a tool to ease integration of external sources of innovation. Standard interfaces is one of the constitutive elements of modularity and it is a means to facilitate design outsourcing. Thanks modularity firms can easily de-couple both the design and the manufacturing of the components that constitute a product; moreover it facilitates the integration of externally supplied components into the final product architecture.
In the automotive sector, in order to integrate newly designed components inside the car system, the carmakers and their suppliers have developed "hand in glove" relationships and started sharing a relevant amount of information. However component modularity should ideally reduce the need for a tight coordination between buyer and supplier during the product development stage. Indeed the suppliers who design and produce modular components know *ex ante* the interfaces of the component; this, in turn, reduces the need to share information to design a component that fits the overall product design. Since components' design and development can thus be isolated and carried out separately by suppliers thanks a standardized product

architecture, the need for intense coordination is lowered. Furthermore component modularity foster the introduction of modular and incremental innovations. At the end modular products are just the sum of modules, separated by well-defined and standardized interfaces, so that products can be innovated simply adding, upgrading, substituting, or subtracting components, without changes in the other product components. Secondly the concurrent and autonomous development of components make faster the product development activities, thus reducing the relative costs thanks the exploitation of the economies of scale (Modularity, interfaces definition and the integration of external sources of innovation in the automotive industry , September 2012, p. 664).

Despite all these advantages linked to modularity, major car makers can exploit their market power and dominant position in order to impose their own standards, information systems and business processes against their suppliers, forcing them to adapt. However, as we argued in precedence, the complexity of vehicles and of their internal architecture is continuously growing, and so it is almost impossible to have a product design fully codified and predetermined.

Globalization, the ICT revolution and the unbundling of the production processes around the world affected the automotive industry (and its innovative activities) in a very deep way, redefining also its spatial structure. Indeed, due to the high concentration of automotive demand, the final assembly activities are dispersed in a large number of sites all over the world (very close to the final markets), but in the same time a few number of historical clusters, specialized in the automotive sector, keep to exist. We call these clusters "motor city", and they are urban areas where major car makers were founded and grew up, and where now value added and knowledge intensive activities such as R&D, engineering and design persist to be carried on. In these places the R&D centers of the most important automotive suppliers are localized and also other actors such as universities and public and private research institutions are localized in order to exploit better the synergies with carmakers and work together on generation of new technologies. Thanks proximity advantage inside the "motor city" interactions and exchanges of knowledge (especially tacit and unencodable information) can be easy, frequent and very productive. Moreover, in the "motor city" we find, like in other urban contexts, agglomeration phenomena, knowledge spillovers and specialized labor markets.

Historically, before the disruption in terms of organization in the automotive industry that we described so far, exchanges of tacit information mostly occurred within the boundaries of the highly integrated and established car makers' network; face-to-face the interactions were mainly face-to-face and information and knowledge exchange were totally based on proprietary standards. The growing involvement of suppliers in innovation activities along the entire supply chain and their increasingly contribution in terms of added value, made mandatory to strengthen knowledge exchange between lead firms and the suppliers of complex parts and components.

Finally the dispersion of innovative activities among the several entities along the supply chain requires a correct and well organized management of information flows across the boundaries of a single firm. Indeed today, due to a more blurred boundaries

among firms at the different tiers in the automotive network, the protection of intellectual rights is a more delicate issue more compared to the past. The increasing of patents generation is positively correlated to the number of innovative firms operating in the industry, and this give us an idea about the innovation intensity of the sector. Finally, considering the high complexity of the final product, having complementary patents is necessary to develop a good cooperation with other firms (Cullino, Fabrizi, Linarello, & Orame, 2012, p. 3 - 5).
In summary, during the last years, globalization and the Information and Communication Technology (ICT) have contributed to reshape the industrial and geographical reorganization of the automotive industry. The increasingly product complexity forced the principal car makers to outsource in order to involve suppliers in design and R&D activities. The majority of assembly plants were localized both in peripheral areas of OECD countries, attracted by lower costs, both in developing economies to exploit better the geographic proximity to large and fast growing markets. In contrast in a few specialized clusters, which are mainly cities where car-makers originally localized their headquarters and characterized by the presence of specialized labor markets and other institutions supporting the automotive industry, R&D, design, engineering and other higher-value-added activities remained concentrated in order to benefit from the agglomeration economies phenomenon.
As we analyzed so far the study of innovation in the automotive industry deserves careful attention; in fact innovation is a key determinant for the long-run growth of economy, so understanding its determinants is crucial from a policy perspective.

2.6.1 Bosch case study

In order to explore better the concept of Open Innovation and how this strategy is implemented in the automotive sector, the paper “Open innovation in the automotive industry: a multiple case study” (Alfredo De Massis, Valentina Lazzarotti, Emanuele Pizzurno and Enrico Salzillo) can be particularly useful. In this paper the information was collected mainly from face to face interviews and secondary sources to study different point of view of the several players acting in the supply chain. Bosch is one of the various companies operating in automotive sector studied inside this paper.
Bosch is one of the most important and established supplier for the main automotive companies worldwide. The reason of its importance is related to the support it gives to automotive companies by researching and developing 360° innovative solutions for the cars of the future and supplying standard components in a large scale. Nowadays, considering the increasingly level of competition and the entrance of new players in the industry, customers are demanding more and more reliable and sophisticated products but, at the same time, they do not accept any increase in the price. For this reason Bosch investment strategy is based on the reaching of economies of scale in order to lower costs for the new released products. Moreover, as the competition increases (especially from eastern countries), Bosch is trying to acquire new markets and penetrate them as first mover. The result is that, as shown by the reported data, in

every car the Bosch's components contribute to the final product value creation for at least the 15%.
In addition to this constant research allows Bosch to maintain its leader position in innovation, but in the same time emerges an high risk of imitation of the standard components.
The innovative ideas generated in Bosch come both through an analysis of market trend both from a specific need of the customers; in the latter case the company looks for customers with who would carry on the development of the idea (in order to satisfy their specific needs) and would make an initial application of it.
Before the designing phase, Bosch develops a business plan in strict cooperation with the customer because the success of the product depends on how many cars the client intend to sell. Especially when the idea is developed according a specific customer need, the whole project cycle is carried on collaborating with the customer. Bosh usually opts for co-development contracts or joint ventures according to the importance of the project. If the product specifications are clear, Bosch usually prefers a co-development agreement; instead, for longer collaborations, the joint venture is the preferred option.
The testing cycle is another important step during the innovation process; first of all, the component is tested internally in order to verify whether the technical specifications provided by the customer are respected and the quality level is satisfied. Moreover Bosch has also an internal society (ETAS) that develops and tests simulation systems and the software needed for the electronic components. This phase is characterized by a high degree of complexity, especially for components with a relevant percentage of electronic parts (which are increasingly present in the modern cars).
Time-horizon of the innovation process depends on the time to market of the car; in the case the work is done in co-development with a specific customer, it usually lasts 14-15 months. Instead in the scenario of a joint venture there is not always a specified time frame, considering that the goal is to collaborate as long as possible. Bosch, when decide to set a joint venture strategy, has as first objective to gain complementary knowledge in order to have a stronger contractual power in the future. Among the most successful joint ventures, it is worth to remember the one with Samsung, for the development of lithium-ion batteries.
Furthermore Bosch tends to hire people of different nationalities within the same project to stimulate creativity.
Finally, as explained in precedence, innovative intellectual property is an important issue, and for this reason any project can't start if an agreement about the protection of intellectual property rights is signed and accepted by all the participants. In addition to this, people interviewed reinforced this concept, underling that without IP policies all investments in innovation would have no sense and would risk being in vain (Massis, Lazzarotti, Pizzurno, & Salzillo, March 2012, p. 231 - 233).

3. EMPIRICAL ANALYSIS

In the last chapter we described the literature on which the entire theory of FDI is based. At the beginning we listed the resulting benefits for the competitiveness and economy of a country linked to the foreign investments from multinational firms. Then we explained which are the main drivers for the location choice of investments, because the factors that influence the decision of a company to invest in a country rather than another one are very heterogeneous and linked to several field. Indeed the location of an investment can be influenced by economic factors such as the GDP, the average wages, population, taxation ecc…

However we have seen that the economic indicators are not enough to justify a foreign investment, and other factors referred to the local market have to be considered, and in this case the 5 Porter's Force framework can be a very effective tool (customers and suppliers ' bargaining power, barriers to entry, competitors and substitutes threats). In addition to this also the political situation of a country must to be assessed, in order to quantify the ease of business in that particular nation.

Besides all these national characteristics, an important component that influences the location choice of a business is the innovation level of the country. This is the case of the knowledge – seeking investments, that are justified by the will of a company to acquire the last cutting – edge technology and/or to exploit all the benefits linked to an innovative and well developed business context (spillover effect). This phenomenon is even more pronounced in those market where the constant financing in research and the development in innovative processes and products are the key success factors.

For that reason in this paper we decided to focus our analysis on the automotive market, where the financing of innovative products it has always been an essential part of the business. Moreover, due to the new European regulation about the emissions and the increasingly concern about the environment from the public opinion, the major car manufacturing players have been forced to invest in innovative projects aiming to put into the market cleaner and more efficient vehicles.

In general, from a theoretical perspective, we explained that the innovation level of a state or region is an important stimulus to attract FDI, but it is not yet clear how big this contribution is for the location choice.

The objective of this paper is to explore the relationship between FDI and the degree of innovation of the host country, in order to quantify its importance in the location selection process.

In econometric terms what we will assess is the causal effect correlation between indicators that characterize the innovation within an European state and the decision of a firm to invest in that specific nation. After all a lot of business strategies require quantitative estimates of how a change in one variable affects another one so, thanks econometric tool, it will be possible for us to estimate the causal effects.

