

Czech University of Life Sciences Prague

Faculty of Economics and Management



**The relationship between foreign direct investment and innovation strategy of
selected OECD countries**

Master's Thesis

Study program: Economics and Management

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

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DIPLOMA THESIS ASSIGNMENT

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Economics and Management

Thesis title

The relationship between foreign direct investment and innovation strategy of selected OECD countries

Objectives of thesis

The aim is to find out the relationship between foreign direct investment and elements of innovation in selected OECD countries. we explore the following elements: R&D expenditure, number of patents yearly, number of scientific staff, export of innovative technological goods

The relationship between foreign direct investment and innovation strategy of selected OECD countries

Research questions

1. What is the direction of the relationship between FDI inflow and country's innovation capacity?
2. Does FDI inflow increase the export of high-tech products?
3. What is the role of research and development played in the foreign direct investment flow?

Objectives of Thesis

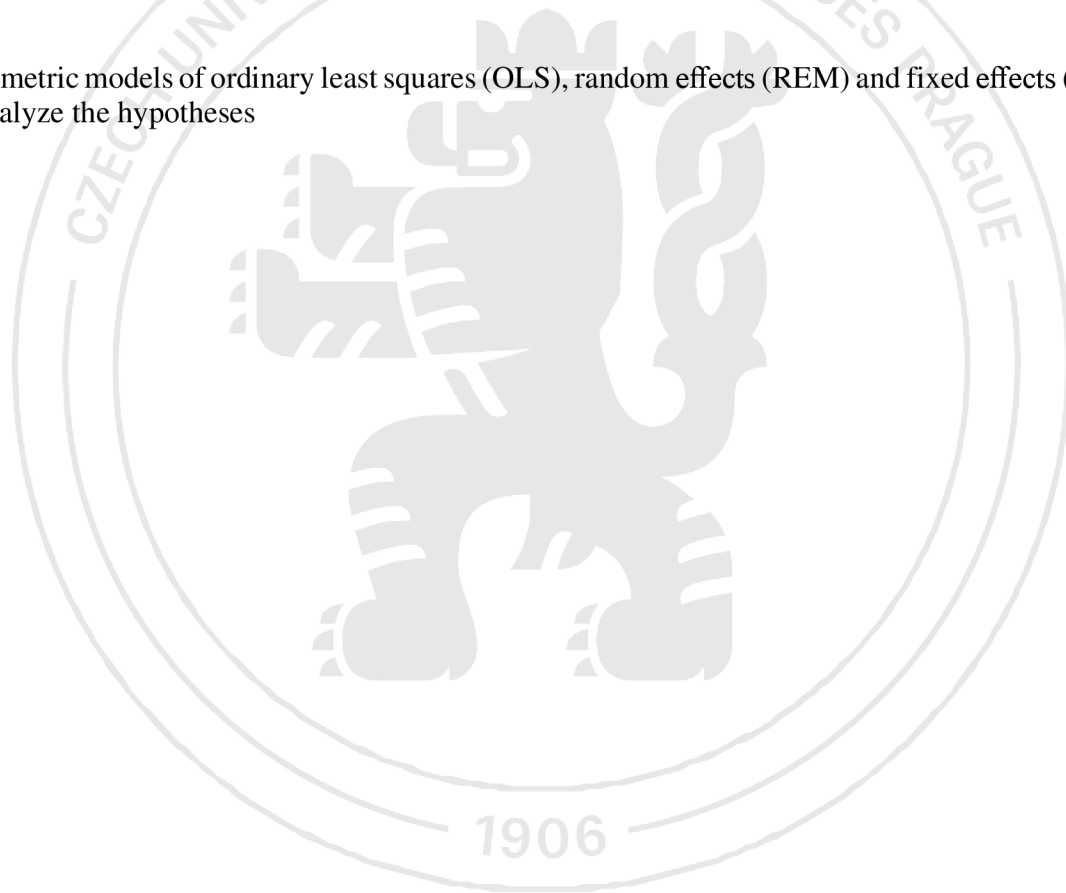
The aim is to find the relationship between foreign direct investment and elements of innovation in mentioned countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Sweden, and Switzerland. The time period taken into consideration is from 2007 to 2015. Elements of innovation are the following: R&D expenditure, number of patents yearly, number of scientific staff, and export of innovative technological goods.

Methodology

Foreign direct investment (FDI) is critical to the success of recipient countries because it brings those economies enormous financial resources, technological know-how, and management expertise. In this thesis, the relationship between foreign direct investments and elements of innovation will be assessed. National innovation elements are R&D, number of patents, number of scientific personnel employed, and amount of high-tech product exports yearly. R&D activities are a fundamental innovation parameter for researchers. A patent, which is accepted as one of the R&D activities, is easily obtainable information for researchers and at the same time, the patent contains objective information. In this study, the effects of foreign direct investments on these parameters were examined by using R&D expenditures, R&D personnel expenditures, high technology product exports and number of patents as innovation criteria. For foreign direct investments, annual investment amounts will be considered as a criterion.

Panel data analysis will be used as an examination method for thesis work. Panel data analysis allows for the examination of factors that are specific to each unit, which is helpful in resolving the issue of heterogeneity that occurs when working with complicated data sets. The sample countries will include the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Sweden, Switzerland. (n=11). The period between 2005-2017 will be assessed to gather necessary data through OECD data bank.

The econometric models of ordinary least squares (OLS), random effects (REM) and fixed effects (FEM) will be used to analyze the hypotheses



The proposed extent of the thesis

60 - 80 pages

Keywords

Investment, innovation. Patent, R&D, expenditure

Recommended information sources

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Declaration

I declare that I have worked on my master's thesis titled "The relationship between foreign direct investment and innovation strategy of selected OECD countries" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the master's thesis, I declare that the thesis does not break any copyrights.

In Prague on 31.03.2023

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The relationship between foreign direct investment and innovation strategy of selected OECD countries

Abstract

This thesis examines the critical role of foreign direct investment (FDI) for innovation in the economy. The integration of innovation strategies in FDI decision-making processes is crucial for attracting more FDI and fostering technological progress. The research aims to assess the relationship between FDI and innovation by analyzing the impact of FDI on national innovation elements such as R&D, number of patents, scientific personnel employed, and high-tech product exports. The research questions focus on the direction of the relationship between FDI inflow and a country's innovation capacity, the impact of FDI on high-tech product exports, and the role of research and development in FDI inflows. Panel data analysis will be used to examine the specific factors of each unit and resolve the issue of heterogeneity that arises when working with complicated data sets. The study will use data for 11 countries from 2005 to 2017.

Keywords: foreign direct investment, innovation, R&D, high-tech product exports, panel data analysis.

Vztah přímých zahraničních investic a inovační strategie vybraných zemí OECD

Abstraktní

Tato diplomová práce zkoumá důležitost přímých zahraničních investic (PZI) pro inovace v ekonomice. Pro přilákání většího objemu zahraničních investic (FDI) a podporu technologického pokroku je důležitá integrace inovačních strategií do rozhodovacích procesů státu. Cílem tohoto výzkumu je posoudit vztah mezi PZI a inovacemi pomocí analýzy dopadu PZI na národní inovační faktory zkoumaných zemí. Mezi tyto faktory patří výzkum a vývoj, počet patentů, zaměstnaný vědecký personál a vývoz high-tech produktů. Práce se zaměřuje také na vztah mezi přílivem FDI a inovační kapacitou země, na dopad FDI na export high-tech produktů a na roli výzkumu a vývoje v přílivu FDI. Ke zkoumání specifických faktorů byla použita panelová analýza dat každé jednotky pro překonání problému heterogenity, který vzniká při práci s komplikovanými datovými soubory. Studie používá data z 11 zemí od roku 2005 do roku 2017.

Klíčová slova: přímé zahraniční investice, inovace, R&D, export high-tech produktů, panelová analýza dat.

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1. Introduction

Foreign direct investment (FDI) and innovation are two critical factors for economic growth and development of countries. The integration of innovation strategies into the foreign direct investment decision-making process has become an important determinant for countries to attract more foreign direct investment and foster their technological progress. The Organization for Economic Co-operation and Development (OECD) countries are among the world's leading economies, and their experiences provide valuable insights into the relationship between foreign direct investment and innovation strategies.

Foreign direct investment (FDI) is critical to the success of recipient countries because it brings those economies financial resources, technological know-how, and management expertise. In this thesis, the relationship between foreign direct investments and elements of innovation will be assessed. National innovation elements are R&D, number of patents, number of scientific personnel employed, amount of high-tech product exports yearly. R&D activities are a fundamental innovation parameter for researchers. A patent, which is accepted as one of the R&D activities, is an easily obtainable information for researchers and at the same time, the patent contains objective information. In this study, the effects of foreign direct investments on these parameters were examined by using R&D expenditures, R&D personnel expenditures, high technology product exports and number of patents as innovation criteria. For foreign direct investments, annual investment amounts will be considered as a criterion. The research questions are described below:

1. What is the direction of the relationship between FDI inflow and country's innovation capacity?
2. Does FDI inflow increase the export of high-tech products?
3. What is the role of research and development played in the foreign direct investment flow?

Panel data analysis (Pooled OLS) will be used as an examination method for thesis work. Panel data analysis allows for the examination of factors that are specific to each unit, which is helpful in resolving the issue of heterogeneity that occurs when working with complicated data sets. The sample countries will include the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Sweden, Switzerland. (n=11). The period between 2005-2017 will be assessed to gather necessary data through OECD data bank. Panel data analysis will be used as an examination method for thesis work. Panel data analysis allows for the examination of factors that are specific to each unit, which is helpful in resolving the issue of heterogeneity that occurs when working with complicated data sets. The positive relationship between foreign direct investment

(FDI) and innovation parameters that the author anticipates would be found was also obtained from research conducted by Jalles (2010), Fu (2008), and Girma et al (2009). Cheung and Ping (2004) etc.

2. Theoretical Literature Review

2.1 Foreign Direct Investment Theories

Companies that initiate operations in one country and move their activities to other countries to establish a new facility, acquire an existing one, or enter into partnerships to maximize profits are engaging in Foreign Direct Investments (FDI). The liberalization and diffusion of foreign capital movements began to accelerate in the 1980s, coinciding with the start of international liberalization movements in the economic sector. These movements began in the 1970s. The significance and effects of liberal economic policies became apparent, resulting in accelerated growth of worldwide markets and production.

It was observed that this circumstance contributed to the development of an awareness of the significance of FDI and the expansion of its scope on a global scale. Currently, as a result of the globalization process, it is commonly understood that foreign direct investment is at the forefront as a significant resource for eliminating borders between nations and, in particular, for meeting the capital needs of developing countries. Foreign direct investments (FDIs) are particularly important for delivering resources to developing countries because they have a positive impact on employment and technology in the country in which they are invested.¹

Countries have begun to develop strategies and policies aimed at increasing the attractiveness of current market environments to attract Foreign Direct Investments (FDIs), as they realize the significance of FDIs in boosting their economies. These strategies are designed to lure FDIs to their borders. Investment activity refers to all activities undertaken by investors that are connected to investment or realization in some way. Investing in financial assets encompasses not only the purchase of securities but also other types of financial assets, such as loans, regulatory funds, and other investments.²

They own both domestic and international financial assets in their portfolios simultaneously. Every economic process must have sufficient economic reserves and production elements available in order to continue operating without interruption. It will take both time and money to construct commercial structures and acquire the necessary equipment for business activities. As a result, in order to initiate any kind of economic activity, an

¹ Denisia, V. (2010). Foreign direct investment theories: An overview of the main FDI theories. *European journal of interdisciplinary studies*, (3).

² Miyamoto, K. (2003). Human capital formation and foreign direct investment in developing countries. *Organisation for Economic Co-operation and Development (OECD) Paper*, (211).

entrepreneur must first raise the price of acquiring resources, which results in the creation of the factors of production. As a consequence of this, there is a requirement in the economy to make investments in the manufacturing process, and as a consequence of these investments, the anticipated income can be received.

