RESEARCH AND DEVELOPMENT IN FINLAND, SECTORIAL FOREIGN DIRECT INVESTMENT LEADING TO GROWTH

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1.Abstract

The objective of this report was to study how research and development and sectoral FDI in Finland lead to its economic growth. This study was mainly done because Finland is known to be having state of the art technologies relating to Research and Development and due to being declared a developed country by OECD and foreign organizations, there has been an inflow FDI into Finland which has also affected its Research and Department sector. While the spill overs of FDI are large, in the long run this could also lead to economic growth.

While analysing the sector-wise FDI normalized net inward flow for each sector in Finland. We also compared the FDI investment in Finland to other nations in the Baltic and Nordic region. We also analysed the contribution of different nations in the FDI of Finland. While analysing the Research and Development sector of Finland we analysed why Finland Research and Development sector has been going down in recent years compared to its OECD and European counterparts and specially in this post covid era. We also analysed Finland has set a RDI roadmap for Research, Development and Innovation. We then compared Finland's R&D funding in its best 5 sectors.

We have analysed the impact of Research and Development (R&D) and Sector-wise Foreign Direct Investment (FDI) on the growth of Finland. Growth was measured in terms of Gross domestic Product. We show that there is no statistically significant relation between growth and R&D.

2.Introduction

When a company invests in another company in a foreign country, the investment is said to be a foreign direct investment (FDI).

Foreign Direct Investment (FDI) flows are the value of cross-border transactions related to direct investment during a given period of time, usually a quarter or a year. Financial flows consist of equity transactions, reinvestment of earnings, and intercompany debt transactions. Outward flows represent transactions that increase the investment that investors in the reporting economy have in enterprises in a foreign economy, such as through purchases of equity or reinvestment of earnings, less any transactions that decrease the investment that investors in the reporting economy have in enterprises in a foreign economy, such as sales of equity or borrowing by the resident investor from the foreign enterprise. Inward flows represent transactions that increase the investment that foreign investors have in enterprises resident in the reporting economy less transactions that decrease the investment of foreign investors in resident enterprises.

FDI flows are measured in USD and as a share of GDP. When we compare countries across the globe, it is sometimes easier to compare FDI as a percentage of GDP because a large economy may have much higher absolute FDI flows but if it is a small percentage of the GDP then it is much less relevant than say for a smaller economy which may have lower absolute numbers but if the share of GDP is much higher, then it could indicate that FDI flows are critical to that economy. FDI creates stable and long-lasting links between economies.

Due to Covid-19 lead to a dramatic fall in FDI. The fall was much more dramatic in the developed countries compared to emerging markets as Asia was resilient through the crisis and the fall there was much more moderate. This lead to the share of FDIs to Emerging markets being more that Developed markets.

Types of the FDIs are further categorised into four types:

1. Horizontal FDI

The most popular type of FDI is Horizontal FDI, which is investing funds in a foreign company in the same industry as that of the investor. So, a company invests in another company located in a different country, wherein both the companies are producing similar goods. For example, the Spain-based company Zara may invest in or purchase the Indian company Fab India, which also produces similar products as Zara does. Since both the companies belong to the same industry of merchandise and apparel, the FDI is classified as horizontal FDI.

2. Vertical FDI

A vertical FDI occurs when an investment is made within a typical supply chain in a company, which may or may not necessarily belong to the same industry. As such, when vertical FDI happens, a business invests in an overseas firm which may supply or sell products. Vertical FDIs are further categorised as backward vertical integrations and forward vertical integrations. For instance, the Swiss Coffee producer Nescafe may invest in coffee plantations in countries such as Brazil, Columbia, Vietnam, etc. Since the investing firm purchases, a supplier in the supply chain, this type of FDI is known as backward vertical integration. Conversely, forward vertical integration is said to occur when a company invests in another foreign company which

is ranked higher in the supply chain, for instance, a coffee company in India may wish to invest in a French grocery brand.

3. Conglomerate FDI

When investments are made in two completely different companies of entirely different industries, the transaction is known as conglomerate FDI. As such, the FDI is not linked directly to the investors business. For instance, the US retailer Walmart may invest in TATA Motors, the Indian automobile manufacturer.

4. Platform FDI

The last types of foreign direct investment is platform FDI. In the case of platform FDI, a business expands into a foreign country, but the products manufactured are exported to another, third country. For instance, the French perfume brand Chanel set up a manufacturing plant in the USA and export products to other countries in America, Asia, and other parts of Europe.

FDI into a country can be a factor that could help in maintaining the Balance of Payment.