In the paragraph 2.1 we described the positive contribution of FDI for the economy of the host country, so the political action is necessary to create a favorable business field

aiming to attract multinational companies. The final goal of this paper is to find out how relevant the public policies are in the innovation context to encourage inflow investments.
We explained that automotive sector is the most important industry in Europe, and the strategies of its major players are influenced by different factors. In particular the automotive market is highly sensitive to innovative and advanced technologies so it is reasonable to think that the most developed countries are the favorable destination for foreign investments. For that reason the focus of our study is the automotive FDI, aiming to quantify the real contribution of innovation for the attractiveness of a country.
Obviously in our analysis we will evaluate also the impact of economic indicators, which are very important for the business location choice and cannot be neglected; in fact if they are not considered the main risk is to overestimate the importance of the host country's innovation level. For that reason it is fundamental to isolate the impact of innovation in order to find out the real sensitivity of FDI toward the innovative context of the destination State.
At the end the goal of this study is to understand the role and the magnitude of the innovation policies among all the European countries for the automotive sector.
In the case the final results show a relevant importance of the national innovative context in the attraction of foreign companies, the conclusion will be that public policies to foster innovation (acting both in the public and private sector) can be crucial for the growth of the economy.

3.1 Data description

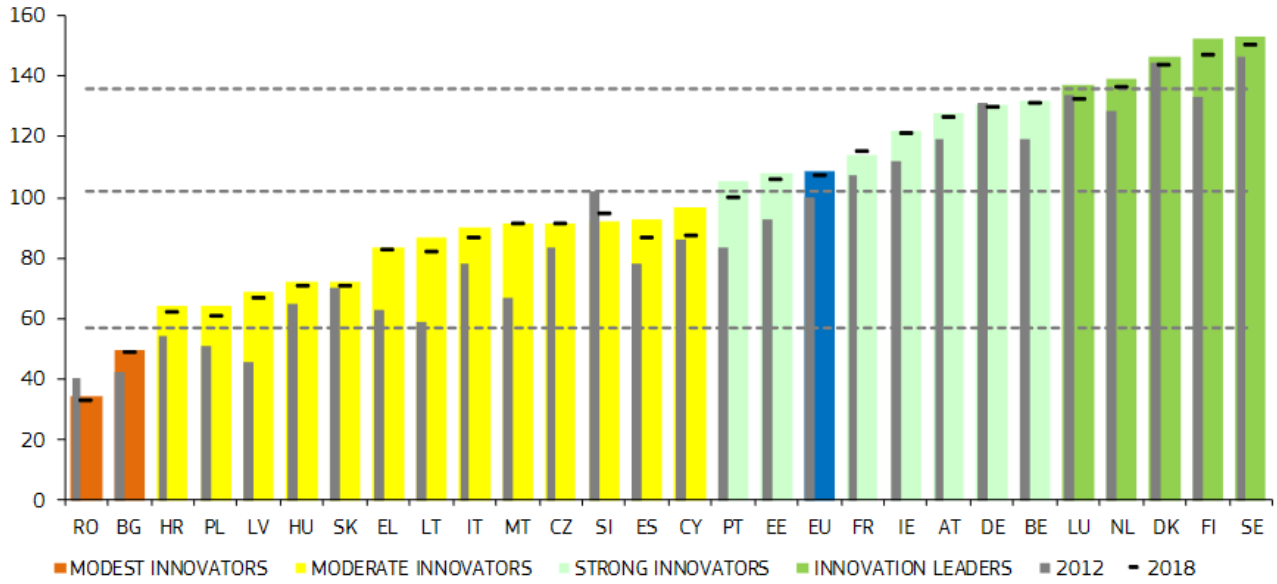
Understanding to what extent the decision to invest in a particular country is linked to its innovative environment is a quantitative question, which requires a quantitative answer. Economic theory described in the previous chapter can give us some suggestions about the answer, underling that there is a positive correlation between the number of investments in a place and the innovation degree associated to that location. However the actual value of the correlation numbers can only be learned empirically, going to analyzing time series data.
In order to estimate how much the location choices are driven by innovation, we collected and examined all the FDI occurred in Europe between 2003 and 2018 within the automotive sector, exploring the FDI market database of Financial Times intelligence.
For each investment several information were available : first of all was specified the date of the investment, the capital invested, the jobs created and obviously the destination country. Secondly was indicated the source country, the Parent company and the industry sector. As we said in precedence the focus of our study is the automotive industry, considering its large volumes in Europe and the importance that

innovation plays within it. For that reason, among all the possible industry sectors present in our initial European FDI database, we selected the fields of Automotive OEM, Automotive components and Transportation.
Obviously the nature of the investments is very heterogeneous and different from each other. Indeed the field of application of a certain capital invested can be very varied and each investment can have a different purpose. This information is summarized inside our FDI dataset in the column called Industry Activity, where is described the specific function linked to an investment.
Especially in the automotive sector, which is characterized by a huge complexity of the market and with a great number of corporate departments involved, the type of Industry Activity for an investment is very varied. This aspect can be noticed in the table below, where all the different typologies of Industry Activity present in the FDI dataset for the automotive sector in Europe are listed :

IndustryActivity	Freq.	Percent	Cum.
Business Services	1,720	0.26	0.26
Customer Contact Centre	2,408	0.37	0.63
Design, Development & Testing	19,608	2.98	3.61
Education & Training	2,924	0.44	4.06
Headquarters	18,576	2.83	6.88
ICT & Internet Infrastructure	344	0.05	6.94
Logistics, Distribution & Transportat..	210,442	32.02	38.96
Maintenance & Servicing	14,792	2.25	41.21
Manufacturing	209,754	31.92	73.12
Recycling	172	0.03	73.15
Research & Development	3,096	0.47	73.62
Retail	34,228	5.21	78.83
Sales, Marketing & Support	135,966	20.69	99.52
Shared Services Centre	2,924	0.44	99.96
Technical Support Centre	258	0.04	100.00
Total	657,212	100.00	

What stands out is that the Industry Activity that a specific FDI can have is really diversified. This reflect that the heterogeneity that characterize the FDI dataset regarding the European automotive sector.
In fact, as it is possible to see, the majority of investments in Europe within the automotive industry concern manufacturing activities and logistic and transportation. This is quite reasonable considering the great relevance that manufacturing has for the automotive sector; furthermore in this market the players involved in the entire supply chain are a lot so this is the reason because investments in logistic are so pronounced.
However, due to the size in terms of volume and network, many companies invest money in sales & marketing, strengthen their retails and offer a better maintenance and service to their customers.
Finally, in an industry like the automotive one where is crucial to acquire the last innovative capabilities and knowledge in order to have the most advanced technology

on the market, is mandatory for firms to invest in research, design, development and training. Obviously this last aspect is strictly correlated with the innovation degree of the destination country.
In our study we didn't decide to focus our analysis only on some specific cluster of automotive FDI in Europe (based on the industry activity); instead we opted to study the total of investments going to consider all the typologies of industry activities. The goal of this paper is to find out the correlation between investments and innovative and development level of the destination country. Analyzing all the FDI, without discriminate about a specific type of specific industry activity, will allow us to estimate the weight and the relevance of innovation on all automotive investment occurred in Europe in the last decade.
Of course the scenario is very diversified and what we aspect is that innovation is an important driver for the location choice concerning R&D, while for manufacturing activities national indicators such as the average wage have an higher weight.
The primary objective of the study is to find out to what extent the innovation degree of the European destination country counts in the location choice of all automotive investments; nevertheless in this paper we will conduct also heterogeneity analysis clustering our FDI based some macro categories of industry activities.
So far we explained the FDI dataset we used to conduct our study; of course if we want to estimate the correlation between investments and innovation we need to adopt some indicators or factors which reflect how the destination country is innovative.
Innovation has a broad meaning and, being a very general concept, is difficult to have an unique indicator to measure it. Moreover innovation covers more field and it is impossible describe it with a single definition. For this reason, in order to conduct our analysis properly and as completely as possible, we use more index; each of them can be used like reference to assess how innovative a specific nation is. All these indicators are well explicative and provide us a description of innovation from different perspectives.
In order to quantify the innovation degree of each country we adopted the European Innovation Scoreboard (EIS), which groups together different index (27 in total) that express from different point of view the capacity of a nation in terms of innovation and technological advancement.
EIS is drawn up annually by the European Commission and it is a tool that provides a comparative assessment of research and innovation performance of European countries (both EU member and not). This report is particularly useful for policy – makers because it allow them to evaluate relative strengths and weaknesses of national research and innovation systems, track progress, and identify priority areas where to act to boost innovation performance.
As explained in precedence EIS is based on 27 separate indicators and, according their value, a composite indicator called Summary Innovation Index is calculated. Then, based on this final value, an European state fall into four possible performance groups : innovation leaders, strong innovators, moderate innovators and modest innovators.



Considering the great number of indicators present inside the EIS all the possible innovation aspects and traits are captured; now let's see in detail which are all these indices.
The EIS distinguishes all its indicators in four main categories (framework conditions, investments, innovation activities and impacts), covering ten innovation dimension (European Commission, Innovation Scoreboard 2020 - Methodology report 2019, p. 3 - 4).