As is common knowledge, there is a period of time that elapses between the formation of the production process in the economy, the funds invested in raw materials, the supply of materials, and the beginning of the production process. This time gap exists between the formation of the production process in the economy and the beginning of the production process itself. Hence, additional finances are required in order to consistently repeat the economic process and guarantee that manufacturing will continue uninterrupted. Raising the total amount of output by investing in additional capital is one definition of the term "investment."

An investment that is made overseas and results in the creation of a new manufacturing facility or the acquisition of a minimum stake of an already existing business is known as a foreign direct investment (FDI). An individual, a business, a multinational company (MNC), a financial institution, or even a national or international government can all qualify as direct investors. The foundation of multinational corporations (MNCs) is foreign direct investment (FDI), as many MNCs are based in other countries. In addition, multinational corporations (MNCs) are a significant driver of foreign direct investment (FDI), accounting for as much as ninety-five percent of global FDI flows. Foreign direct investments, in contrast to foreign bank loans and foreign portfolio investments, involve the existence of a long-term relationship between the direct investor and the enterprise, as well as the direct investor being significantly influenced in the administration of the business.³

Several researchers and policymakers believe that the development efforts of the host nation might potentially benefit considerably from foreign direct investment. Foreign direct investment (FDI) may not only be a source of direct equity investment, but it may also be an important source of technology, assist economic growth, and strengthen links with local enterprises. These explanations have prompted rich governments as well as developing nations to offer incentives in an effort to enhance the amount of FDI that enters their economy.

If a company is willing to participate in international commercial partnerships and investments, we call that company a multinational corporation since it demonstrates that it conducts business on a global scale. As a consequence of this, multinational corporations (MNCs) play an essential role in the growth of foreign direct

³ Kuemmerle, W. (1999). The drivers of foreign direct investment into research and development: An empirical investigation. *Journal of international business studies*, 30(1), 1-24.

investment (FDI). Multinational corporations frequently move certain steps of the production process to other countries that they believe have superior economic conditions.

The concept of the "home country," which is another component that will assist in gaining a better understanding of foreign direct investment (FDI), refers to the country in which multinational corporations (MNCs) that participate in FDI primarily conduct their business and house their management and control centers. A number of factors, such as the inadequacy of the technology available in the home country, the absence of a market in which the necessary profit can be made, and the high cost of labor and production, effectively force multinational corporations to search for new markets outside of their country of origin. The investments that multinational corporations make in a host country bring with them a plethora of benefits that are not available in the home nation.⁴

Neoclassical school of thought interpret investment as an increase in the demand for resources. As a result, the investment takes into account the complete expansion of manufacturing facilities, including fundamental circulation and liquidity. The circumstances that necessitate the investment are many and can be categorized into three categories: the expansion of production activity, the establishment of a new type of activity, and the renewal of the existing material technical foundation. In general, the success of investment projects is what will decide the economic development of society as a whole as well as the enhancement of the overall material well-being of each individual citizen.

In recent times, however, there has been a shift toward calling into question the specific merits of foreign direct investments and, more specifically, the types of incentives that are provided to foreign companies. The empirical evidence for foreign direct investment (FDI) to provide beneficial spillovers for host nations is questionable on both the micro and the macro levels, which feeds into the argument and contributes to its momentum. Hanson (2001) argues in a recent literature assessment that the evidence for beneficial spillover effects of foreign direct investment (FDI) for host nations is scant.⁵

Gorg and Greenwood (2002) reached this conclusion by analyzing the microdata on overseas spillovers from enterprises that were held by foreign entities and found that the effects were predominantly negative.⁶ In his

⁴ Aharoni, Y. (2015). The foreign investment decision process. In *International Business Strategy* (pp. 24-34). Routledge.

⁵ Alfaro, L., Rodríguez-Clare, A., Hanson, G. H., & Bravo-Ortega, C. (2004). *Multinationals and linkages: an empirical investigation* [with Comments]. *Economia*, 4(2), 113-169.

⁶ Alfaro, L. (2003). *Foreign direct investment and growth: Does the sector matter*. Harvard Business School, 2003, 1-31.

analysis of the micro literature, Lipsey (2002) adopts a more optimistic stance and says that there is evidence to support the good impacts that have been observed.⁷ Lipsey came to the conclusion after conducting a search for macro-experimental studies that there is no consistent association between the amount of internal FDI stocks and their flows in relation to GDP and growth. In addition to this, he contends that more thought ought to be paid to the myriad of factors that either inhibit or stimulate the occurrence of spillover occurrences.

Investment initiatives are pursued by both the public sector and the private sector (also known as civil society). Investing in the public sector is done by a variety of entities, including government agencies, private enterprises and institutions, and non-profit organizations. A type of private investment activity known as non-state investment is carried out by a business that is not a subsidiary of another business, organization, or government body. In addition, there are operations involving investments made in international markets that are carried out by citizens of other countries, enterprises, governments, and other organizations. The institutional foreign investment environment is created through these many efforts.

Those activities referred to as "joint investment operations" are those that are carried out in the public and private sectors jointly by domestic and international companies. An investment strategy is a course of action adopted at various points along the investing process, and it is something that is only known to the investor and the investor's team. The investment habitat is the location where these events take place. The ultimate result of investing activities in an investment environment is the investor, entrepreneur, or businessman bringing in a profit or increasing their income.

Investment acts as a stimulant for both macroeconomic and microeconomic growth. It lays a financial foundation that may be used to improve structural changes in the country, accelerate e-businesses, and raise performance standards. The country's socioeconomic transformations, improvements to the production and social infrastructure, and capitalization of investment activity are all strongly tied to the country's escalating radical economic reforms. Moreover, improvements to the country's production and social infrastructure have already begun.

Despite the fact that global corporations and the natural consequences of their presence, specifically foreign direct investment, are the most real and most discussed problems of today, the theories on this subject

⁷ Assaf, A. A. (2014). The Effect of Macroeconomic Variables on Jordan's Economic Growth. *European Journal of Social Sciences*, 42(1), 101-111.

have not yet reached a sufficient level of maturity. Competitive Advantage and its analysis, also known as the Heckscher-Ohlin Model, provide the basis for the standard approach to the study of international trade theory. This model was developed by Heckscher and Ohlin.⁸

According to Smith's Law of Supremacy, which promotes the advantages of unrestricted international trade, every country should develop expertise in producing goods that are particularly well-suited for the market in which it operates. Despite being correct in most ways, this method did not take into account a significant portion of the spatial specialization present. For instance, a nation might have a natural advantage over several different commodities, or even over all the things currently available in the market. The absolute benefit theory has reached its conclusion regarding this particular set of circumstances. Ricardo's comparative advantages, established by the Theory of Comparative Advantages, aimed to erase these shortcomings to make the system more efficient, with the goal of making it more effective. According to this theory, if a nation produces commodities that may be sold at a price comparable to that of other nations, it should import and export those items, as well as buy them from other nations. If countries take care of their limited factors of production, they will be able to employ those factors to their full potential.

According to Lipsey (2004), his macroeconomic theory views foreign direct investment (FDI) as a specific kind of capital movement across national boundaries, from home nations to host countries, measured in balance of payments statistics. Lipsey defines FDI as "a particular kind of capital movement across national boundaries from home nations to host countries." These flows are responsible for a specific accumulation of capital in the host nations. Capital, in this context, refers to the value of local nation investments in businesses and can be characterized as follows: These investments are frequently made in companies that are overseen by a nation's owner or in which a country owner has a specified voting position.

Alternatively, these investments may be made in enterprises that are owned by a country. In addition to this, Lipsey (2004) points out that the variables of interest are the financial capital flow, the value of the capital stock accumulated by the investing businesses, and the income flow that is the outcome of the investments made. Examples of macro-level determinants that affect a host country's ability to attract foreign direct investment include institutional factors such as market size, economic growth rate, gross domestic product (GDP),

⁸ Leamer, E. E. (1995). The Heckscher-Ohlin model in theory and practice.

infrastructure, natural resources, and the country's political stability (FDI). In the following, we shall examine a variety of possible hypotheses.⁹

One of the early hypotheses that attempted to explain FDI was known as the Capital Market Theory. This theory, also known as the Currency Space Theory, is acknowledged as one of the early hypotheses. When contrasted with currencies in a stronger position, weaker currencies have a greater potential to attract foreign direct investment (FDI) and are better positioned to capitalize on shifts in the rate at which market capitalization is valued. Portfolio investors only have a superficial understanding of the MNC from the source country; as a result, they can borrow money at a lower interest rate than businesses operating in the host nation. Source country multinational corporations based on stable currencies are eligible to borrow money. This gives companies based in the source nation a competitive advantage when it comes to borrowing money, as these companies can obtain funding for their foreign subsidiaries and subsidiaries at lower costs than local companies can obtain the same amount of cash. This gives these companies an advantage over local companies when it comes to borrowing money.¹⁰

Even though this theory of the capital market can be applied to industrialized nations like the United States, the United Kingdom, and Canada, later academics have cast doubt on its validity on the grounds that it ignores the fundamentals of currency risk management. This is despite the fact that this theory of the capital market can be applied to industrialized nations like the United States, the United Kingdom, and Canada. Nayak and Choudhury (2014) do not explain that Aliber's theory does not explain investment between two developed countries with currencies that are similar to each other in terms of development, nor do they explain how MNCs from developing countries can invest in developed countries with weak currencies. Neither of these explanations is provided by Nayak and Choudhury (2014). This point is driven home by the example of Chinese enterprises that have substantial financial stakes in the economies of other countries, notably the United States and the United Kingdom.¹¹

⁹ Lipsey, R. E., Feenstra, R. C., Hahn, C. H., & Hatsopoulos, G. N. (1999). The role of foreign direct investment in international capital flows. In *International capital flows* (pp. 307-362). University of Chicago Press.

¹⁰ Bar-Yosef, S., & Kolodny, R. (1976). Dividend policy and capital market theory. *The Review of Economics and Statistics*, 181-190.

¹¹ Nayak, D., & Choudhury, R. N. (2014). A selective review of foreign direct investment theories.

Although good behavior and the reasons for its location have an effect on where foreign direct investment is located, the ultimate decision that determines this is based on economic geography. This is not a microeconomic decision; rather, it is a macroeconomic decision because it takes into account the features of each particular country. Researchers believed that the theory might explain the success of foreign direct investment (FDI) among countries by basing it on a nation's level of wealth. This includes the utilization of natural resources, the accessibility of labor, the size of the local market, the infrastructure, as well as the government's policy regarding these national resources. However, this location-based hypothesis is challenged by the gravitational gravity approach to foreign direct investment (FDI).

If two countries are geographically, economically, and culturally comparable to one another, it is hypothesized that there will be a flow of foreign direct investment (FDI) between the two countries. Important predictors of foreign direct investment (FDI) flows include similar criteria such as size, degree of development, distance, and common language, in addition to extra institutional elements such as shareholder protection and trade openness. Yet, this perspective of foreign direct investment economics is overly simplistic because FDI flows are more complex than merely being about ties between nations. Being physically close to one another can reduce the cost of transportation, but it does not necessarily reduce the cost of labor if two businesses are competing with each other. In addition, the fact that two countries have a common culture does not necessarily result in an increase in the amount of money made or the amount of business conducted between those countries.

The term "FDI fitness" was coined by Wilhems and Witter (1998) in response to the idea that a nation's capacity to attract, retain, and utilize foreign direct investment (FDI) served as the impetus for the development of the concept. Whether or not a nation is successful in luring investment is directly proportional to its capacity to meet both the internal and external expectations of its business community.¹²

The theory itself makes an attempt to explain why flows of foreign direct investment (FDI) are not spread uniformly across countries. FDI stands for "foreign direct investment." The view that Wilhelm has concerning the suitability of firms in reference to overseas direct investment is supported by the four pillars of relevant government, market, education, and sociocultural factors. According to Wilhelms and Witter (1998), the level of the pyramid that is the most fundamental is made up of socio-cultural aspects. These elements are the institutions

¹² Makoni, P. L. (2015). An extensive exploration of theories of foreign direct investment. *Risk Governance & Control: Financial Markets and Institutions*, 5(2), 77-83.

that have been around the longest and are the ones that are the most difficult to understand. The authors' assertion that educated human capital is necessary to create an environment that is appealing to foreign direct investment is supported by the fact that education increases inventiveness in R&D and the ability to process knowledge. In addition to this, education creates an environment that is more attractive to foreign direct investment. Since the criteria for foreign direct investment (FDI) are set by the various skill requirements of the projects that are to be carried out, it would appear that the actual degree of education does not matter all that much for FDI. One thing is certain, however, and that is the fact that the efficiency of FDI activities can be affected by the level of education one possesses at the most fundamental level. This is due to the fact that fundamental education may give formative training, such as speaking, hearing, comprehending, interpreting, and implementing the keys that are required to attract foreign direct investment (FDI).¹³

2.2 Innovation - theoretical framework

In today's economy, whether it is a developed or a developing country, it needs innovation in order to survive and gain momentum. Innovation adds vitality to economies. It develops companies, increases competition and ensures that competing markets are followed. Innovations adopted to develop a foreign market also increase export performance.¹⁴ Innovation can be realized in many areas such as product, service, organization, marketing, process. Creativity is the basis of innovation. Creativity, which is realized to provide added value to internal and external customers in any subject, is the main subject of all companies today.

In the literature research conducted for this study, mostly product innovations were encountered, and product innovations are generally considered together with technological development. In the literature, product innovation is also referred to as technological innovation. OECD (2006) research lists the reasons for the increase in innovation and R&D as follows.

- 1) With the legal regulations on non-competitive products, companies are supported to increase their R&D activities and incentives for innovation are increased.
- 2) Stable macro-economic conditions and low real interest rates create a stable and low-cost environment for investment in innovation, encouraging the increase in innovation activities.

¹³ Ibid

¹⁴ Azar, G., & Ciabuschi, F. (2017). Organizational innovation, technological innovation, and export performance: The effects of innovation radicalness and extensiveness. *International business review*, 26(2), 324-336.

- 3) Accessible internal and external financial resources.
- 4) Expanding public research supporting sectoral research. Doing both at the same time will increase the need for human resources.
- 5) The application of financial incentives affects the increase in R&D activities, especially when companies are faced with financial pressure. Tax exemption for R&D studies may be more encouraging for companies than direct government support. The reason for this is that the purpose of direct government incentives is to meet the needs of the government such as energy, defense, or security, rather than encouraging R&D studies in the private sector.
- 6) To be open to foreign R&D activities, especially when domestic R&D investments and capacities are high.

Research on innovation and organizations such as WTO and OECD have made definitions about innovation. In the Oslo Manual 3rd Edition (2019), innovation is the application of a new or significant development in a product (good or service) or process, a new marketing method, or a new way of doing business, in the organization at work, or in external relations. has been defined as. As can be understood from this definition, the application area of innovation can vary as product or service, process, marketing and organization.

Drucker and Maciariello (2008) emphasized that the purpose of the company is to create customers and that this goal can only be achieved through two basic functions such as marketing and innovation. Marketing and innovation produce results, everything else is costs.¹⁵ In the literature research, there are studies emphasizing that invention and innovation do not have the same meaning. Roberts (1988) made a clear distinction between invention and innovation and stated that invention produces an idea, while innovation deals with invention and utility together. As can be understood from the definition of Roberts (1988), the combination of invention and utility is innovation. Not every invention is an innovation.¹⁶ According to Sher and Yang (2005), innovations can be classified into two groups according to the innovation level of technology:¹⁷

¹⁵ Drucker, P. F., & Maciariello, J. A. (2008). *Management: revised edition*. Collins, New York.

¹⁶ Roberts, E. B. (1988). What we've learned: Managing invention and innovation. *Research-Technology Management*, 31(1), 11-29.

¹⁷ Sher, P. J., & Yang, P. Y. (2005). The effects of innovative capabilities and R&D clustering on firm performance: the evidence of Taiwan's semiconductor industry. *Technovation*, 25(1), 33-43.

1) Radical innovations can be defined as obtaining a product that did not exist before by engaging in R&D activities. In addition, radical innovations have a destructive feature as they can make the previous innovation ineffective. For example, the production of a new vaccine or microprocessor.

2) Incremental innovations can be expressed as the improvement of the benefit of an existing product without the need for intensive R&D work. It only increases product variety and therefore does not have the destructive effect of radical innovations. For example, introducing 32-bit-chip electronics instead of 16-bit-chip.

Radical innovation offers companies great opportunities in terms of growth and expansion of the market segment. Radical innovation enables companies to establish a competitive position in the market and enables new companies to gain a solid place in the market.¹⁸ Biemans (2018) defined the development of innovation as the process of producing a new product, the adaptation process of a new product, the process of obtaining derivatives from the new product itself. Innovations can be carried out within companies, mostly in R&D departments, or they can be realized with support from sources outside the company. In this way, innovations are divided into two.¹⁹

1. Closed innovations (CI): Innovations realized using resources within the firm. Closed innovation is an old innovation model where R&D activities take place within the boundaries of the firm. From the perspective of closed innovation, in order to achieve a successful innovation, the production and spread of innovation must be controlled by innovative firms.²⁰

2. Open innovations (OI): These are the innovations realized by the firm by outsourcing. Firms are constantly exposed to increasing pressure due to the competitive environment, the increase in speed and the rise in customer demands. Research and development departments are often unable to fulfill their duties and become dysfunctional due to this increased pressure. As a result, unlike closed innovation, companies tend to acquire knowledge from outside, such as purchasing know-how or getting support from universities.²¹ Open innovation is based on the

¹⁸ Xin, J. Y., Yeung, A. C., & Cheng, T. C. E. (2008). Radical innovations in new product development and their financial performance implications: An event study of US manufacturing firms. *Operations Management Research*, 1, 119-128.

¹⁹ Biemans, W. G. (2018). *Managing innovation within networks*. Routledge.

²⁰ Da Silva, M. A. (2019). Open innovation and IPRs: Mutually incompatible or complementary institutions?. *Journal of Innovation & Knowledge*, 4(4), 248-252.

²¹ Niehaves, B. (2010). Open process innovation: The impact of personnel resource scarcity on the involvement of customers and consultants in public sector BPM. *Business Process Management Journal*.

flow of information managed using monetary and non-monetary resources appropriate to the innovation that the firm wants to realize.²² On the other hand, open innovation processes generally do not allow to outsource all innovation activities. Instead, internal and external innovation activities need to be combined and integrated. In particular, the interfaces of these activities should be designed to facilitate the flow of ideas.²³ Directly linking other stakeholders such as customers or universities and intermediary institutions that have a common interest in increasing the company's income, especially in ensuring its sustainability, can be the basis for the use of open innovation. In addition, the involvement of collaborators can help the firm gain intelligence and knowledge that can be useful for innovation activities and overcome market failures.²⁴

2.3 FDI Spillovers and Innovation

The importance of foreign direct investment (also known as FDI) cannot be overstated in the context of international trade and investment. An investment that is made by a foreign entity, typically a corporation or government, in a business or sector that is located in another country is what is known as foreign direct investment (FDI). Foreign direct investment is known to bring several benefits to the country that receives it. Some of these benefits include employment opportunities, the transfer of technology, and innovation spillovers. The effects of foreign direct investment (FDI) on innovation have been the subject of a great deal of research over the past few years. This essay will discuss foreign direct investment (FDI) spillovers and innovation, focusing on the significance of both topics while also investigating the various types of spillovers.²⁵

The ability to innovate is one of the most important factors in economic expansion and development.²⁶ The transformation of ideas into tangible goods, services, and operational procedures is the method by which value is generated for a society. A number of different factors, such as research and development, educational and training opportunities, and access to capital, can all play a role in driving innovation. Foreign direct

²² Chesbrough, H., & Bogers, M. (2014). Explicating open innovation: Clarifying an emerging paradigm for understanding innovation. *New Frontiers in Open Innovation*. Oxford: Oxford University Press, Forthcoming, 3-28.

²³ Lichtenthaler, U. (2016). Five steps to transforming innovation processes: continually adjusting to new environments. *Journal of Business Strategy*, 37(5), 39-45.

²⁴ Rauter, R., Globocnik, D., Perl-Vorbach, E., & Baumgartner, R. J. (2019). Open innovation and its effects on economic and sustainability innovation performance. *Journal of Innovation & Knowledge*, 4(4), 226-233.

²⁵ Lu, Y., Tao, Z., & Zhu, L. (2017). Identifying FDI spillovers. *Journal of International Economics*, 107, 75-90.

²⁶ Thompson, M. (2018). Social capital, innovation and economic growth. *Journal of behavioral and experimental economics*, 73, 46-52.

investment (FDI) carries with it the possibility of playing a significant part in the host nation's efforts to boost innovation. When companies from other countries invest in a country, they often bring with them new methods of production, technologies, and management practices that can result in innovation spillovers. These spillovers can manifest themselves in a number of different ways, including the transfer of technologies and knowledge as well as network effects.²⁷

Technology transfer is one of the primary forms of Foreign Direct Investment spillovers. The act of passing on one organization's technological capabilities, expertise, or body of knowledge to another is referred to as "technology transfer." When multinational corporations invest in a host nation, they frequently bring cutting-edge technology with them, which may or may not already exist in the host nation. It is possible for there to be an increase in the level of technological capabilities in the host country as a result of the transfer of technology from foreign firms to domestic firms. This has the potential to be beneficial not only for domestic companies but also for the economy as a whole. Domestic businesses have the opportunity to boost their levels of productivity, efficiency, and competitiveness with the help of new technologies, while the economy as a whole stands to gain from higher rates of innovation.²⁸

Knowledge transfer is an additional type of foreign direct investment (FDI) spillover. The transfer of information, capabilities, or expertise from one entity to another in an unintended manner is an example of a knowledge spillover. This can happen when foreign companies hire workers from domestic companies, collaborate with domestic companies, or participate in research and development activities together with domestic companies. The knowledge that is passed on can be in the form of tacit knowledge, which is challenging to codify and pass on explicitly, or it can be in the form of explicit knowledge, which is simpler to pass on. The host nation may experience an increase in its overall level of knowledge and expertise as a result of knowledge spillovers, which may in turn stimulate innovative activity.

The term "FDI spillovers" actually refers to network effects as well. Network effects occur when the presence of a foreign firm in the host country creates positive externalities for other firms operating in the same sector. This can be beneficial for both the foreign firm and the host country. For instance, the presence of a

²⁷ Loukil, K. (2016). Foreign direct investment and technological innovation in developing countries. *Oradea Journal of Business and Economics*, 1(2), 31-40.

²⁸ Djulius, H. (2017). Foreign direct investment and technology transfer: Knowledge spillover in the manufacturing sector in Indonesia. *Global Business Review*, 18(1), 57-70.

multinational corporation in a specific industry can lead to the formation of a network of suppliers and customers that can be of use to domestic corporations operating in the same industry. The network effects may result in an increase in the amount of competition, innovation, and productivity in the country that is being hosted.²⁹

The host nation may reap multiple benefits as a result of the spillover effects of foreign direct investment (FDI) on innovation. The rise in both productivity and efficiency is one of the most important advantages brought about by this. When foreign companies invest in a host nation, they bring with them innovative technologies, processes, and management practices that have the potential to improve the levels of efficiency and productivity of the domestic firms. This may result in an increase in the amount of output as well as the competitiveness of the country that is hosting the event. The higher level of innovation that results from FDI spillovers is yet another advantage of this type of investment. The development of new markets and an increase in the overall level of consumer welfare can both be facilitated by innovation, which can lead to the production of new goods and services. Foreign direct investment (FDI) spillovers can lead to an increase in the level of innovation if they provide access to new technologies, knowledge, and expertise for domestic businesses.

Spillovers from foreign direct investment can also result in an increase in the number of people employed in the host nation. When international businesses invest in a host nation, they often end up providing locals with employment opportunities. The rise in the number of available jobs has the potential to bring about improvements in both the standard of living and the level of poverty. In addition, when domestic businesses boost their levels of productivity and innovation, they are able to generate additional employment opportunities, which results in an employment boost that has a multiplier effect.³⁰

Even though there is the possibility that foreign direct investment will have a positive impact on innovation, there are still some obstacles that need to be overcome. One of the challenges is the possibility that the transfer of technology will be restricted to just a few specific industries or companies. This can lead to the development of a technological divide between different sectors or firms in the host country, which can limit the potential for innovation spillovers.