"Framework conditions" category groups together three dimensions which assess the innovative grade of the external environment:

- The *human resource* dimension includes three indicators and measures the availability of high skilled and educated workforce
- *Attractive research system* dimension includes three indicators and measures the international competitiveness of the science base by focusing on international scientific co – publications, most cited publications and foreign doctorate students
- *Innovation friendly environment* dimension captures the context in which enterprises operate and include two indicators

"Investments" category groups together two innovation dimensions which describe the public and private financing in innovative projects:

- *Finance and support* dimension includes two indicators and measures the availability of finance for innovation project by Venture Capital expenditure and the support of government for research and innovation activities (through financing universities and research institutes)

- *Firm investments* dimension includes three indicators linked to investments that firms make to generate innovation and to the effort of enterprises to upgrade the ICT skills of their personnel

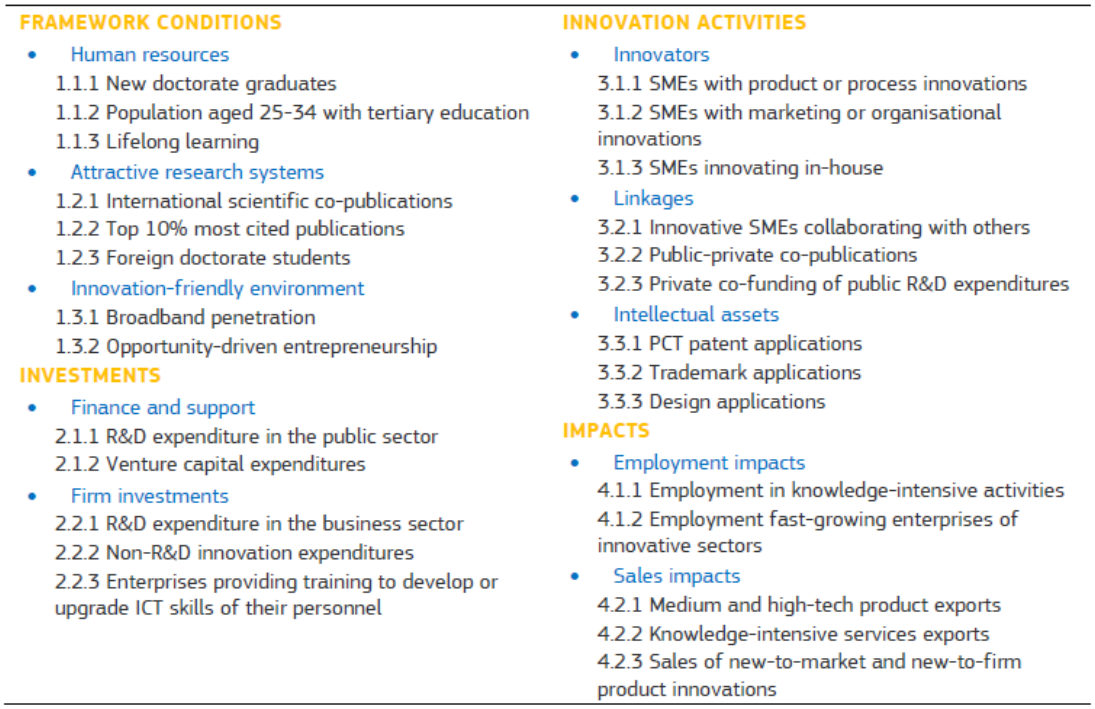
"Innovation activities" groups together three innovation dimensions which describes the intensity of innovation effort from the business sector:

- *Innovators* dimension includes three indicators measuring the share of firms that have introduced innovation into the market or within their organization
- *Linkages* dimension includes three indicators measuring the degree of collaboration (both public and private) and the level of the network among firms regarding innovative projects
- *Intellectual assets* dimension captures different forms of Intellectual Property Rights (IPR) generated during the innovation process

"Impacts" category groups together two innovation dimensions which describe the effects of innovative activities on society:

- *Employment impacts* dimension includes two indicators and measures the impact of innovation on the national employment
- *Sales impact* dimension includes three indicators and measures the economic impact of innovation

In the specific, in the image below, is possible to see all the EIS indicators sorted among the ten innovation dimension explained previously.



Obviously we will not use for our analysis all the indexes, but we collected just a small portion of them, selecting only those indicators that are most relevant for attracting investments.

The first indicator studied in this paper is "New doctorate graduates" (code 1.1.1). The value of this measurement is calculated dividing the number of doctorate graduates and the population aged between 25 and 34 years (the source of information for the calculation of the values is Eurostat). This indicator is part of the dimension *Human resources* and it reflects the availability of new doctorate graduates in all fields of training. As we explained in precedence in the paragraph 2.5 (Innovation strategies) a company, which is carrying out an innovative project, often needs to collaborate with universities in order to exploit the capabilities and knowledge of the doctorates. Moreover many PhD students involved in these projects later are hired by the firms. For this reason we assume that the number of new doctorate graduates can be a factor to attract more investments, so we expect a positive correlation between FDI and the indicator 1.1.1 of the EIS.
Another indicator we decided to pick up is "Population aged 25 – 34 with tertiary education" (code 1.1.2). The value of this measurement is calculated dividing the number of persons in age class with some form of post-secondary education and population between and including 25 and 34 years (the source of information for the calculation of the values is Eurostat). Also in this case this indicator belongs from *Human resources* dimension but, contrary to 1.1.1, it is less specific. Indeed this is a general index of the supply of advanced skills. It is not limited to science and technical fields, because the adoption of innovations in many areas, in particular in the service sectors, depends on a wide range of skills. Furthermore this indicator focuses on a relatively young age cohort of the population, aged 25 to 34, and will therefore easily and quickly reflect changes in educational policies leading to more tertiary graduates (European Commission, European Innovation Scoreboard 2020 - Methodology report, 2019, p. 5).
The third indicator we collected from EIS is "R&D expenditure in the public sector" (code 2.1.1). The value of this measurement is calculated dividing all R&D expenditures in the government sector and the higher education sector with the Gross Domestic Product, so the index express the public expenditure as percentage of GDP (the source of information for the calculation of the values is Eurostat). This indicator is part of *Finance and support* dimension and in fact R&D expenditure represents one of the major drivers of economic growth in a knowledge based economy and its trend can provide indications about the future competitiveness and wealth of that country. Research and development spending is essential for making the transition to a knowledge-based economy as well as for improving production technologies and stimulating growth.
Another important indicator, very useful for the purpose of this paper, is "R&D expenditure in the business sector" (code 2.2.1). The value of this measurement is calculated dividing all all R&D expenditures belong to business sector and the Gross Domestic Product, so the index express the private expenditure as percentage of GDP

(the source of information for the calculation of the values is Eurostat). This indicator is the complementary of the precedence one; indeed while 2.1.1 describes the R&D financing from the public point of view, this index is more focused on the private sector and its innovation dimension of reference is *Firm investments*.
The indicator captures the formal creation of new knowledge within firms and it is particularly important in the science-based sectors (like the automotive industry that is the object of this thesis) where most new knowledge is created in or near R&D laboratories (European Commission, European Innovation Scoreboard 2020 - Methodology report, 2019, p. 7).
The next indicator taken for the study is "SMEs introducing product or process innovations" (code 3.1.1). The value of this measurement is calculated dividing the number of small and medium-sized enterprises (SMEs) who introduced at least one product innovation or process innovation either new to the enterprise or new to their market and the total number of small and medium sized enterprises present in the country (the source of information for the calculation of the value is Eurostat – Community Innovation survey). In this way the index express the percentage of SMEs involved in innovative activities and for that reason the innovation dimension of reference is *Innovators*.
A high share of technological innovators reflects a high level of technological innovation activities, which are a key ingredient for industries such as the automotive one. According the European Innovation Scoreboard report the definition of product innovation is "the introduction into the market of a new or significantly improved good or service with respect to its capabilities, user friendliness, components, or sub-systems", while the definition of process innovation is "the implementation of a new or significantly improved production process, distribution method, or supporting activity". The main companies operating in the automotive sector are used to collaborate with many SMEs, going to adopt their technologies; so that is important to include in our analysis an indicator which tracks the diffusion of innovation among SMEs (European Commission, European Innovation Scoreboard 2020 - Methodology report 2019, p. 8).
Finally the last indicator adopted for the study is "Patent applications per billion GDP" (code 3.3.1). The value of this measurement in calculated dividing the number of patent application under PCT and the Gross Domestic product in Purchasing Private Standard (the source of information for the calculation of the values is OECD for patents data and Eurostat for GDP). PCT stands for Patent Cooperation Treaty and it is a document signed at international level. It establishes that when a patent is filed in Europe is subject to novelty research by an international authority (for the EU member is designated the European Patent Office). Patent counts are based on the priority date, the inventor's country of residence and fractional counts. This indicator is part of *Intellectual assets* dimension and it reflects the capacity of firms in a country to develop new products and processes in order to determine a competitive advantage. The number of new patents is a measure of the rate of innovative products and it gives an idea about the business dynamism of a nation in terms of innovation.

Especially in a sector like the automotive one where the final vehicle is made up of many complex components each one with different reference licenses and where very often is necessary to cooperate with other companies since no firm is able to have all the required competencies in – house, the number of new patents generated can be a fundamental factor for a country to attract FDI (European Commission, European Innovation Scoreboard 2020 - Methodology report, 2019, p. 9).

All the indicators taken from EIS described so far are measures to assess the innovation degree of each of the European countries. Nevertheless, as we explained before, in a complex industry as the automotive one the innovation level is an important driver, but obviously is not the only one. Indeed, considering that the object of our analysis is the totality of FDI in the automotive sector without discriminating based on a specific industry activities, national economic indicator must be included in the study.
The problem we may have not counting indexes of the economy of the destination country is to overestimate the effect of innovation on location choice of investment; in econometrics term this issue is called Omitted Variable Bias.
Ignoring data about the economy, such as GDP growth for example, will make the estimate of the effect of innovation on FDI location choice quite misleading or, more precisely, biased. In the specific the omitted variable bias occurs when two conditions are true : when the omitted variable is correlated with the included regressor (in our case one of the index from EIS) and that determines in part the dependent variable (as we will see in the next paragraph the probability of an investment in a specific country is our dependent variable).
In our case these two conditions are both met; the first one is true because as we know the national dynamism in terms of innovation has a positive impact on the economy, while the second is also met because obviously economic factors are an important driver for the investments.
In order not to have a misleading final outcome due to the omitted variable bias, we decided to insert in the analysis indicators relating to the economic level of the European countries. The indicators chosen are the following ones :

- GDP growth
- Population
- Unemployment
- Capital (gross capital formations as a percentage of GDP)
- Tariff
- Border cost (sum between exportation and importation cost)

These data are part of World Development Indicators database (WDI), which is the World Bank's premier compilation of cross country comparable data on development. The database groups together relevant, high quality and internationally comparable statistics about the global development, containing information about 217 economies going back more than 50 years.