²⁹ Vujanović, N., Stojčić, N., & Hashi, I. (2021). FDI spillovers and firm productivity during crisis: Empirical evidence from transition economies. *Economic Systems*, 45(2), 100865.

³⁰ Abor, J., & Harvey, S. K. (2008). Foreign direct investment and employment: host country experience. *Macroeconomics and finance in emerging market economies*, 1(2), 213-225.

Another challenge is the potential for foreign firms to engage in knowledge hoarding, which can limit the potential for knowledge spillovers. Foreign firms may be reluctant to share their knowledge and expertise with domestic firms, either to protect their intellectual property or to maintain a competitive advantage. This can limit the potential for domestic firms to benefit from the presence of foreign firms in the host country. Moreover, the potential for network effects to occur is dependent on the level of interaction and collaboration between foreign and domestic firms. If foreign firms are isolated from domestic firms, then the potential for network effects to occur is limited. Therefore, policies that encourage collaboration and interaction between foreign and domestic firms can help to maximize the potential for network effects to occur.

2.4 Government Institutions and Innovation

The processes of innovation in each nation are significantly influenced by the actions of their respective governments. They are an essential component in the formation of an atmosphere that is receptive to innovation, and they offer support to both individuals and organizations that are actively engaged in innovative endeavors. This support can be provided in a variety of ways, including financial assistance, tax incentives, and regulatory frameworks that encourage innovation. In this essay, we will investigate the relationship between governmental institutions and innovation, as well as the various ways in which governments can support and promote innovation in their respective fields.³¹ To foster an atmosphere that is open to new ideas and concepts is one of the most significant responsibilities that fall under the purview of government institutions. This involves the establishment of policies and regulations that encourage the development and implementation of new ideas and technologies. Specifically, the phrase "new ideas and technologies" is used. For instance, governments can lend their support to research and development (R&D) efforts by providing financial assistance to academic institutions such as universities and research centers. They are also able to offer tax incentives to businesses that participate in research and development or invest in emerging technologies.³²

In addition to cultivating an atmosphere that encourages innovative endeavors, the role of government institutions can also include providing direct support for innovative endeavors. For instance, they are able to offer

³¹ He, J., & Tian, X. (2020). Institutions and innovation. *Annual Review of Financial Economics*, 12, 377-398.

³² Berry, F. S., & Berry, W. D. (2018). Innovation and diffusion models in policy research. *Theories of the policy process*, 253-297.

financial support to newly established companies as well as small businesses that are involved in innovative endeavors. Businesses that make investments in emerging technologies or participate in research and development may be eligible for government subsidies or other forms of financial incentive. The provision of the infrastructure and other resources essential to the creation and application of new technologies is another way in which governments can contribute to the promotion of innovation. They could, for instance, provide funding for the construction of research facilities or for the development of new transportation systems, both of which will make it easier to distribute innovative goods and services.

In the area of intellectual property rights (also known as IP rights), government institutions play an additional significant role in the process of technological innovation. The intellectual property rights of individuals and businesses that participate in innovative activities can be safeguarded through the establishment of laws and regulations by governmental entities. This can include things like patents, trademarks, and copyrights, all of which serve to offer ideas and technologies that are developed as a result of innovative activities some form of legal protection.³³

Government institutions have the potential to play a role in the dissemination of new technologies as well as the adoption of those technologies, in addition to their role in the creation of an environment that is conducive to innovation. For instance, they could provide funding for the creation of training programs that instruct individuals and organizations on how to make use of newly developed technologies. They are also able to establish regulations that require businesses to adopt new technologies in order to improve the efficacy of their operations and maintain a competitive edge in the market.³⁴

Last but not least, institutions of the state have a part to play in the process of encouraging international cooperation and collaboration in the field of innovation. They have the ability to establish programs and initiatives that encourage the sharing of knowledge and expertise across international borders, and they have the ability to provide funding for collaborative research and development projects. Historically, communities have encouraged the generation of new ideas using many methods. One of them is intellectual property right. Intellectual property rights include patent, copyright and trademark registration, which differ from each other in terms of scope,

³³ He, J., & Tian, X. (2020). Institutions and innovation. *Annual Review of Financial Economics*, 12, 377-398.

³⁴ Hall, B. H., & Khan, B. (2003). Adoption of new technology.

structure and application conditions. These methods ensure that the person who finds a new idea or a new product has a monopoly on the production of that idea or product. Yueh (2009) stated that a property rights system should be included in patent law in a way that will protect the innovation returns and also increase the drive towards innovation by protecting against expropriation.³⁵

In the empirical study by Suzuki (2015), it was determined that firms do not remain dependent on patent protection in cases where the emergence of trade secrets is low. Conversely, when its occurrence is high, firms patent their inventions, and strengthening patent protection significantly increases the firm's profits. In this case, he emphasized that the strengthening of patent protection increases economic growth.³⁶

2.5 The Role of Institutions in FDI Spillovers

The extent to which FDI spillovers occur and the nature they take are both determined by a number of different factors. These factors include the characteristics of the foreign investor, the characteristics of the domestic firm, the industry, and the institutional framework of the host country. In this analysis, the function of institutions in foreign direct investment spillovers is the primary point of emphasis.

In order to successfully attract foreign direct investment (FDI) and facilitate FDI spillovers in the host country, institutions play a critical role. Institutions are the formal and informal rules that govern the behavior of individuals, firms, and governments. Institutions can be broken down into two categories: formal and informal. A nation's institutional framework is comprised of its legal system, regulatory framework, structure of governance, and protection of property rights, among other components.

Institutions contribute to ensuring that foreign investors are able to have faith that their investments will be protected and that they will be able to conduct business in an environment that is stable and predictable.

In addition, strong institutions can boost the potential for foreign direct investment spillovers by encouraging healthy competition, facilitating access to skilled labor, and encouraging innovative thinking. For instance, effective patent systems can encourage technology transfer from foreign investors to domestic firms, while robust anti-monopoly regulations can prevent foreign firms from dominating local markets. Both of these factors are important in fostering economic growth.

³⁵ Yueh, L. (2009). Patent laws and innovation in China. *International Review of Law and Economics*, 29(4), 304-313.

³⁶ Suzuki, K. (2015). Economic growth under two forms of intellectual property rights protection: patents and trade secrets. *Journal of Economics*, 115, 49-71.

On the other hand, having weak institutions can limit the potential for foreign direct investment spillovers. A decrease in the amount of foreign direct investment (FDI) that a country receives may be the result of factors such as corruption, which can erode the confidence of foreign investors in the host nation's legal and regulatory system. When regulatory environments are inefficient, the cost of doing business goes up, and it becomes more difficult for foreign companies to compete with domestic companies. This can discourage foreign direct investment (FDI).

The connection between institutions and foreign direct investment spillovers has been the subject of investigation in a number of studies. According to the findings of some studies, robust institutions are required for foreign direct investment spillovers to take place, whereas the findings of other studies suggest that weak institutions may also help facilitate FDI spillovers. The following channels can be used to gain an understanding of the impact that institutions have on the spillovers of foreign direct investment (FDI):

1. Property rights protection:

Protection of property rights is a prerequisite for foreign direct investment spillovers to take place. A robust protection of property rights ensures that foreign investors can legally enforce their intellectual property rights and that the knowledge and technology they bring to the host country are not inappropriately appropriated by the government of that country. This protection gives foreign investors the necessary incentives to share their expertise and technology with domestic businesses, which helps to foster economic growth. Multiple studies have come to the conclusion that nations that have stricter protections for property rights have higher levels of foreign direct investment spillovers. For instance, Li and Liu (2005) find that the strength of intellectual property rights protection positively affects the level of FDI spillovers in China.³⁷ Similarly, Gorg and Strobl (2001) find that property rights protection is a significant factor in explaining FDI spillovers in the UK.³⁸

2. Regulatory framework:

The regulatory framework of a country can also have an effect on the amount of foreign direct investment that a country receives. Regulations that create a favorable environment for business, such as those that reduce red tape, ease entry and exit barriers, and ensure fair competition, can encourage foreign investors to transfer knowledge and technology to domestic firms. Examples of such regulations include: Several studies have found that a

³⁷ Li, X., & Liu, X. (2005). Foreign direct investment and economic growth: an increasingly endogenous relationship. *World development*, 33(3), 393-407.

³⁸ Gorg, H., & Strobl, E. (2001). Multinational companies and productivity spillovers: A meta-analysis. *The economic journal*, 111(475), 723-739.

favorable regulatory framework can facilitate FDI spillovers. For instance, Wang and Blomstrom (1992) discover that the magnitude of regulatory reform has a positive correlation with the amount of foreign direct investment (FDI) spillovers that occur in Mexico.³⁹ In a similar vein, Javorcik (2004) discovers that a regulatory environment that is friendly to business is an essential component in luring foreign direct investment (FDI) and encouraging FDI spillovers in Central and Eastern Europe.⁴⁰

3. Governance structure:

The manner in which a nation is governed is another factor that can have an effect on the volume of foreign direct investment spillovers. Good governance ensures that public officials act in the best interest of the country, creates an environment that is politically stable, and provides a level playing field for all businesses, both domestic and international. When considering making long-term investments or providing domestic companies with knowledge and technology, foreign investors must have the assurance that the political climate will remain stable. Several studies have come to the conclusion that there is a positive correlation between the level of good governance and the amount of FDI spillovers. For example, Blomstrom and Kokko (1998) discover that nations with strong governance have higher levels of foreign direct investment (FDI) spillovers.⁴¹ Similarly, Habib and Zurawicki (2002) find that the quality of governance is an important factor in explaining FDI spillovers in developing countries.⁴²

4. Human capital

The knowledge, experience, and capabilities of an employee pool are collectively referred to as their "human capital." The availability of skilled labor can make it easier to attract foreign direct investment (FDI) spillovers, since international investors can tap into the local talent pool to share their expertise and transfer technology to homegrown businesses. According to the findings of a number of studies, the availability of human capital has a significant positive correlation with the amount of FDI spillovers. For instance, Kokko and Tingvall (2008) find

³⁹ Wang, J. Y., & Blomström, M. (1992). Foreign investment and technology transfer: A simple model. *European economic review*, 36(1), 137-155.

⁴⁰ Javorcik, B. S. (2004). The composition of foreign direct investment and protection of intellectual property rights: Evidence from transition economies. *European economic review*, 48(1), 39-62.

⁴¹ Blomström, M., & Kokko, A. (1998). Multinational corporations and spillovers. *Journal of Economic surveys*, 12(3), 247-277.

⁴² Habib, M., & Zurawicki, L. (2002). Corruption and foreign direct investment. *Journal of international business studies*, 33, 291-307.

that countries with higher levels of human capital have higher levels of FDI spillovers.⁴³ Similarly, Alfaro et al. (2009) find that the availability of skilled labor is an important factor in explaining FDI spillovers in Latin America.⁴⁴

2.6 Linking R&D Strategy and FDI inflow

The link between R&D strategy and FDI is a complex one. The two are intertwined in various ways, and the success of one often depends on the success of the other. In this section, we will explore some of the key ways in which R&D strategy and FDI inflows are linked.

1. Access to new markets and resources:

Foreign direct investment can provide multinational corporations with access to new consumer markets and resources in those nations in which the FDI is made. This can be especially useful for research and development efforts, as multinational corporations are able to draw into the resources and knowledge available in the local area to develop new goods and technologies. For instance, a food and beverage corporation might make an investment in a foreign nation in order to get access to the agricultural resources that are available there and to create new goods that are adapted to the preferences of the people who live there. Similarly, a technology business may choose to make an investment in a nation in order to gain access to a new pool of consumers and to develop new products that are more suited to the requirements of the local market.

2. Collaborations and partnerships:

Foreign direct investment (FDI) can make it easier for multinational corporations and domestic businesses to work together and form partnerships. This can be especially useful for research and development efforts, as local companies may have specialized knowledge and insights that multinational corporations can leverage to boost their own R&D skills. Collaborations can also result in the creation of new technologies and goods that are superiorly suited to the particular markets in which they are introduced. For instance, a pharmaceutical

⁴³ Kokko, A., Ljungwall, C., & Tingvall, P. G. (2008). Economic Growth and Growth Linkages in China.

⁴⁴ Alfaro, L., Kalemli-Ozcan, S., & Sayek, S. (2009). FDI, productivity and financial development. *World Economy*, 32(1), 111-135.

corporation might form a partnership with a regional research facility in order to create new treatments that are specific to the diseases that are prevalent in the region.

3. Transfer of knowledge and technology:

Inflows of foreign direct investment (FDI) can make it easier for countries to share their expertise and technologies with one another. This can be especially significant for research and development activities because multinational corporations are able to bring their own knowledge and technology to the host country while simultaneously gaining information from local businesses and researchers. The development of new products and technologies that are better suited to local markets can be facilitated for multinational corporations by this factor. In addition, local businesses and academics may benefit from the transfer of information and technology since they are able to gain knowledge from multinational corporations (MNCs) and apply this knowledge to their own work. For instance, a semiconductor company might bring its own technology to a host country while simultaneously learning about new materials and techniques from experts based in that country.

4. Government incentives and support:

Inflows of foreign direct investment (FDI) can make it easier for countries to share their expertise and technologies with one another. This can be especially significant for research and development activities because multinational corporations are able to bring their own knowledge and technology to the host country while simultaneously gaining information from local businesses and researchers. The development of new products and technologies that are better suited to local markets can be facilitated for multinational corporations by this factor. In addition, local businesses and academics may benefit from the transfer of information and technology since they are able to gain knowledge from multinational corporations (MNCs) and apply this knowledge to their own work. For instance, a semiconductor company might bring its own technology to a host country while simultaneously learning about new materials and techniques from experts based in that country.

5. Access to talent:

Foreign direct investment can help multinational corporations access fresh talent pools. This might be of utmost importance for research and development activities, which require personnel with specific skills and training. Multinational corporations have the opportunity to tap into local talent pools and improve their research and development skills when they invest in a foreign location. This can assist them in the creation of new products

and technologies, as well as the improvement of those already in existence. For instance, a car manufacturer might make an investment in a foreign nation in order to get access to local talent that has experience in the design of electric vehicles.

The Organization for Economic Co-operation and Development (OECD) has created a variety of policies and initiatives to assist its member governments in improving their research and development (R&D) strategies and fostering innovation. These policies are intended to assist member nations in enhancing their research and development (R&D) performance, boosting their competitiveness, and propelling economic expansion. The creation of a robust innovation system is one of the primary goals that the OECD strives to accomplish through its many programs. To accomplish this goal, a network of institutions and stakeholders that collaborate to provide support for R&D and innovative endeavors needs to be established. Institutions such as universities, research institutes, private companies, and public agencies are all examples of this. Building a robust innovation system allows member states to cultivate an atmosphere that is encouraging of research and development and innovation, which in turn can attract foreign direct investment (FDI).

The OECD encourages its member states to invest in research and development as well as innovation in both the public and private sectors of their economies. This can include giving funds for both fundamental and applied research, in addition to assisting R&D activities carried out by firms. When member states invest in research and development and innovation, they have the ability to develop new technologies and products that are appealing to foreign investors. This, in turn, can contribute to an increase in the amount of FDI that is brought into the country. The OECD is committed to promoting another important strategy, which is the cultivation of a skilled labor force. Investing in education and training programs that can assist in establishing a pool of talented and skilled people who can support activities related to R&D and innovation is one way to accomplish this goal. It is possible for member states to entice foreign investors who are searching for access to talented and specialized individuals if they build skilled workforces and put those workers to work.

In addition, the OECD encourages policies and methods that enhance collaboration and partnership building amongst various stakeholders, including enterprises, researchers, and other interested parties. Creating networks and clusters of businesses and organizations that work together to support research and development and innovation is one way to accomplish this. Member states have the ability to establish an environment that is appealing to foreign investors by fostering collaboration and partnerships. These investors may be seeking

possibilities to engage with local enterprises and organizations. The OECD urges its member states to foster an environment that is conducive to research and development (R&D) as well as innovation by enacting policies that are positive and supportive. This can involve the creation of new rules and regulations that encourage the development of new technologies and products, as well as the provision of incentives for firms to invest in research and development as well as innovation. It is possible for member states to establish an environment that is appealing to foreign investors and, as a result, see an increase in the amount of foreign direct investment (FDI) that is brought in as a result of this.

2.7 OECD innovation policy approach

According to the Organization for Economic Cooperation and Development (OECD), the purpose of national innovation policy is to overcome market failures in order to achieve optimal investment in research and development (R&D) and innovation. Because of the high level of risk that is connected with the creation of new technologies, market mechanisms by themselves are unable to supply sufficient investment in research, which results in investment levels that are lower than the level that is socially optimal. Because of this, extensive action from the government is required in the funding of fundamental research and certain parts of innovation. The national innovation system is an essential component in elucidating the roles that various actors play in the development of skills and the commercialization of those skills, as well as the connections that should exist between those actors. The major responsibility of the government is to function as a conduit for communication and the exchange of information between various groups of actors.⁴⁵

In the majority of OECD nations, universities are managed by a council that is responsible for determining priorities. In 68% of OECD member countries, private sector participation is present on the administrative boards of universities. It is common practice in several nations to include representatives from small and medium-sized businesses (SMEs) on university councils. This helps to emphasize the institutions' commitment to collaborating with industry and facilitating the transfer of knowledge. The Swedish government's innovation agency, VINNOVA, as well as the policymakers responsible for innovation in Finland, use the metaphor of a triple helix

⁴⁵ Paic, A., and Viros, C. (2019, October). Governance of science and technology policies. OECD Science, Technology and Industry Policy Papers. No. 84.

to highlight the close collaboration that exists within the innovation system among government bodies, universities, other research institutions, and industries. In Finland, funding programs are meant to support enterprises of all sizes, universities, research institutions, and allied public sector institutions. In this way, the country is able to take full advantage of the triple helix strategy.

In countries that are members of the OECD, the establishment of institutions that are responsible for establishing national or regional benchmarks for the purpose of systematic evaluation and monitoring of universities and research institutes is becoming an increasingly prominent trend. There are similar agencies in 19 out of the 37 countries that make up the OECD, which accounts for around 51% of the countries. According to the OECD, the National Agency for the Evaluation of Universities and Research Institutes, which was founded in Italy in 2006, is one of the most famous examples of such an entity.

The decades immediately following World War II were marked by the proliferation of civil research and development departments as well as the emergence of government agencies that provide support for civil science and engineering. Its expansion was made possible in large part by the widespread conviction at the time that organized research and development might stimulate economic growth and lead to greater affluence. The Cold War era provided additional impetus for the expansion of research programs by government agencies, including those that were unrelated to the defense sector. This expansion led to the development of models for government-funded research and development carried out by private sector contractors. This institutional growth in the public sector's generation of scientific and technological information led to a large increase in the government's financial commitments for research and development (R&D). Despite the fact that the vast majority of research and development is carried out by non-governmental groups, governments have implemented a variety of tax and subsidy policies in an effort to entice private businesses to carry out R&D initiatives on their own.

When looking at the historical evolution of national innovation and R&D policies, it is clear that the current scientific systems of industrialized countries began to emerge predominantly in the 1950s. This is evident when reviewing the historical progression of these policies. Governments and universities in certain nations took a piecemeal approach to remedy deficiencies in the innovation process. One example of this is the founding of the National Research and Development Corporation in the United Kingdom in 1949 to promote and spread ideas. According to the World Bank, France formed sectoral technical centers to provide technical research, help, and information to industry, while Germany developed a Fraunhofer applied research and development system.

After 1950, the scientific ideology held that technology was a natural outcome of science and that all that governments needed to focus on was developing a strong scientific basis. This idea persisted to the present day. On the other hand, the market ideology held the belief that innovation occurs naturally in a competitive business environment, and that the role of government should be limited to ensuring that competition is fair and funding public goods, such as fundamental research, when the private sector is unable to do so. Both ideologies, despite their divergent points of view, worked together to advance their respective interests, and governments started taking special measures to encourage innovation. This was largely driven by initiatives taken during World War II and the active role that governments played in the development of defense technologies. During the 1960s and 1970s, the efforts of the government were predicated on the linear model of innovation, which placed an emphasis on the implementation of scientific and academic findings in many fields of industry and technology.

During this time period, the newly established OECD used the Office of Scientific Affairs as its primary conduit for directing the formation of national science policy. From 1961 until the publication of literature on national innovation systems, the OECD produced several policy documents that focused on the institutional and contextual aspects of research and development (R&D). These documents took a systems approach that divided R&D into four sectors: government, universities, industry, and non-profit organizations, in addition to the economic and international environment. These documents were produced until the literature on national innovation systems was published.

The Innovation and Technology Policy Working Group was founded by the OECD in 1993 with the purpose of promoting sustainable and inclusive knowledge-based economic growth and providing evidence-based policy guidance for scientific, technological, and industrial (STI) fields. The mission of this organization is to improve the effectiveness of public research institutions, foster the development of businesses focused on science and technology, and enhance the contribution of these organizations to innovation and economic performance.

During the 2000s, member nations of the OECD increasingly adopted the strategy of establishing organizations designed to foster national innovation and research activities. For instance, Poland's Ministry of Science and Higher Education established the National Center for Research and Development to promote innovation and competitiveness by supporting the planning and implementation of modern solutions and technologies in the field of economics. This helps to ensure that Poland remains at the forefront of economic innovation.

In 2009, European ambulance services, university health research institutions, hospitals, and other healthcare organizations came together to form a cooperative known as the European Smart Ambulance Provider Platform. Each member of the consortium brings a unique set of skills and experiences to the project, including expertise in areas such as ambulance manufacturing, cutting-edge emergency services, innovative public health practices, and project management. This project has the backing of a number of OECD countries, including Denmark and the Netherlands, among others.⁴⁶

The National Research Plan, a brand-new research development strategy, was presented to the public by the Dutch government in 2014. In order to provide the greatest amount of assistance to a wide variety of social groups, one of the key pillars of the development process was the utilization of digital platforms for public engagement. Throughout this portion of the event, participants are encouraged to ask the scientists questions of their own. In an effort to make society more relevant and accountable, the CIMULACT project, which is supported by the EU, got underway in 2015 with the process of redefining the European research and innovation agenda. More than one thousand people from thirty different countries are involved in the initiative, in addition to other participants. Through discussion and collaboration with other participants, as well as the formulation of ideas for future research and innovation policies and concerns, the project gives participants the opportunity to voice their vision for a desired and sustainable future.⁴⁷

The goal of publicly funded research and development projects is to encourage collaboration amongst the most appropriate partners, as well as participation from academic institutions and private industries located in other countries. Nanotechnologies, which are among the most significant achievements of national innovation and R&D, require collaboration between different departments and/or across international borders in order to realize their full potential. One such initiative is the European Union's Horizon 2020 global cooperation project, which will run from 2014 to 2020. This approach has four parts: research and development (R&D), innovation, scientific excellence, and industrial competitiveness and leadership, as well as addressing social concerns. Public support, which is frequently associated with funding from the United States Department of Defense, has been a major factor in the development of leading AI research institutions around the world, such as those located at Stanford University, Carnegie Mellon University, and the Massachusetts Institute of Technology (MIT).