These indicators must be inserted in our model in order to "depurate" the effect of innovation on investment, so not to have the risk to estimate a biased result.
The purpose of the study is to find out the weight of innovation on the FDI location choice process, holding constant all the other economic variable. In this way we will be able to isolate the impact linked only to the innovation degree of the destination country (described through the EIS indexes).
The economic indicators are called control variable because are kept constant; they are all the variables that are not of interest to the study's aim, but are controlled because they could influence the outcomes.

Furthermore, for our study on the automotive FDI in Europe, we decide to include also variables regarding the past investments. Indeed usually a company decide to invest in a country it already knows, due to past investments occurred in that location. For this reason, in order to carry out a thorough and complete research from all points of view, we built variables which keep track of previous similar FDI in a determined State.
Specifically this is the list of variables included in the analysis:

- Cum_inv : this variable is the cumulative sum of previous investments done by the Investing company in that specific destination country
- Cum_bilateral : this variable is the cumulative sum of previous investments occurred between that specific origin country and that specific destination country
- Cum_activity : this variables is the cumulative sum of previous investments for that specific industry activity occurred in that specific destination country

All these three variables are related to the information dimension that drives location choice process of investments. The more past FDI have been made in a specific destination country , the more information there are regarding that particular location. We can explain this concept as a kind of inertia in the investments; if in the past there were many FDI in a country, the probability of the next investment in that nation will be higher.
The first variable (cum_inv) is linked to the company; indeed a firm may decide to invest in a State where in the past it has already made investments, in order to exploit its experience and its established network in that location (internal agglomeration).
The second variable (cum_bilateral) is linked to the commercial relationship between the origin and the destination country. This describes the behavior of a company to invest in a country which historically has good relations with the origin country of that firm (country of origin agglomeration). This phenomenon can be explained by the fact that, if there have been many investments between two nations, evidently there are commercial agreements that facilitate the business and a company can decide to exploit these benefits.
Lastly the third variable (cum_activity) is linked to the purpose and the field of application of an investment. Indeed a company tend to invest for a specific industry

activity in a country where there have been in the past years many FDI in that industry activity (industry agglomeration). This because a firm hopes to exploit the knowledge and capabilities already present in that location, in order to internalize and absorb them more easily (benefiting from the spillover effect).
In summary these three variables highlight the level of information that a company has about the destination country. These information, dictated by the previous FDI occurred, are certainly a driver which influences the decision to invest in a particular location (Castellani & Lavoratori, 2020). For that reason what we aspect in general is that more FDI have been in a country, higher is the probability that an investment will locate there.
The objective of the study is to isolate the impact of innovation variables in order to estimate their importance for the location choice of the automotive investments; hence cum_inv and cum_bilateral and cum_activity will be part of the control variables, together with the economic indicators explained in previously.

3.2 Descriptives

The goal of this paper is to find out how much the innovation dimension drives the location choice of automotive FDI in Europe. For this reason our variable of interests are those which come from the European Innovation Scoreboard, that we described in the paragraph 3.1. Here below there is the list of these variables with their related codes :

1.1.1 New doctorate graduates
2.1.1 R&D expenditure in the public sector
2.2.1 R&D expenditure in the business sector
3.1.1 SMEs introducing product or process innovation
3.3.1 PCT patent application

Instead the variable “Population aged 25-34 with tertiary education” (code 1.1.2), despite is part of EIS, will not be a variable of interest but it will be included in the control variables as we explained at the end of the last paragraph. This decision is due to the fact that “Population aged 25 - 34 with tertiary education” is an indicator related to the qualification of the workforce of a country, that is a measure apart from innovation. Hence the index 1.1.2 will be inserted with the other control variables, together with the indicators connected to the economic and information dimension described previously.

Now in the table in the next page are reported all the summary statistics of each of the variables used in the study.

Variable	Obs	Mean	Std. Dev.	Min	Max
choice	105,350	.0324822	.1772778	0	1
D_111	105,350	1.819347	1.411701	.1785156	13.75984
D_112	105,350	3.70058	.2081652	3.226844	4.060443
D_211	105,350	.618102	.2495546	.21	1.11
D_221	105,350	.9894821	.7005758	.05	2.4
D_311	105,350	34.13859	12.6288	4.633023	56.03439
D_331	105,350	2.55549	2.447154	.0302688	9.496027
gdp_growth	105,350	1.2878	.5263273	-.575958	3.264328
pop	105,350	15.59582	1.44743	12.6989	18.23021
unemployment	105,350	2.224745	.4691532	1.319593	3.36834
capital	105,350	3.12015	.1935373	2.417432	3.648431
tariff	105,350	1.272123	.131324	.8285518	1.991976
border_cost	105,350	2.498023	2.82134	0	6.594413
cum_bilate~l	105,350	35.14806	67.23405	0	372
cum_inv	105,350	.6273944	2.480584	0	50
cum_activity	105,350	82.76925	118.5499	0	576

As is possible to see the observations remain stable for all the variables and this is fundamental to conduct a more qualitative analysis and have an objective comparison between variables.

In the table in the following page is shown the correlation matrix instead. It is very important consider the correlation values among the variables analyzed, in order to avoid any issue linked to multicollinearity. This phenomenon arises when one regressor is a perfect linear combination (perfect multicollinearity) or highly correlated (imperfect multicollinearity) with other regressors. If this problem occurs, the coefficients of regressors will be imprecisely estimated and, as a consequence, will be difficult to evaluate the partial effects on the dependent variable using the data at hand.

	choice	D_111	D_112	D_211	D_221	D_311	D_331	gdp_gr~h	pop	unempl~t	capital
choice	1.0000										
D_111	0.0149	1.0000									
D_112	-0.0426	0.1665	1.0000								
D_211	0.0281	0.4037	0.3106	1.0000							
D_221	0.0437	0.5305	0.2394	0.7878	1.0000						
D_311	-0.0517	0.1644	0.3456	0.5221	0.4535	1.0000					
D_331	0.0241	0.4283	0.2739	0.7921	0.8854	0.4785	1.0000				
gdp_growth	-0.0157	-0.1288	0.0885	-0.3520	-0.2182	-0.2231	-0.2309	1.0000			
pop	0.1766	0.1697	-0.2389	0.2726	0.3046	-0.0877	0.2565	-0.3488	1.0000		
unemployment	-0.0162	-0.1449	-0.1402	-0.3793	-0.4857	-0.1016	-0.3779	-0.2826	0.0558	1.0000	
capital	-0.0045	-0.0336	0.0060	0.0457	0.1392	-0.0348	0.1284	0.3436	-0.1163	-0.2850	1.0000
tariff	-0.0203	0.1121	0.0527	0.1665	0.1002	-0.0054	0.1183	-0.1876	0.1259	0.0658	0.2479
border_cost	-0.0827	-0.1254	0.2283	-0.0580	-0.0525	0.2985	0.1204	0.1152	-0.4080	0.0462	0.0650
cum_bilate~l	0.1620	-0.0196	-0.1467	-0.0140	0.0553	-0.2294	-0.0323	0.0115	0.4172	-0.0751	0.0503
cum_inv	0.1938	0.0198	-0.0485	0.0416	0.0641	-0.0536	0.0383	-0.0283	0.2237	-0.0195	-0.0033
cum_activity	0.2183	0.0124	-0.1880	0.0529	0.1189	-0.2232	0.0284	-0.0240	0.5992	-0.0910	0.0113

	tariff	border~t	cum_bi~l	cum_inv	cum_ac~y
tariff	1.0000				
border_cost	0.1361	1.0000			
cum_bilate~l	-0.0517	-0.3188	1.0000		
cum_inv	-0.0255	-0.1204	0.3136	1.0000	
cum_activity	-0.0790	-0.3441	0.4335	0.2536	1.0000

Generally not to fall into the problem of multicollinearity we have to be careful that the correlation values do not exceed 0.6. What stands out from the matrix is that there are some high correlations among the EIS indexes (between variables 2.1.1 and 3.3.1, between variables 2.2.1 and 3.3.1 and between variable 2.1.1 and 2.2.1). This is quite understandable since all of them belongs to innovation dimension and they are one the consequence of the other. For that reason we decided to analyze the EIS variables of interest (1.1.1, 2.11, 2.2.1, 3.1.1 and 3.3.1) one at the time and not all together, so that avoiding any errors due to multicollinearity. Regarding instead the control variables (in which we remind 1.1.2 is also included) there are no very big correlation values, and this is fundamental since the control regressors are the common elements of the analysis. In the case of a correlation relationship higher 0.6 between two control variables or between a control variable and a variable of interest, the only possible solution would have been to delete that control regressor. Finally, in the table shown in the next page, is possible to see in which way the automotive FDI are distributed across Europe, giving us an idea about the preferred destination countries.

iso_dest	Freq.	Percent	Cum.
RUS	1,378	9.02	9.02
POL	1,346	8.81	17.82
FRA	1,338	8.75	26.58
DEU	1,284	8.40	34.98
ESP	1,258	8.23	43.21
CZE	942	6.16	49.37
ROU	860	5.63	55.00
HUN	750	4.91	59.91
BEL	664	4.34	64.25
TUR	608	3.98	68.23
NLD	510	3.34	71.57
SVK	504	3.30	74.86
ITA	480	3.14	78.00
AUT	424	2.77	80.78
SRB	278	1.82	82.60
BGR	270	1.77	84.36
PRT	248	1.62	85.99
SWE	248	1.62	87.61
UKR	214	1.40	89.01
DNK	182	1.19	90.20
IRL	176	1.15	91.35
LTU	152	0.99	92.34
CHE	150	0.98	93.33
FIN	146	0.96	94.28
SVN	108	0.71	94.99
NOR	92	0.60	95.59
LVA	88	0.58	96.17
HRV	78	0.51	96.68
MKD	78	0.51	97.19
GRC	74	0.48	97.67
BLR	72	0.47	98.14
EST	70	0.46	98.60
BIH	56	0.37	98.97
LUX	38	0.25	99.21
MDA	30	0.20	99.41
MLT	22	0.14	99.56
MNE	18	0.12	99.67
CYP	16	0.10	99.78
ALB	12	0.08	99.86
ISL	6	0.04	99.90
LIE	6	0.04	99.93
MCO	6	0.04	99.97
AND	4	0.03	100.00
Total	15,284	100.00	