⁴⁶ European Commission. (2019). European Innovation Scoreboard 2019: Methodology Report. European Commission

⁴⁷ OECD. (2018). OECD Science, Technology and Innovation Outlook 2018: Adapting to Technological and Societal Disruption. Paris: OECD Publications

Yet, recent developments in AI have made it easier for private companies to conduct more research and development in the field of AI. The five tech giants Google, Amazon, Apple, and Facebook spent a combined total of \$60 billion on research and development in 2017, with a significant portion of that money going into artificial intelligence. In comparison, the total amount spent by the United States government in 2017 on research and development for manufacturing and technology that was not related to defense was around 760 million dollars.⁴⁸

Because governments play such an important part in the process of developing new technologies, they frequently work to create an environment that is receptive to innovation. This can be accomplished through the government's direct or indirect support of technological development, as well as through the government's use of incentives and regulation. The macroeconomic, corporate, and governance aspects all have a significant bearing on the innovation climate. This is due to the fact that every society needs to develop its own methods and instruments for innovation in accordance with the specific requirements and capabilities of that society. Despite the nature of these conditions in low- and middle-income nations, a well-designed and executed innovation policy can be a useful tool for stimulating change and development within the larger framework of a country. This is the case even given the nature of these conditions in these nations. These nations have the potential to make significant economic and social advancements if they make use of and adapt the technology and knowledge that is available on a global scale to their specific conditions. Trade operations, such as the importation of equipment and goods, international enterprises, and brilliant diasporas, are all sources of knowledge and technology that can be acquired from other countries.

For decades, an objective of public policy in the nations that make up the OECD has been to encourage innovation in firms of all sizes, including SMEs. The focus on small and medium-sized enterprises (SMEs) is based on the presumption that these types of companies face unique barriers to research and development (R&D) and innovation, the majority of which can be traced back to flaws in the functioning of the market. As a result, the majority of governments in the OECD region participate in a wide variety of initiatives that promote research and development as well as innovation among businesses.

⁴⁸ OECD. (2018). OECD Science, Technology and Innovation Outlook 2018: Adapting to Technological and Societal Disruption. Paris: OECD Publications

In addition, governments, particularly educational institutions and public research institutes, are working to develop programs and policy instruments to improve innovation outcomes. These initiatives specifically support R&D collaboration, the transfer of knowledge and technology, or encourage co-creation for a multidimensional and more interactive perspective. The policy emphasis is evolving as a result of changes in global competitiveness and technological change, as well as the extent and volume of public assistance for research, development, and innovation; and the rising needs of the business sector in reaction to those changes.⁴⁹

Innovation outcomes govern innovation-oriented growth policies, particularly in developing nations. This is because innovation outcomes give a vast database of precise indicators and insights into the inputs and outputs of countries' innovation and research operations. In point of fact, individuals are inspired by innovation activities, particularly the younger generation of business owners in the economic unit and those who are actively interested in innovation activities. In addition, the performance of innovation is essential to the efficiency of the plans and programs that will be subsequently produced, developed, and implemented in the future.

Since 2007, Cornell University, which is headquartered in New York, the European Institute of Business Administration, which is located in France and is a European business university, and the World Intellectual Property Organization (WIPO) have collaborated to publish the Global Innovation Index. Professor Datta was the one who came up with the idea for the KIE project, which aims to find measurements and methods that better reflect the wealth of invention in society and go beyond the typical innovation measures that have been used previously.

⁴⁹ Hutschenreiter, G., Weber, J., and Rammer, C. (2019). Innovation Support in The Enterprise Sector: Industry and SMEs. OECD Science, Technology and Industry Policy Papers, 82.

3. Empirical literature review

Studies investigating the relationship between FDI and Innovation/R&D activities usually address the causal relationship between FDI and innovation/R&D, or investigate the effects of R&D activities on FDI.

Damijan et al. (2003) examined different channels of global technology transfer for the transition countries for the period of 1994-1998. It was concluded that direct foreign investments did not create positive sector spreads in terms of R & D activities.

Cheung and Lin (2004) used the provincial level data between 1995-2000 in their study for China. In the study, the panel data method was used, it was concluded that DYM had positive effects on the number of patent applications and thus affecting R & D activities positively.⁵⁰

According to Cheung and Lin (2004), there are several ways that foreign direct investments can benefit the innovation activities of local companies in the homeland country. The first is the reverse engineering that can be realized using the products and technology brought by investors to the country; Secondly, the participation of technical knowledge and experience in the company where foreign direct investment is made; The third is that local companies increase their R & D activities by trying to prove themselves.⁵¹

Multinational firms and their partners are important players in the regional innovation system. Multinational firms greatly trigger new technology research and innovation. In the study of Fu (2008) on the contribution of foreign direct investments to China on the contribution of regional innovation, it was concluded that foreign direct investments could greatly contribute to the regional innovation capacity. As a result of the research, foreign direct investments contribute to regional innovation in four ways. The first is Research and Development (R & D), the second is information spreaders, the third is competition, the fourth is the practices

⁵⁰ Cheung, K. Y., & Ping, L. (2004). Spillover effects of FDI on innovation in China: Evidence from the provincial data. *China economic review*, 15(1), 25-44.

⁵¹ Cheung, K. Y., & Ping, L. (2004). Spillover effects of FDI on innovation in China: Evidence from the provincial data. *China economic review*, 15(1), 25-44.

and experiences under innovation management. The power of this positive effect is that the host region depends on the suction capacity of the region and the accessibility of complementary assets.⁵²

Falk and Hake (2008) examined the relations between exports and FDI for the period of 1973-2004 using the data of 7 developed EU member countries. In the study, the panel causality test was used, it was concluded that there was a strong evidence that exports cause FDI and that R & D activities of the countries were the main determinant of this.⁵³

In Baskaran and Muchie (2008), they investigated the impact of DYY on R & D activities, taking into account the differences in the national innovation system. In the study conducted for BRICS countries between 1990-2006, the results achieved showed that foreign investments for R & D activities have a strong relationship with the national innovation system in these countries.⁵⁴

Sasidharan and Kasuria (2008) examined the relationship between R & D and DYY at the level of domestic companies. Panel data method was used in the study where 1,843 India firm, which operates in the manufacturing industry between 1994-2005, was used. As a result, it has been found that the DYY had no effect on R & D expenditures and that companies depend on increasing technology imports.⁵⁵

Pittiglio et al. (2009) found that the companies in the international markets in their fields of small and medium -sized companies in Italy produce more information compared to the companies that are in their fields and sell only to domestic. They stated that there were two reasons for this. First, companies with international relations include high innovation. The second is that international companies have access to a wide flow of ideas from outsourcing. Foreign capital companies perform better in providing new products and transactions than local companies.⁵⁶

⁵² Fu, X. (2008). Foreign direct investment, absorptive capacity and regional innovation capabilities: evidence from China. *Oxford development studies*, 36(1), 89-110.

⁵³ Falk, M., & Hake, M. (2008). A panel data analysis on FDI and exports (No. 012). *FIW-Research Reports*.

⁵⁴ Baskaran, A. & Muchie, M. (2008), "Foreign Direct Investment and Internationalization of R&D: The Case of BRICS Economies", *DIIPER Research Series*, 7, 1-34.

⁵⁵ Sasidharan, S., & Kathuria, V. (2011). Foreign direct investment and R&D: Substitutes or complements—A case of Indian manufacturing after 1991 reforms. *World Development*, 39(7), 1226-1239.

⁵⁶ Pittiglio, R., Sica, E., & Villa, S. (2009). Innovation and internationalization: the case of Italy. *The Journal of Technology Transfer*, 34, 588-602.

In the study carried out by Jalles (2010) using the data of 73 countries, direct foreign investments stated that innovation and technology spreads have a very few but positive effects on the growth of technology.⁵⁷ The relationship between policies related to foreign direct capital and innovation policies is essential for economic development.⁵⁸ In the study conducted by Branstetter and Saggi (2011), strengthening the right to intellectual property in host countries reduces the imitation rate and leads to an increase in foreign investment flows.⁵⁹ According to the research conducted by Garcia et al. (2013) through producer companies in Spain, the relationship between foreign direct investments realized on industry and firm basis and innovation activities of local companies is negative. In addition, foreign direct investments made to another country are dulling innovation in the investor country.⁶⁰ Anwar and Nguyen (2013) investigated the impact of DYD on total factor efficiency between 2000-2005 for eight regions of Vietnam. The results achieved in the study show that the impact of DYD on total factor efficiency has changed significantly according to regions. Accordingly, foreign direct investment has a strong positive effect on total factor efficiency in some regions, while this effect in other regions is negative and mostly insignificant.⁶¹

According to Sekuloska (2015), foreign direct investments are one of the most important channels to consider in order to acquire a new technology and support the invention process and to improve the domestic innovation capacity. Foreign collaborations can provide many advantages to companies such as accessing new information, developing new information and reducing innovation costs, decreasing risks related to R & D activities and innovation projects.⁶² In contrast, in some cases, the right to strong intellectual property may cause a decrease in foreign direct investments in the homeland country. However, according to Pece et al. (2015),

⁵⁷ Jalles, J. T. (2010). How to measure innovation? New evidence of the technology–growth linkage. *Research in Economics*, 64(2), 81-96.

⁵⁸ Guimón, J. (2011). Policies to benefit from the globalization of corporate R&D: An exploratory study for EU countries. *Technovation*, 31(2-3), 77-86.

⁵⁹ Branstetter, L., & Saggi, K. (2011). Intellectual property rights, foreign direct investment and industrial development. *The Economic Journal*, 121(555), 1161-1191.

⁶⁰ García, F., Jin, B., & Salomon, R. (2013). Does inward foreign direct investment improve the innovative performance of local firms?. *Research Policy*, 42(1), 231-244.

⁶¹ Anwar, S., & Nguyen, L. P. (2014). Is foreign direct investment productive? A case study of the regions of Vietnam. *Journal of Business Research*, 67(7), 1376-1387.

⁶² Sekuloska, J. D. (2015). Innovation oriented FDI as a way of improving the national competitiveness. *Procedia-Social and Behavioral Sciences*, 213, 37-42.

foreign direct investments have a great impact on the development of information transfer and technological processes.⁶³

Crescenzi et al. (2015) examined the effects of multinational companies on the innovation performance of multinational companies operating in the same sector for the UK. In the study of the 1998-2005 period, information production function was used at the company level. The findings obtained in the study reveal that domestic companies operating in the sectors in which MNC invest shows a stronger innovation performance.⁶⁴

According to the findings of Gao and Zhou (2017), foreign direct investment has the potential to improve a company's innovation performance in the United States. They argued that foreign direct investment could give companies access to new technologies, knowledge, and markets, all of which could enhance the innovative capabilities of the companies.

According to the findings of Wang et al. (2019), FDI has the potential to encourage the creation of innovative technologies and products in Canada. They argued that foreign direct investment could give companies access to new markets, resources, and knowledge, all of which could stimulate the innovation activities of the companies.⁶⁵

⁶³ Pece, A. M., Simona, O. E. O., & Salisteanu, F. (2015). Innovation and economic growth: An empirical analysis for CEE countries. *Procedia Economics and Finance*, 26, 461-467.

⁶⁴ Crescenzi, R., Gagliardi, L., & Iammarino, S. (2015). Foreign multinationals and domestic innovation: Intra-industry effects and firm heterogeneity. *Research Policy*, 44(3), 596-609.

⁶⁵ Feng, Y., Wang, X., Du, W., Wu, H., & Wang, J. (2019). Effects of environmental regulation and FDI on urban innovation in China: A spatial Durbin econometric analysis. *Journal of Cleaner Production*, 235, 210-224.

4. Methodological chapter

4.1 Research Aim

The aim of this research is to investigate the relationship between foreign direct investment (FDI) and innovation strategies of selected OECD countries. Specifically, this research aims to examine how FDI affects the development of innovation strategies in these countries and how innovation strategies can attract FDI inflows. To achieve the research aim, the following objectives will be pursued:

1. To review the literature on FDI and innovation strategies: This objective aims to examine existing literature on the relationship between FDI and innovation strategies. The literature review will help identify the key theoretical and empirical perspectives on the relationship between FDI and innovation strategies and guide the research methodology.
2. To investigate the relationship between FDI and innovation strategies: This objective aims to investigate the relationship between FDI and innovation strategies in selected OECD countries. This investigation will involve a quantitative analysis of the data collected on innovation strategies and FDI inflows. This analysis will help identify the extent to which FDI inflows affect the development of innovation strategies in these countries and vice versa.
3. To provide policy recommendations: This objective aims to provide policy recommendations for selected OECD countries to enhance their innovation strategies and attract FDI inflows. These recommendations will be based on the findings of the research and will aim to provide practical guidance for policy makers in these countries.