3.3 Model description

We decided to study the location choice of FDI in Europe for the automotive sector, in particular focusing on the innovation dimension. To carry out this analysis we adopted the Conditional Logit model, which is a particular type of regression.
Typically the decision of a company about where to locate its investment is based on the expected utility which can be obtained and, according the Conditional Logit model, the investor will choose the location that gives the highest utility.
In our case we can consider utility as a linear function of regressors which are all connected to the destination country of the investment. In the analysis we will consider N investments, while J is the number of all the possible European destination countries. The utility associated to a generic investment *n* (*n* = 1,2,…,N), localized in the destination country *i* (*i* = 1,2,…,J) and coming from the origin country *o* in the time t is denoted U_{niot}. Specifically the utility function will be :

$$U_{niot} = X_{it}\,\alpha + Y_{iot}\,\beta + Z_{nit}\,\gamma + \varepsilon_{niot}$$

Now let's examine the nature of regressors of the function written above.
X_{it} is a type of regressor which describe the characteristics of the destination country i at time t and it can influence the utility of the potential location. In our specific case, considering the variables we decided to collect and that are described in the paragraph 3.1, examples of this type of regressor are all the innovation indicators from EIS and the economic parameters chosen as control variables (GDP growth, population, taxes, unemployment, capital, tariff and border cost); that because these variables are linked exclusively to the destination country in a determined time.
Secondly Y_{iot} is a type of regressor whose value depends both from the country of origin both from the destination country. In our analysis the variable that has this nature is cum_bilateral, because it account for the cumulative number of FDI occurred until time t between the country of origin o and the destination country i.
Lastly Z_{nit} is the third typology of regressor to consider in this model and it is characterized by the specific investment n and by the destination country i at time t. For this paper the variables of this type are cum_inv and cum_activity, because they are related to the destination country, but in the same time they depend respectively from the investing company and industry activity, that is unique for each investment.
Therefore the variables used in this study cover all the three kinds of regressors.
α, β and γ are the regressors' coefficients to estimate in order to assess the impact of the variables to the utility belongs to that location. ε_{niot} is simply the error term of the utility function instead.

We will denote the deterministic component of the utility as V_{niot}; thus the utility function can be written now in this way : $V_{niot} = \alpha X_{it} + \beta Y_{iot} + \gamma Z_{nit}$
P_{niot} is probability that the investment *n* from country *o* will be localized in the European country *i* at time *t* and it can be calculated as the probability that the utility U_{niot} is higher than the utility of all the other alternative countries in Europe (j is a generic alternative location among the J European countries considered). In mathematic terms we can write :

$$U_{niot} > U_{njot} \; ; \forall \, j \neq i$$
$$U_{niot} = V_{niot} + \varepsilon_{niot}$$
$$U_{njot} = V_{njot} + \varepsilon_{njot}$$
$$P_{niot} = Prob(\, U_{niot} > U_{njot} \quad \forall \, j \neq i \,) = Prob(\, V_{niot} - V_{njot} > \varepsilon_{njot} - \varepsilon_{niot} \quad \forall \, j \neq i \,)$$

According the Conditional Logit model the dependent variable is Choice, that is a binary variable equal to 1 in the case an investment occurs in a country, zero otherwise. A generic investment n has J possibilities where to localize, but at the end it will materialize in only one place. For the chosen country the value of Choice is 1, for the other J – 1 alternative location Choice will be zero. Considering that in our analysis we collected N different FDI, each one with a set of alternatives composed of J countries, we will have in total N x J choice dependent variables.
Now what stand out is :

$$P_{niot} = Prob(Choice_{niot} = 1) = \frac{e^{V_{niot}}}{\sum_{j=1}^{J} e^{V_{njot}}} \quad \forall \, j \neq i$$

In this way we obtained a logarithmic function, which tell us what is the probability that a specific investment will localize in a country *i,* and therefore that the dependent variable Choice will be 1. Furthermore, in order to have an easier readings of results, we transformed all the variables collected in logarithms, so that the value of coefficients will tend to their elasticity. Indeed logarithms convert changes in variables into percentage changes, and many relationships are naturally expressed in terms of percentages.
Specifically for our analysis, given a generic regressor X which has as coefficient the value β_x, a 1% change in X is associated with a β_x% change in the probability that the investment occurs in that place, that is the probability that $Choice_{niot} = 1$.
The decision about the location of the investment will be based exclusively on the final utility; the absolute value is not important but what really matters is the difference in utility that the specific country *i* yields for the investment *n* compared with the other alternatives. Hence, attributes of the alternative that do not create a difference in utility, or attributes of the investment that do not vary over alternatives, will not affect the

choice and will not be estimated. For that reason the variables considered are all connected with the possible destination country, in order to discriminate among all the J alternatives. Consequently variables such as capital invested or economic indicators of the origin country do not make sense to be included because their value does not change among all the alternative countries of destination, therefore they do not impact on the difference in utility.
Finally, in terms of interpretation, the marginal effect associated to a generic regressor x_{niot} will be: $\frac{\partial V_{niot}}{\partial x_{niot}} P_{niot}(1\text{-}P_{niot})$.
This formula represents the impact of the regressor x_{niot} for the location choice of the investment *n* in the country *i*. Mathematically this value is maximized when $P_{niot} = 1\text{-}P_{niot} = 0.5$, that means when the choice probability is neither very likely nor very unlikely. We can conclude that the impact of a change of a generic regressor for the location choice of an investment is relevant for those country which have an average attractiveness for FDI (Train, 2009). In these locations the margin for improvement in terms of utility of an investment is the best. Contrary, in countries which are a lot attractive for FDI (high P_{niot}) or in countries with a poor attractiveness of FDI (low P_{niot}), the marginal effect of a generic regressor x_{niot} to the utility V_{niot} will be less relevant (Benfratello, D'Ambrosio, & Sangrigoli, Why investing in Africa ? The differential role of Chinese government support, Politecnico di Torino, p. 15 -16).

3.4 Results analysis

In this paragraph we are going to analyze all the results obtained using the Conditional Logit model (thanks the application of Stata software). As explained in precedence in the paragraph 3.2, considering the high value of correlation among the EIS indicators which are our variables of interest, we decided to study them one by one. Consequently, given that our variables of interest that quantify the degree of innovation of the destination countries are five (1.1.1, 2.1.1, 2.2.1, 3.1.1 and 3.3.1), we conducted the regression analysis five times. Instead the control variables chosen for the study remain the same every time we apply the model, in order to have a better consistency and a fair comparison of results. Obviously the coefficients of the control variables change when we replace the variable of interest, but the sign of the values are the same and this reflects a stability of the model.
In the case the coefficient of one regressor is positive it means that variable increase the probability that the investment will localize in that country, while if the coefficient is negative it means that variable decrease the probability of choosing that country for the investment.

Before describing specifically the outcomes obtained, we focus first on the control variables, to assess their importance and role for the attraction of FDI in the automotive industry in Europe. Basically the results confirm our expectations because those variables, that according economics theories are factors to attract investments, have positive coefficients, while those variables which historically represent a barrier for the business have negative coefficients.

We start our results analysis looking the control variables related to the economies of the European countries, which give an indication about the business conditions. The first regressor adopted for our study is *GDP growth*, that is a measure of the prosperity of a country. The value of its coefficient is positive for every model and this confirms our idea that a destination with a growing economy can be attractive for the location choice of the FDI. Indeed a possible destination characterized by an increasing trend of GDP growth is symptom of an healthy economy and a dynamic environment. This create, as a consequence, a favorable business context for automotive firms, both in terms of potential new partnerships both to reach new customers. For that reason the GDP growth is one of the main indicators which drive the choice about the destination country of automotive investments, and this is underlined by the coefficients estimated by the Conditional Logit model. Moreover what stands out looking the table in the next pages is that the value of *Z* related to *GDP growth* is always higher than 2 and as a consequence the P-value is very small; this indicate our results are significant. Indeed P-value measures the credibility of the null hypothesis (coefficient is zero); if the P-value is low it means that we can reject the null hypothesis with an high degree of confidence, so that we can say that the coefficient is not zero.

According the outcome from our analysis another factor which increase the probability that a country is chosen as a destination of automotive FDI is the *population* (pop). A country with a high level of population is an attractive place to localize investments because it represents on one hand a source of workforce and on the other an opportunity to serve new customers. For that reason not only the *population* coefficients estimated are positive for every model, but in the same time they are always higher than coefficients related to *GDP growth*. These results tell us that *population* is a more relevant driver to localize the investments for the automotive sector compared to *GDP growth*. In addition the value of *Z* is very large (the highest among the economic control variables) so we can conclude the outcome of the model is reasonable.

Another control variable collected for the analysis is *unemployment*. As is noticeable the sign of coefficients estimated in the iterations is negative now; this means that more the value of the national unemployment goes up less is the probability that a company will locate in that country. This is in line with our expectations, due to the fact that an high level of unemployment can be connected to a low demand of vehicles and to a

suffering economy from the business point of view, so a company has few incentives to invest there. However, despite the negative coefficients, the value of *Z* of *unemployment* regressor are not so significant; this can be explained because unemployment can also be a positive driver for FDI, representing a source of potential new workforce. Hence we can say that *unemployment* does not attract investments in general, but in some circumstances can be a positive factor for a foreign multinational to exploit the available human resources.