4.2 Research Methodology

Panel data, also known as longitudinal data, is a type of data that consists of observations of a group of individuals, entities, or objects over time. In panel data, each individual, entity, or object is observed repeatedly at different time periods, which makes it possible to analyze changes over time and to control unobserved heterogeneity. Panel data can be represented in different formats, including the wide format and the long format. In the wide format, each observation is represented by a single row, and each variable is represented by a separate column. In the long format, each observation is represented by multiple rows, one for each time period, and each variable is represented by a single column.

Panel data is particularly useful in statistics because it allows researchers to control unobserved heterogeneity, which refers to the differences between individuals, entities, or objects that are not measured or observed. Unobserved heterogeneity can arise from various sources, such as innate characteristics, environmental factors, or random shocks. By controlling unobserved heterogeneity, researchers can avoid biased estimates and improve the accuracy and reliability of their results. Panel data is also useful in statistics because it allows researchers to analyze changes over time, which can reveal trends, patterns, and relationships that are not apparent in cross-sectional data. For example, panel data can be used to estimate the effects of policy interventions, to study the dynamics of economic behavior, or to predict future outcomes based on past trends.

OLS regression, also known as ordinary least squares regression, is a statistical technique that is used to estimate the relationship between a dependent variable and one or more independent variables. The basic idea of OLS regression is to find the line that best fits the data by minimizing the sum of the squared residuals, which are the differences between the actual values and the predicted values.

The OLS regression model is estimated using a sample of data, which is a subset of the population of interest. The sample is used to estimate the coefficients of the model, which are then used to make predictions about the population. The OLS regression model assumes that the error term is normally distributed with a mean of zero and a constant variance, and that the independent variables are linearly related to the dependent variable. The model also assumes that the independent variables are not highly correlated with each other, a condition known as multicollinearity, which can affect the accuracy and reliability of the estimates.

To estimate the OLS regression model, the researcher needs to choose the appropriate independent variables, specify the functional form of the model, and estimate the coefficients using a method such as maximum likelihood or least squares. The researcher also needs to test the assumptions of the model, such as the normality and homoscedasticity of the error term, and check for multicollinearity using techniques such as variance inflation factors (VIF).

OLS regression can be used for various purposes, such as hypothesis testing, prediction, and causal inference. For example, OLS regression can be used to test whether there is a significant relationship between a person's income and their level of education, to predict the future demand for a product based on past sales data, or to estimate the effect of a policy intervention on a particular outcome.

In panel data analysis, OLS regression can be used to estimate the relationship between the dependent variable and the independent variables while controlling for unobserved heterogeneity and analyzing changes over time. Panel data analysis can also help to overcome some of the limitations of cross-sectional analysis, such as omitted variable bias, endogeneity, and selection bias.

4.3 Research Data

The dataset used in this research consists of observations of four variables, namely FDI (Foreign Direct Investment), Patent, R&D exp (% of GDP) (Research and Development expenditure as a percentage of Gross Domestic Product), R&D personnel, and High-tech product export, for the period of 2005-2017. The dataset covers 11 countries, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Sweden, Switzerland. The dataset includes 143 observations, 13 for each country, representing the values of the aforementioned variables for each year from 2005 to 2017. The variables are measured using different units, including billion dollars for FDI, number of patents for Patent, percentage for R&D exp (% of GDP), number of people for R&D personnel, and billion dollars for High-tech exports. Variable definitions are given below:

1. FDI (Foreign Direct Investment):

Foreign direct investment refers to investments made by foreign companies or individuals in the domestic economy of another nation. In other words, it is the acquisition of assets in a host country by a foreign corporation for the purpose of creating a long-term economic stake. FDI might take the form of purchasing firm shares, establishing a new business, or purchasing property or land. FDI plays a crucial role in fostering economic growth and development by providing capital, technology, and transfer of knowledge to the host nation.

2. Patent:

A patent is a legal document issued by the government that grants the holder the exclusive right to create, use, and sell an invention for a specified length of time, often twenty years from the date of application. Inventors who have invented something novel, non-obvious, and valuable are granted patents. Patents safeguard the rights of inventors and promote creativity and technical progress.

3. R&D exp (% of GDP) (Research and Development expenditure as a percentage of Gross Domestic Product):

R&D expenditure as a share of GDP is an indicator of the proportion of a country's economic output spent on research and development. This statistic measures a country's level of spending in research and development. The greater the percentage, the more the investment in R&D activities, which will likely result in increased innovation, productivity, and economic growth.

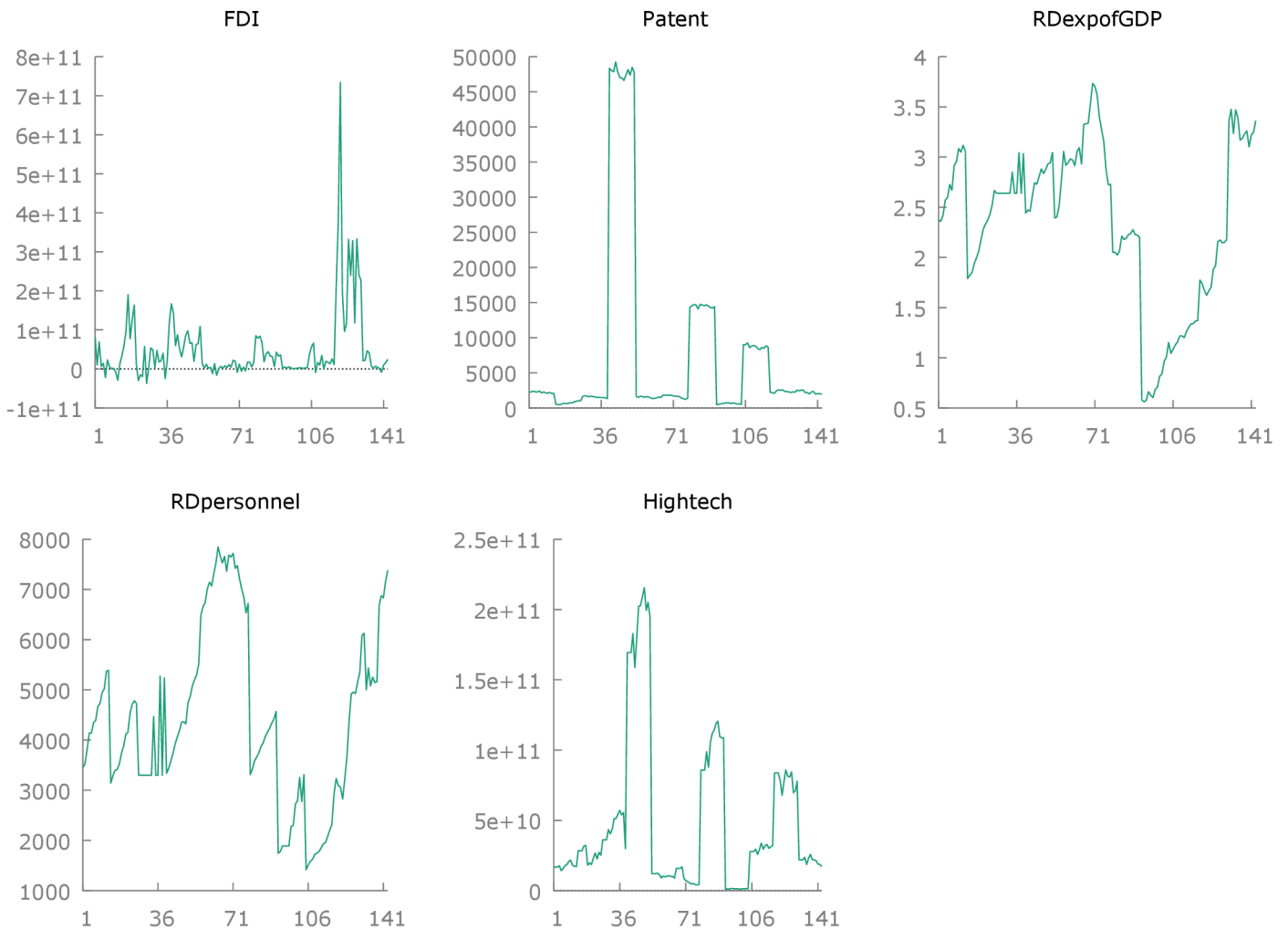
4. R&D personnel:

R&D personnel refers to the number of individuals employed in a country's research and development efforts. This variable assesses the availability of human resources for research and development, which is vital for fostering creativity and technological progress.

5. High-tech product export:

Export of high-tech products refers to the export of high-tech goods, such as advanced electronics, aerospace, pharmaceuticals, and biotechnology products. This variable assesses a country's participation in high-tech sectors and its capacity to compete on the global market with high-value products. Exports of advanced technologies are an indicator of a nation's competitiveness in the global economy.

Figure 1. Graphs of dataset



4.4 Research Hypotheses

Hypotheses are described below:

- H_{10} : There is no relationship between FDI and R&D expenditures.
- H_{20} : There is no relationship between FDI and R&D personnel
- H_{30} : There is no relationship between FDI and high technology product exports
- H_{40} : There is no relationship between FDI and number of patents.

5. Findings and evaluations

The table 1 descriptive statistics highlight the distribution of each variable within the dataset.

Table 1. Summary statistics

Variable	Mean	Median	S.D.	Min	Max
RDexpofGDP	2.35	2.52	0.801	0.561	3.73
l_Hightech	23.9	24.0	1.33	20.7	26.1
l_FDI	23.7	23.8	1.70	17.4	27.3
l_Patent	7.96	7.64	1.27	6.12	10.8
l_RDpersonnel	8.30	8.33	0.429	7.26	8.97

RDexpofGDP is the proportion of a nation's gross domestic product (GDP) that is allocated to research and development (R&D) activities. The mean value of 2.352 means that, on average, the nations in the sample spend around 2.35 percent of their GDP on research and development. The median value of 2.515 indicates that the distribution of RDexpofGDP is slightly skewed to the left, indicating that there are a greater number of nations with higher RDexpofGDP values. The standard deviation of 0.8007 suggests that RDexpofGDP values are relatively distributed around the mean, with some nations spending significantly more (3,734) or significantly less (0,5612) on R&D than the average.

l_Hightech is the logarithm of a country's high-tech export proportion. The mean value of 23.92 indicates that the nations in the dataset exported high-tech items at a rate of approximately $10(23.92)\% = 9.47\%$ on average. The median value of 23.97 indicates that the distribution of l_Hightech is slightly skewed to the right, indicating that there are a greater number of nations with lower l_Hightech values. The standard deviation of 1.334 suggests that l_Hightech values are somewhat distributed around the mean, with certain nations exporting much more (26.10) or significantly fewer (20.67) high-tech products.

l FDI is the logarithm of the amount of foreign direct investment (FDI) a country receives. The mean value of 23.71 indicates that the nations in the dataset received FDI at a pace of around $10(23.71) = \$218.1$ billion on average. The median value of 23.79 indicates that the distribution of l FDI is slightly skewed to the right, indicating that there are a greater number of nations with lower l FDI values. The standard deviation of 1,704 suggests that the values of l FDI are highly spread around the mean, with some nations receiving significantly more (27.32) or significantly less (17.37) foreign direct investment than others.

The logarithm of the number of patents awarded to a country is denoted by l Patent. The mean value of 7.965 indicates that, on average, the countries in the dataset received around $10(7.965) = 22$. The mean of the R&D personnel variable's natural logarithm is 8.304, indicating that the typical country has around 4.4 million R&D workers. The median value of 8.332 indicates that the data are distributed somewhat symmetrically. The standard deviation is 0.4288, which indicates that the data are grouped closely around the mean.