The next control variables inserted in the study is *capital*, that represent the capital generation within the border of a nation as a percentage of GDP. Also in this case, like for *GDP growth* and *population*, the coefficients are positive for every iteration done, so as we expected a country which generates a lot of capital promotes the location of automotive FDI. This variable gives indications about the economic development of a nation, focusing in particular to the business sector. According the results the firms are encouraged to invest in location with a good *capital* measurement, aiming to exploit the richness generated. Nevertheless the value of *Z* linked to this regressor is smaller compared the ones of the other regressors, so that the variable *capital* is less significant for our analysis.

Another variable adopted as control regressor for our model is *tariff*. Looking the tables in the next pages its coefficients are negative for every model, so consequently if the national tariffs increase, the probability that an automotive investment will be localized in that country declines. This is not a surprise from a theoretical point of view; indeed tariffs are a source of revenue for governments but they represent also a cost for companies. Therefore if tariffs are too high the foreign competitive pressure is reduced and, as a consequence, the FDI inflow is impaired. Moreover analyzing the results the *Z* associated to this regressor are valid and P-values are small, so the consistency of our outcomes is confirmed.

Finally the last control variable used in the study to assess the economic context of a possible destination country is *border cost*. This variable, which is simply the sum of import and export cost, is an indicator to evaluate the trade cost across the borders of a country. Like for *unemployment* and *tariff* , the coefficient of the variable *border cost* is negative for every iteration and this highlight the idea that FDI are hindered in presence of relevant cross-border cost. This variable describes the trade openness of a country and, especially in the automotive industry, it plays a crucial role. Indeed many automotive firms decide to carry on manufacturing activities in a country and later export the products or they may also implement some cross-border merger to strengthen their global position in the sector. All these strategies, typical for the automotive field, can be seriously threatened in case the local government puts into practice high border cost. Lastly what stands out from the tables of results in the next

pages is that the *Z* of *border cost* is significant too, so we can conclude that also in this case the final numbers are robust.
So far we explained the results obtained from the Conditional Logit model associated to the control variables adopted to describe the economy of the destination countries. However, as we argued in the paragraph 3.1, the FDI is not driven only by economic decisions so we decided to include as control variables some regressors which take into account the information dimension.
Following our expectations, the coefficients of the variables *cum_bilateral*, *cum_inv* and *cum_activity* are positive for all the iterations and also their values remain stable changing the EIS variable of interest. *Cum_bilateral* is referred to the phenomenon of country of origin agglomeration and the positivity of its coefficient confirms the theory that a firm tend to locate in a country which have good trading relationship with the origin country of the mentioned company. *Cum_inv* variable capture the internal (or company) agglomeration instead. As expected, the tendency of many automotive firms is to locate in countries where they have already invested, due to their established experience in that location. Last but not least *cum_activity* variables gives us an idea about the industry agglomeration and the subsequent spillover effect. According our results the automotive corporations tend to invest in those country where is present an agglomeration of firms operating in the same industry activity.
Both as regards the variable *cum_activity* and as regards the variable *cum_bilateral* automotive investors benefit of potential information externalities when choosing a specific destination country. Regarding instead the variable *cum_inv* the investing company justify the FDI location choice by the exploitation of its intra-firm agglomeration economies.
The P-values of these three variables are small enough for all the models to remark ulteriorly the consistency of our estimation and they tell us that, in line with the literature, *cum_bilateral*, *cum_inv* and *cum_activity* promote significantly the location of FDI.
Finally, the last regressor we decided to insert among the control variables is *Population aged between 25 – 34 with tertiary education*. As argued in the paragraph 3.2 this indicator (code 1.1.2), despite belongs to EIS where our variable of interest are grouped, will be part of the control variables because it refers more to the dimension of workforce qualification, which is independent of innovation. What is noticeable and a little bit surprising is that the coefficient of regressor is negative for all the five models, except for the first one. So that we can assume that *Population aged between 25 – 34 with tertiary education* seems not to affect (or affect negatively) the location choice of automotive investments in Europe. At the same time this can be justified by the high measurements of P-values due to the low *Z*, which make the impact estimation

of this variable on FDI less significant because we cannot reject the null hypothesis with reasonable confidence.

So far we explained in general way how much the control variables affect the decision about the location of investments. Now we will analyze in details the outcome of our study, aiming to find out the relevance of innovation for the FDI. We have already argued that, due to the fact the variables of interest are correlated to each other, we carried on our study examining them one at time; considering the regressors of interest are five, we implemented five different models, each one with one variable of interest related to the innovation degree of the destination country and with all other control variables.

3.4.1 Model 1

Number of obs = 105,350
LR chi2(11) = 5493.63
Prob > chi2 = 0.0000
Log likelihood = -8980.2878 Pseudo R2 = 0.2342

choice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_111	.107204	.0139063	7.71	0.000	.0799481	.1344598
D_112	.0548044	.0932744	0.59	0.557	-.1280101	.2376188
gdp_growth	.1507433	.0510078	2.96	0.003	.0507698	.2507167
pop	.4192941	.0238556	17.58	0.000	.372538	.4660502
unemployment	-.1568662	.0502106	-3.12	0.002	-.2552772	-.0584552
capital	.5207217	.1613894	3.23	0.001	.2044043	.8370391
tariff	-.998877	.3459265	-2.89	0.004	-1.67688	-.3208736
border_cost	-.0752269	.0087982	-8.55	0.000	-.0924711	-.0579827
cum_bilateral	.0037578	.0003428	10.96	0.000	.0030859	.0044297
cum_inv	.1038242	.0048891	21.24	0.000	.0942418	.1134066
cum_activity	.0034891	.0001808	19.30	0.000	.0031348	.0038434

In the model 1 the variable of interest is *New doctorate graduates*, which code from EIS is 1.1.1. What emerges looking the table above is that the number of new PhD graduates affects positively the location choice of foreign investment in the automotive sector. Specifically, according the results, if in a State the variable of interest increase by 1% and all other control variables remain constant, the subsequent probability that an investment will be localized in that country goes up by 0.1%. This latter percentage represents the marginal impact of our variable of interest for the attraction of FDI, keeping all the other factors steady. In addition the *Z* computed is 7.71 and the

subsequent P-Value is practically nil, so we can say that the level of significance of the coefficient estimated is enough to reject the null hypothesis. Indeed, as is possible to notice looking the fourth column, the probability that the null hypothesis (coefficient is zero) is true is irrelevant.
The model 1 the only one where the variable 1.1.2 (*Population aged between 25 – 34 with tertiary education*) has a positive coefficient, but as we explained previously, the P-value associated to this regressor is high, so that the estimation is less significant. Among the control variables, the most important to affect the location choice of investments is *capital*, which marginal effect accounts for 0.52%, while the one with the worse negative interaction is *tariff* (-0.99%). We can conclude that, evaluating all the regressors inserted, the coefficients are statistically significant and in line with our expectation.

3.4.2 Model 2

```
                                  Number of obs     =    105,350
                                  LR chi2(11)       =    5463.87
                                  Prob > chi2       =     0.0000
Log likelihood = -8995.1684       Pseudo R2         =     0.2330
```

choice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_211	.4627149	.1100109	4.21	0.000	.2470974	.6783324
D_112	-.072256	.1001405	-0.72	0.471	-.2685277	.1240157
gdp_growth	.2300314	.0581485	3.96	0.000	.1160625	.3440003
pop	.4004803	.0241483	16.58	0.000	.3531504	.4478101
unemployment	-.0635619	.0526243	-1.21	0.227	-.1667036	.0395798
capital	.3557901	.1656007	2.15	0.032	.0312187	.6803616
tariff	-.8184266	.3407832	-2.40	0.016	-1.486349	-.1505038
border_cost	-.0771042	.0093954	-8.21	0.000	-.0955189	-.0586896
cum_bilateral	.0037222	.0003423	10.87	0.000	.0030514	.0043931
cum_inv	.1046762	.0049043	21.34	0.000	.095064	.1142884
cum_activity	.003476	.0001804	19.27	0.000	.0031225	.0038295

In the model 2 the variable of interest is *R&D expenditure in the public sector*, which code from EIS is 2.1.1. In this second case what turns out is that the public financing in research and development activities is a positive factor for foreign investors. We have already argued how much R&D projects are fundamental in industries such as the automotive one and this is confirmed by the numbers from the table above. Indeed, in the case the government decides to enhance the public spending for research activities by 1%, and in the scenario that all other control variables doesn't change, the

probability that an automotive foreign investment will be localized in that country improve by 0.46%. The estimated coefficient of the variable *R&D expenditure in the public sector* is higher than the coefficient associated to variable of interest of the previous iteration, so the financing from the government in research plays a more dominant role for the attraction of FDI compared the numbers of new doctorate graduates. Furthermore the *Z* of the interest regressor is 4.21, so we can conclude that the estimation done is significant. Considering instead the control variables, the regressor which impact most for the choice of location is *population* (with a large significance level), while the one with the highest negative coefficient is *tariff* (as resulted in the first model).

3.4.3 Model 3

```
                                              Number of obs     =    105,350
                                              LR chi2(11)       =    5473.68
                                              Prob > chi2       =     0.0000
Log likelihood = -8990.2615                   Pseudo R2         =     0.2334
```

choice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_221	.2430182	.0464745	5.23	0.000	.1519298	.3341065
D_112	-.1153239	.1013362	-1.14	0.255	-.3139392	.0832913
gdp_growth	.2824152	.0603338	4.68	0.000	.1641631	.4006674
pop	.3833509	.0246603	15.55	0.000	.3350176	.4316842
unemployment	.0061422	.0569961	0.11	0.914	-.1055681	.1178525
capital	.226746	.1711972	1.32	0.185	-.1087944	.5622865
tariff	-.6899738	.3414955	-2.02	0.043	-1.359293	-.020655
border_cost	-.0845518	.0097425	-8.68	0.000	-.1036467	-.0654569
cum_bilateral	.0037887	.0003447	10.99	0.000	.003113	.0044643
cum_inv	.1037417	.0048892	21.22	0.000	.0941591	.1133243
cum_activity	.0035242	.000181	19.47	0.000	.0031694	.0038789

In the model 3 the variable of interest is *R&D expenditure in the business sector*, which code from EIS is 2.2.1. As we expected investments in research from the private sources affect positively the probability that FDI take place, with a marginal effect on destination choice of 0.24% and a value of *Z* of 5.23 which guarantees the consistency of the calculation. However, comparing the coefficients between the second and the third model, the importance of *R&D expenditure in the business sector* for the attraction of FDI appears to be minor compared the *R&D expenditure in the public sector*. These results suggest us that, in order to stimulate the local economy thanks the arriving of foreign investors, the role of government and public institutions is crucial. Regarding instead the control variables, *tariff* is confirmed to be the most relevant

barrier for investments while the regressor with the highest coefficient is *population*. Finally among all models, in this case *GDP growth* shows its best value (0.28), and this may be due to the presence as variable of interest of *R&D expenditure in the business sector*; in fact these two regressors are one the consequence of the other and vice-versa.

3.4.4 Model 4

		Number of obs	= 105,350
		LR chi2(11)	= 5454.08
		Prob > chi2	= 0.0000
Log likelihood = -9000.0618		Pseudo R2	= 0.2325

choice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_311	.0056625	.0020085	2.82	0.005	.0017258	.0095992
D_112	-.0078701	.0975043	-0.08	0.936	-.198975	.1832348
gdp_growth	.2153349	.0622814	3.46	0.001	.0932656	.3374042
pop	.4185061	.0236574	17.69	0.000	.3721384	.4648738
unemployment	-.1024363	.0510056	-2.01	0.045	-.2024055	-.0024671
capital	.4249303	.1608117	2.64	0.008	.1097451	.7401155
tariff	-.7939901	.3393798	-2.34	0.019	-1.459162	-.128818
border_cost	-.0736792	.0095308	-7.73	0.000	-.0923592	-.0549993
cum_bilateral	.0037277	.0003448	10.81	0.000	.0030518	.0044035
cum_inv	.1046619	.0048945	21.38	0.000	.0950688	.114255
cum_activity	.003532	.0001826	19.34	0.000	.003174	.0038899

In the model 4 the variable of interest is *SMEs introducing product or process innovations*, which code from EIS is 3.1.1. According our model the percentage of innovators among SMEs influences the location choice of FDI but, as is possible to see from the table above, its marginal contribution is residual (only 0.0056). Among all the innovation variable chosen to be our regressor of interest, this is the least influential for the attraction of foreign investments, but this is quite reasonable. Indeed foreign investors are more interested about policies to foster and support the innovative activities, which are very common in the automotive sector, while the innovation degree associated to SMEs is a factor not so relevant to determine the destination country of FDI. Anyway, also in this case, the *Z* of the variable of interest tell us that the coefficient estimated is statistically significant. Furthermore, evaluating the outcome related to the control variables, we can say that the situation remained stable and in line with the results obtained from the previous models.

3.4.5 Model 5

Number of obs = 105,350
LR chi2(11) = 5468.87
Prob > chi2 = 0.0000
Log likelihood = -8992.6674 Pseudo R2 = 0.2332

choice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_331	.0611659	.012833	4.77	0.000	.0360136	.0863181
D_112	-.1180983	.1027269	-1.15	0.250	-.3194393	.0832426
gdp_growth	.2417866	.0577319	4.19	0.000	.1286342	.354939
pop	.3717355	.0257809	14.42	0.000	.321206	.4222651
unemployment	-.0386293	.0538991	-0.72	0.474	-.1442695	.0670109
capital	.310981	.1676243	1.86	0.064	-.0175565	.6395185
tariff	-.6620686	.343615	-1.93	0.054	-1.335542	.0114045
border_cost	-.0911122	.0107178	-8.50	0.000	-.1121187	-.0701057
cum_bilateral	.0038979	.0003498	11.14	0.000	.0032123	.0045835
cum_inv	.1040857	.0048923	21.28	0.000	.0944969	.1136744
cum_activity	.0036194	.0001847	19.60	0.000	.0032575	.0039814

In the model 5 the variable of interest is *PCT patent application*, which code from EIS is 3.3.1. From a theoretical point of view we explained the key role which patents play in industries like the automotive one and this is reflected by the coefficient estimated. In this case, if the number of patents within a nation increase by 1% and all other control variables remained unchanged, the marginal effect on the probability that an investment will be localized in that country is 0.061%. The conclusion is that patents are more considerable for investors than *SMEs introducing product or process innovations* considering their strong connection with the automotive sector, but in the same time they are less determinants respect both *R&D expenditure in the public sector* and *R&D expenditure in the business sector*. The possible explanation of this phenomenon is that the automotive companies are more focus on R&D projects carried on in the destination country rather than paying to acquire patents, which can be very expensive.
Regarding the control variables the situation doesn't change compared the previous model; in fact *tariff* is still the regressor with the most important negative impact on FDI while *population* and *capital* continue to represent attractive factors for foreign investors. Finally the variable *GDP growth* and the three regressors associated to information dimension (*cum_bilateral*, *cum_inv* and *cum_activity*) maintain their marginal effect stable for all the five models.

What emerged from the five models is that the main innovation variables for the investments attraction are *R&D expenditure in the public sector* and *R&D expenditure in the business sector*. These results are statistically significant and the comparison among the five models was possible because the number of observations remained constant (105350 obs.). So far we conducted our analysis considering FDI as a whole, without discriminating regarding the specific industry activity because our goal was to find out the impact of innovation for the location choice of a generic FDI. The results obtained describe how innovation is important on the totality of automotive investments.
However we are aware that the nature of automotive FDI is very varied, depending from the specific industry activity associated to a single investment. For that reason, in order to have a more complete vision, we decided to implement a heterogeneity analysis. This time the variables of interest chosen are only *R&D expenditure in the public sector* and *R&D expenditure in the business sector*, because they resulted to be the most important innovation driver for the FDI location choice. Moreover they are, among the EIS variables, the most policy sensitive and so, in the next page, the heterogeneity study on them will allow us to understand the relevance of political policies for the attraction of foreign investments.

3.4.6 Heterogeneity analysis

We start our heterogeneity analysis focusing only on R&D FDI, which take into account as industry activities "Design, development and testing", "Research and development" and "Education and training". The results of the study, just considering R&D FDI, are in the two tables below.

		Number of obs	= 5,860
		LR chi2(11)	= 393.89
		Prob > chi2	= 0.0000
Log likelihood = -454.52696		Pseudo R2	= 0.3023

choice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_211	.1092175	.5305099	0.21	0.837	-.9305629	1.148998
D_112	-.613626	.485029	-1.27	0.206	-1.564265	.3370134
gdp_growth	-.0153404	.2636669	-0.06	0.954	-.532118	.5014372
pop	.7450136	.1104985	6.74	0.000	.5284405	.9615868
unemployment	-.0871885	.2499228	-0.35	0.727	-.5770281	.4026512
capital	1.393956	.8946885	1.56	0.119	-.3596012	3.147513
tariff	-4.774949	2.371891	-2.01	0.044	-9.423771	-.1261273
border_cost	-.0236736	.0452973	-0.52	0.601	-.1124546	.0651074
cum_bilateral	.0041044	.0013105	3.13	0.002	.0015359	.0066728
cum_inv	.1323672	.0164698	8.04	0.000	.1000871	.1646474
cum_activity	.0109186	.010237	1.07	0.286	-.0091456	.0309827

Number of obs	=	5,860	
LR chi2(11)	=	394.09	
Prob > chi2	=	0.0000	
Log likelihood = -454.42901	Pseudo R2	=	0.3025

choice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_221	.1119287	.2295562	0.49	0.626	-.3379931	.5618505
D_112	-.6821352	.4819257	-1.42	0.157	-1.626692	.2624219
gdp_growth	.0391869	.2842158	0.14	0.890	-.5178658	.5962395
pop	.7375969	.1126469	6.55	0.000	.5168131	.9583808
unemployment	-.037571	.2724996	-0.14	0.890	-.5716603	.4965184
capital	1.340728	.9093711	1.47	0.140	-.4416063	3.123063
tariff	-4.747951	2.410149	-1.97	0.049	-9.471757	-.0241452
border_cost	-.0312919	.0470112	-0.67	0.506	-.1234321	.0608482
cum_bilateral	.0041716	.0013167	3.17	0.002	.001591	.0067523
cum_inv	.1314845	.0164263	8.00	0.000	.0992895	.1636794
cum_activity	.0104363	.0100615	1.04	0.300	-.0092839	.0301565

Now the coefficients of the variables *R&D expenditure in the public sector* (code 2.1.1) and *R&D expenditure in the business sector* (code2.2.1) are positive, but both lower compared to the ones of the previous analysis. This means that these two variables are more considerable for the totality of Automotive FDI, rather than for the specific R&D investments. At the same time we have to say that the number of observations are only 5860, which account just for 5% of the total FDI. This explain the low statistically significance of results, reflected by the values of *Z* of almost all variables.

Now we change the focus of our heterogeneity analysis and we concentrate on manufacturing FDI, which are the investments only for the automotive production activities. The results obtained are summarized in the two tables below.