Table 2. Pooled OLS, H1 results

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>
const	1.31650	0.995732	1.322	0.1885
l_FDI	0.0414351	0.0418932	0.9891	0.3245
Mean dependent var	2.298827	S.D. dependent var		0.804612
Sum squared resid	81.58651	S.E. of regression		0.804681
R-squared	0.007704	Adjusted R-squared		-0.000171
F(1, 126)	0.978250	P-value(F)		0.324527
Log-likelihood	-152.8007	Akaike criterion		309.6014
Schwarz criterion	315.3054	Hannan-Quinn		311.9190
rho	0.982174	Durbin-Watson		0.122434

The outcome of a Pooled OLS regression analysis, which evaluates the link between the independent variable FDI (foreign direct investment) and the dependent variable RDexpofGDP (R&D expenditure as a share of GDP). (see Table 2), is presented in Table 2.

FDI has a correlation of 0.0414, which indicates that a 1% rise in FDI is connected with a 0.0414% increase in R&D expenditure as a percentage of GDP, all other factors being held constant. Nonetheless, this coefficient's p-value is 0.3245, which is above the usual significance level of 0.05. This suggests that the null hypothesis that there is no substantial correlation between FDI and R&D expenditures cannot be rejected. Consequently, based on this research, it can be concluded that there is no link between FDI and R&D spending (H1).

The R-squared value is 0.0077, which indicates that only a small proportion of the variation in RDexpofGDP can be explained by FDI. The Adjusted R-squared value is slightly negative, indicating that the model does not fit the data well. The F-test statistic (0.978) and its associated p-value (0.325) suggest that the model is not statistically significant.

This regression analysis provides evidence that FDI may not have a significant relationship with R&D expenditures. However, the overall fit of the model is not strong, and the results should be interpreted with caution.

Table 3. Pooled OLS, H2

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	8.18243	0.528270	15.49	<0.0001	***
l_FDI	0.00402859	0.0222258	0.1813	0.8565	
Mean dependent var	8.277939	S.D. dependent var		0.425282	
Sum squared resid	22.96387	S.E. of regression		0.426911	
R-squared	0.000261	Adjusted R-squared		-0.007674	
F(1, 126)	0.032854	P-value(F)		0.856457	
Log-likelihood	-71.66522	Akaike criterion		147.3304	

Schwarz criterion	153.0345	Hannan-Quinn	149.6480
rho	0.942953	Durbin-Watson	0.187868

The result from table 3 shows the relationship between the independent variable FDI (foreign direct investment) and the dependent variable l_RDpersonnel (R&D personnel as a share of GDP).

The coefficient for FDI is 0.0040, which means that a 1% increase in FDI is associated with a 0.0040% increase in R&D personnel as a share of GDP, holding other factors constant. However, the p-value for this coefficient is 0.8565, which is much larger than the standard significance level of 0.05. This indicates that we fail to reject the null hypothesis that there is no significant relationship between FDI and R&D personnel. Therefore, based on this analysis, the hypothesis H20 that there is no relationship between FDI and R&D personnel is accepted.

The R-squared value is 0.0003, which indicates that almost none of the variation in l_RDpersonnel can be explained by FDI. The Adjusted R-squared value is negative, indicating that the model does not fit the data well. The F-test statistic (0.0329) and its associated p-value (0.8565) suggest that the model is not statistically significant.

Table 4. Pooled OLS, H3

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	11.6115	1.32105	8.790	<0.0001	***
l_FDI	0.521254	0.0555802	9.378	<0.0001	***
Mean dependent var	23.96917	S.D. dependent var		1.385669	
Sum squared resid	143.6056	S.E. of regression		1.067580	
R-squared	0.411090	Adjusted R-squared		0.406416	
F(1, 126)	87.95462	P-value(F)		3.57e-16	
Log-likelihood	-188.9867	Akaike criterion		381.9734	

Schwarz criterion	387.6775	Hannan-Quinn	384.2910
rho	0.764097	Durbin-Watson	0.479856

In this model, the dependent variable is the R&D high technology product export as a share of GDP and the independent variable is FDI. The results show that the coefficient of FDI is 0.521254, which means that a 1-unit increase in FDI is associated with a 0.521254 increase in R&D high technology product export as a share of GDP. This coefficient is statistically significant at the 1% level, as indicated by the very low p-value of <0.0001.

The R-squared value of 0.411090 indicates that about 41.1% of the variation in the R&D high technology product export as a share of GDP is explained by the variation in FDI. The adjusted R-squared value of 0.406416 suggests that the independent variable explains a significant portion of the variation in the dependent variable after adjusting for the number of independent variables in the model. Therefore, the results suggest that there is a significant positive relationship between FDI and R&D high technology product export as a share of GDP, and the null hypothesis H3: There is no relationship between FDI and high technology product exports is rejected.

Table 5. Pooled OLS, H4

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	2.50420	1.55582	1.610	0.1100	
l_FDI	0.233056	0.0654575	3.560	0.0005	***
Mean dependent var	8.029413	S.D. dependent var		1.313831	
Sum squared resid	199.1820	S.E. of regression		1.257303	
R-squared	0.091411	Adjusted R-squared		0.084200	
F(1, 126)	12.67660	P-value(F)		0.000523	
Log-likelihood	-209.9242	Akaike criterion		423.8484	

Schwarz criterion	429.5525	Hannan-Quinn	426.1660
rho	0.965915	Durbin-Watson	0.087328

Patents as a percentage of GDP is the dependent variable in this regression, whereas FDI is the independent variable. The coefficient for FDI is 0.233056, which indicates that patents as a percentage of GDP rise by 0.233056 units for every unit increase in FDI. Statistically, this coefficient is significant at the 1% level, as evidenced by the p-value of 0.0005.

The R-squared value of 0.091411 indicates that the model explains just a tiny fraction of the variance in the proportion of patents to GDP. Statistically, the model is significant, as evidenced by an F-statistic of 12,67660 and a p-value of 0.000523. As the regression findings suggest a positive link between FDI and patents as a proportion of GDP, the null hypothesis H3, which claims that there is no relationship between FDI and patents as a share of GDP, is thus rejected. Overall results of hypotheses are described below in the table.

Table 6. Results evaluation

Hypothesis	p-value	Result
- H10: There is no relationship between FDI and R&D expenditures.	0.3245	Accepted
- H20: There is no relationship between FDI and R&D personnel	0.8565	Accepted
- H30: There is no relationship between FDI and high technology product exports	<0.0001	Rejected
- H40: There is no relationship between FDI and number of patents.	0.0005	Rejected

Let's examine the acceptance and rejection of the hypotheses from an economic perspective.

Hypothesis H1: There is no relationship between FDI and R&D expenditures. P-value: 0.3245, Result: Accepted.

This finding may be attributable to a number of different variables from an economic point of view. To begin with, it is probable that international investors are more interested in making investments in already existing

technology than sponsoring activities related to research and development. This might be due to the fact that proven technologies are often associated with lower levels of risk and have an effect that is seen more quickly on the bottom line. In addition, it is likely that there are other variables that impact the amount of money that a country invests in research and development activities. Some examples of these elements are the policies of the government, the accessibility of trained personnel, and the availability of finance.

Hypothesis H2: There is no relationship between FDI and R&D personnel. P-value: 0.8565, Result: Accepted.

This finding may be attributable to a number of different variables from an economic point of view. To begin, it is probable that international investors are more interested in making investments in already existing technology rather than providing financial support for the recruitment of research and development employees. This could be due to the fact that established technologies are often associated with lower levels of risk and have an effect that is felt more quickly on the bottom line. However, it is probable that there are additional factors that influence a nation's investment in R&D employees. Some examples of these elements are the policies of the government, the accessibility of skilled labor, and the availability of finance.

Hypothesis H3: There is no relationship between FDI and high technology product exports. P-value: <0.0001, Result: Rejected.

This finding may be attributable to a number of different variables from an economic point of view. To begin, there is a possibility that international investors will be more interested in making investments in nations who have a proven track record of being successful exporters of high technology items. This could be due to the fact that innovation and competitiveness are generally connected with the export of such goods, both of which can make a country more appealing to investors from other countries. In addition, foreign investors may bring new cash, technology, and management methods to a country, all of which can help to improve that nation's ability to export high-tech goods.

On the other hand, the acceptance of Hypotheses 1 and 2 could be explained by the possibility that FDI may not have a direct impact on R&D expenditures and R&D people. Foreign investors may be more interested in investing in industries that are well-established and have a proven track record, as opposed to R&D operations that may take years to bear fruit. In addition, some nations may have more favorable policies for attracting FDI, such as tax benefits, subsidies, or cheaper labor costs, which may or may not be tied to R&D expenditures or

people. Lastly, the rejection of Hypothesis 4 could be explained by the possibility that foreign investors are more willing to invest in nations with robust intellectual property rights safeguards, which can lead to an increase in patent applications. In addition, foreign investors may have greater resources available to invest in R&D operations, which can also result in a rise in patent applications. Consequently, it is logical to anticipate a positive correlation between FDI and the number of patent applications.

6. Conclusion

The importance of foreign direct investment cannot be overstated for any nation, regardless of whether it is developed, developing, or undeveloped. This is one of the significant outcomes of globalization. Countries that are already developed have a requirement for sustainability, while countries that are still growing or undeveloped require expansion and investment. They are working to design legislation that will allow them to get the greatest possible benefits from direct investments from other countries in an effort to facilitate investment. Greenfield investments, mergers and acquisitions, and strategic partnerships are all possible ways for foreign direct investments to enter the country. Greenfield investments are investments made in undeveloped land. The ever-increasing level of competition brought about by globalization boosts both the interest in and the significance of innovation. The level of technological innovation determines the nature of the radical and transformative inventions that are created.

Both established businesses and startups can gain a strong foothold in a market thanks to the revolutionary advancements that are made available to them. Adaptive innovations make the product already on the market better and confer benefits on the firms who produce it. The OECD divided innovations into four distinct categories. The product innovation, the marketing innovation, the process innovation, and the organizational innovation are the four types. This study places a strong emphasis on product innovation, which is also referred to as technological innovation in the existing body of research.

Technological innovation is an innovative activity that creates new value by creatively combining production resources such as processes, markets, resources, and organizations. This activity is also known as technological innovation. The innovation of new technologies takes the shape of a cluster, which is one of the most important factors in the expansion of the economy, and these clusters occur randomly depending on the era and place in question. The present study aimed to investigate the relationship between foreign direct investment (FDI) and innovation strategy in selected OECD countries. The study's objectives were to identify the level of FDI and innovation strategies, analyze the relationship between FDI and innovation strategy, and evaluate the impact of FDI on innovation strategy.

The pooled OLS regression was conducted with panel data analysis consisting of data of 11 OECD countries for the period of 2005-2017. The first two hypotheses (There is no relationship between FDI and R&D expenditures; There is no relationship between FDI and R&D personnel), which suggest that there is no

relationship between FDI and research and development (R&D) expenditures or personnel, were accepted. The third hypothesis (There is no relationship between FDI and high technology product exports), which states that there is no relationship between FDI and high technology product exports, was rejected, while the fourth hypothesis (There is no relationship between FDI and number of patents), which proposes that there is no relationship between FDI and the number of patents, was also rejected.

The findings suggest that foreign investors may be more interested in investing in industries that are already established and have a proven track record, rather than supporting R&D activities. There may also be other variables, such as government policies, access to skilled labor, and availability of finance, that influence a country's investment in R&D activities. On the other hand, FDI may have a positive impact on high technology product exports and the number of patent applications, as foreign investors bring in new cash, technology, and management methods that can help improve a country's ability to export high-tech goods and innovate.

One of the key findings of our study was that there was a positive relationship between FDI and high technology product exports, as well as the number of patent applications. This suggests that FDI can play a role in boosting a country's ability to innovate and compete in the global market. However, our analysis also showed that there was no significant relationship between FDI and research and development (R&D) expenditures or personnel. This indicates that foreign investors may not be prioritizing investment in R&D activities, potentially due to a preference for investing in established industries with a proven track record. Overall, our study highlights the importance of understanding the various factors that influence a country's ability to innovate and attract foreign investment. As a student, I gained valuable experience in conducting research and analyzing data, as well as contributing to the broader understanding of the complex relationship between FDI and innovation.

7. Reference list

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