Number of obs	=	23,504	
LR chi2(11)	=	1776.06	
Prob > chi2	=	0.0000	
Log likelihood = -1729.6354	Pseudo R2	=	0.3392

choice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_211	-.4590481	.2496834	-1.84	0.066	-.9484185	.0303223
D_112	-.2510427	.2633681	-0.95	0.340	-.7672348	.2651494
gdp_growth	-.3423656	.1474325	-2.32	0.020	-.6313279	-.0534032
pop	.0808087	.0596051	1.36	0.175	-.0360152	.1976326
unemployment	.7034524	.1255679	5.60	0.000	.4573439	.9495608
capital	2.165639	.4268377	5.07	0.000	1.329052	3.002225
tariff	.2339158	.687846	0.34	0.734	-1.114238	1.582069
border_cost	-.1624976	.0386742	-4.20	0.000	-.2382976	-.0866975
cum_bilateral	.0026644	.0009083	2.93	0.003	.0008843	.0044445
cum_inv	.2258595	.0145967	15.47	0.000	.1972504	.2544686
cum_activity	.0054879	.0004645	11.82	0.000	.0045775	.0063982

				Number of obs	= 23,504
				LR chi2(11)	= 1778.02
				Prob > chi2	= 0.0000
Log likelihood = -1728.6547				Pseudo R2	= 0.3396

choice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_221	.3106364	.1348832	2.30	0.021	.0462701	.5750027
D_112	-.8402333	.2784438	-3.02	0.003	-1.385973	-.2944934
gdp_growth	-.1813825	.1525018	-1.19	0.234	-.4802805	.1175155
pop	.0310507	.0618444	0.50	0.616	-.090162	.1522634
unemployment	.9636848	.1528552	6.30	0.000	.6640941	1.263275
capital	1.493249	.421802	3.54	0.000	.6665319	2.319965
tariff	.4756852	.689925	0.69	0.491	-.876543	1.827913
border_cost	-.1328724	.037665	-3.53	0.000	-.2066944	-.0590503
cum_bilateral	.0022153	.000907	2.44	0.015	.0004377	.003993
cum_inv	.2283858	.0146546	15.58	0.000	.1996634	.2571083
cum_activity	.0063729	.0005245	12.15	0.000	.005345	.0074009

It is noticeable that now the results of the analysis are more significant, due to the higher number of observations (23504). What is really interesting is that *R&D expenditure in the public sector*, which was the most relevant variable in the aggregated analysis, has a negative coefficient now, while in the same time *R&D expenditure in the business sector* show a positive coefficient instead. According these numbers public spending in research activities inhibits investments in manufacturing; indeed automotive companies which want to invest in production plants seem not to be interested about the public R&D. In contrast research projects belongs to private sector are more attractive for investors, because they have the possibility to exploit the other firms' innovative technologies for production by signing new partnerships and benefiting from the spillover effect.
In addition, looking also the control variables, we can highlight that *GDP growth* has a negative coefficient while *unemployment* show a positive sign. The reason for this fact is that investors in automotive manufacturing look for countries with low wages and low cost, so they are not attracted by growing economies. Furthermore the variable *unemployment* can also be interpreted as available workforce, which is a really important factor if a firm wants to invest in a new production plant.

Finally we conclude the heterogeneity analysis assessing the impact of the innovation variables on the FDI related only to the market-access activities. This time we will consider only those investments which have as industry activities "Customer contact centre", "Sales, marketing and support", "Retail" ad "Business services". We selected these activities because, together with manufacturing field, represent the main functions of the automotive sector. In the two tables in the following page the results of this last analysis are shown.

Number of obs	=	27,476	
LR chi2(11)	=	1324.97	
Prob > chi2	=	0.0000	
Log likelihood = -2399.6944	Pseudo R2	=	0.2163

choice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_211	1.967652	.2352058	8.37	0.000	1.506657	2.428647
D_112	.3124864	.2169976	1.44	0.150	-.1128212	.737794
gdp_growth	.335446	.1052061	3.19	0.001	.1292458	.5416463
pop	.57765	.056693	10.19	0.000	.4665339	.6887662
unemployment	.2074272	.1142179	1.82	0.069	-.0164357	.4312901
capital	-.2489732	.3151237	-0.79	0.429	-.8666042	.3686578
tariff	-1.123711	.5655871	-1.99	0.047	-2.232241	-.0151806
border_cost	-.0039721	.0173909	-0.23	0.819	-.0380577	.0301134
cum_bilateral	.0037441	.0006802	5.50	0.000	.0024109	.0050772
cum_inv	.138903	.0144601	9.61	0.000	.1105619	.1672442
cum_activity	.0018923	.0006937	2.73	0.006	.0005326	.003252

Number of obs	=	27,476	
LR chi2(11)	=	1313.87	
Prob > chi2	=	0.0000	
Log likelihood = -2405.2472	Pseudo R2	=	0.2145

choice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_221	.6790784	.0884973	7.67	0.000	.5056268	.8525301
D_112	.4314668	.2179804	1.98	0.048	.0042331	.8587005
gdp_growth	.3227643	.1044663	3.09	0.002	.1180142	.5275144
pop	.5402575	.0561536	9.62	0.000	.4301984	.6503166
unemployment	.2433654	.12053	2.02	0.043	.0071309	.4795999
capital	-.7021547	.3323951	-2.11	0.035	-1.353637	-.0506724
tariff	-1.014478	.5550682	-1.83	0.068	-2.102391	.0734357
border_cost	-.0113031	.0178027	-0.63	0.525	-.0461957	.0235896
cum_bilateral	.0037766	.0006891	5.48	0.000	.0024259	.0051273
cum_inv	.1357782	.0142745	9.51	0.000	.1078007	.1637557
cum_activity	.0022337	.000685	3.26	0.001	.0008911	.0035762

The FDI to finance market-access activities account for 26% of the total automotive investments of this paper, and this is reflected by the number of observation (27476) which guarantee the statistical significance of the coefficients, as we can see by looking the third column containing the values of *Z*.

Now both the variables *R&D expenditure in the public sector* and *R&D expenditure in the business sector* affect positively the FDI location choice; in fact the automotive firms are attracted by those country where political policies to support the public and the private R&D expenditures are put in place. Previously we highlighted that R&D investments are not a remarkable portion of the total amount of investments, but in the same time the outcome of this last model tell us that market-access FDI are localized in destination country where the expenditure in R&D is high.

We have already argued that public and private financing in R&D are the results of specific policies, and these are perceived by the investing companies as important indicators of the development level of a nation. Indeed countries with high values of

R&D expenditure in the public sector and *R&D expenditure in the business sector* are assessed by automotive firms as fantastic locations where their business can take place and flourish. In contrast with manufacturing activities where the most important drivers were the low cost now, for companies which want to invest in activities such as sales, marketing, retails and business services, what is really attractive is the development and the wealth of the destination country; this latter aspect is usually reflected by the innovation degree of that place.

The conclusion of this heterogeneity analysis is that *R&D expenditure in the public sector* and *R&D expenditure in the business sector* are the most fitted variables to understand the innovation policies of the several European state. The entire automotive industry is based on innovation, so our variables of interest are important factors to attract foreign investments, especially for those activities concerning the market-access process.

4. CONCLUSION

In this paper, through the study of automotive foreign investments data using the Conditional Logit model, we analyzed how innovation is relevant as FDI location determinant in Europe.
In order to quantify and assess the degree of innovation of each European country, we collected indicators from EIS (European Innovation Scoreboard) and we calculated to what extent they contribute to the attraction of investments.
Our results show that, when looking at all automotive investments jointly without any industry activity discrimination, private and public R&D expenditure in a country are an attractive feature for investors. We know that in a sector such as the automotive one the innovation and the technological development play a key role in the companies' business, which aim to preserve their lead position, and this theory is confirmed by the outcomes obtained. Obviously to get more accurate estimates we had to include in the analysis economic data and also variables which take into account the phenomenon of country of origin, internal (or company) and industry agglomeration. At the end of the study, and analyzing all the automotive FDI, the results confirm the economic theories because variables such as *population*, *capital formation* and *GDP growth* affect positively the location choice of investments, while *tariff* and *border cost* have always a negative influence. Regarding instead the innovation variables, which are the main focus of our study, *R&D expenditure in the public sector* and *R&D expenditure in the business sector* are the most considerable innovation drivers for investments and also the most policy sensitive, while *new doctorate graduates*, *SMEs introducing product or process innovations* and *PCT patent application* affect in positive way to a lesser extent.
These results provide us a general vision about the principle location determinants of automotive FDI and allow us to quantify the innovation role in the totality of investments. However we argued that the automotive sector is a very complex environment, so that its investments differ deeply each other based on the specific industry activity. For that reason an heterogeneity analysis was necessary in order to look more specifically at the different functions of investments within the automotive industry, going to consider only *R&D expenditure in the public sector* and *R&D expenditure in the business sector* which are the most policy sensitive variables.
What emerges from the study of heterogeneity is that, despite public and private R&D expenditure are attractive factors for investors, specific investments in research projects account only for 5% of the total FDI examined in this study. In contrast in the automotive market a considerable portion of investments are in manufacturing and

production activities; in this case what stands out is that manufacturing FDI rely mainly on private expenditure in R&D, aiming to adopt the technology developed from other companies for the production processes. Instead public expenditure in R&D is not a prominent feature for manufacturing investors who look mainly for location with low cost and wages. Indeed high public expenditures in R&D are associated to governments of wealthy states, which are not the favorite destination for manufacturing investments. Finally focusing only on market access FDI which involve sales, marketing, retail and business services activities, both public and private expenditure in R&D are an important driver for the choice of destination country. We explained that *R&D expenditure in the public sector* and *R&D expenditure in the business sector* are policy sensitive variables and they are indicators about the development of a country. Our results suggest that automotive investors who want to penetrate in new markets (investing in new retail or marketing campaign for instance) are attracted by these two variables, being strictly connected to the development of a nation.

All this confirm the idea of the importance of government for the attraction of foreign investments, which can be possible through the implementation of policies to foster the local innovation and create, as a consequence, an appropriate business environment for the growing of the companies and of the economy as a whole.

This was the exact goal of the paper : discuss and assess to what extent innovation is a determinant factor for the location choice of the automotive FDI and how key is the government's role to enact policies to support the local innovation. The final outcomes have been coherent with our expectation; indeed all the five innovation variables adopted showed a positive influence for the attraction of FDI. In particular the two best performing have been *R&D expenditure in the public sector* and *R&D expenditure in the business sector*, which are the most depending from political decisions. This remark ulteriorly the idea of the importance of government and public institutions in research phase, in order to develop directly (in case of public R&D) or to create the conditions to develop (in case of private R&D) new and cutting-edge technologies, ready to be exploited and adopted in large scale from private multinationals.

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