Balance of Payment: of a country is the difference between all money flowing into the country in a particular period of time (e.g., a quarter or a year) and the outflow of money to the rest of the world. These financial transactions are made by individuals, firms and government bodies to compare receipts and payments arising out of trade of goods and services.

The balance of payments consists of two components: the current account and the capital account. The current account reflects a country's net income, while the capital account reflects the net change in ownership of national assets.

The capital account in a country's balance of payments covers a variety of financial flows—mainly foreign direct investment (FDI), portfolio flows (including investment in equities), and bank borrowing—which have in common the acquisition of assets in one country by residents of another.

In case there is a deficit in BoP the country may not have enough foreign exchange to pay for the expenses and hence

Global FDI Scenario

Global FDI flows are expected to bottom out in 2021 and recover some lost ground with an increase of 10–15 per cent. This would still leave FDI some 25 per cent below the 2019 level and more than 40 per cent below the recent peak in 2016 (figure I.10). Current forecasts show a further increase in 2022 which, at the upper bound of the projections, could bring FDI back to the 2019 level of $1.5 trillion. The relatively modest recovery in global FDI projected for 2021 reflects lingering uncertainty about access to vaccines, the emergence of virus mutations and delays in the reopening of economic sectors. As FDI tends to trail other macroeconomic indicators after a shock, a full and broad-based recovery in flows to pre-

pandemic levels is expected to take longer. This is despite expectations of a boom in capital expenditures by MNEs as a result of a peak in cash holdings and pent-up spending plans (for details, see section I.C). Increased expenditures on both fixed assets (e.g. machinery and equipment) and intangibles will not translate directly into a rapid FDI rebound, as confirmed by the sharp contrast between rosy forecasts for capital expenditures and still depressed greenfield project announcements.

Current projections suggest that FDI will increase a further 15–20 per cent in 2022, up to $1.4 trillion. This would imply that FDI will largely recover by the end of 2022 in the baseline forecast, which assumes continued improvement in the health and economic situations over the next two years. The most optimistic upper-bound scenario implies the absence of subsequent regional or global crisis relapses, as well as rapid economic growth and high investor confidence. Under these conditions, FDI could fully recover to its pre-pandemic level of about $1.5 trillion by 2022. The lower-bound scenario reflects the possibility of a prolonged downturn in global FDI. Although FDI is not expected to contract further, it could remain at a low level – about $1.2 trillion, over 2021 and 2022.

Research and Development Definition

Research and development (R&D) include activities that companies undertake to innovate and introduce new products and services. It is often the first stage in the development process. The goal is typically gaining new scientific or technical knowledge that can be converted into a scheme or formulation for manufacturing/supply/trading etc. resulting in a business advantage. E.g. This could allow the company to take new products and services to market and add to the company's bottom line.

There are three types of R&D.

1. Basic Research

Research of this objective is to get complete knowledge and understanding of one special subject, not a practical situation. This research is also called as pure or fundamental research. Basic research is a theoretical approach to any subject.

2. Applied Research

Research of this objective is to get complete knowledge and understanding of one special subject in a practical situation. This research is an inverse of basic research. This research is formulated to solve a practical problem.

3. Development Research

This Research is a combination of applied and basic research. This research will be implemented after getting knowledge and understanding of a specific task/subject from the basic and applied research.

We give an insight on the FDIs and Research and Development in Finland. We have alsp analysed and regressed data with many variables to come to our own conclusions based on the data studied

3.Literature Review

1. ON THE CAUSALITY BETWEEN FOREIGN DIRECT INVESTMENT AND OUTPUT: A COMPARATIVE STUDY
   This article examines the effect of foreign direct investment (FDI) on output and total factor productivity (TFP) growth in the host economy. FDI-led growth hypothesis is investigated for Denmark, Finland, Norway, and Sweden by constructing a vector autoregression (VAR) model. On the basis of the new Granger non-causality procedure developed by Toda and Yamamoto (1995) and Yamada and Toda (1998), the results show that FDI and output are causally related in the long run for Norway and Sweden.
   Authors: Johan Ericsson, Manuchehr Irandoust

2. IS FIXED INVESTMENT THE KEY TO ECONOMIC GROWTH?

   In this paper, that issue by again examining changes in capital formation and growth over successive five-year periods is addressed, but with more formal methods of studying the direction of causation. The aim was to determine directions of influence and their timing between capital formation ratios and rates of growth.

   Authors: MAGNUS BLOMSTRGM, ROBERT E. LIPSEY, MARIO ZEJAN

3. Foreign Direct Investment, International Knowledge Transfers, and Endogenous

   Growth: Time Series Evidence

   This paper proposes open- and closed-economy versions of an endogenous growth model to evaluate the impact of foreign direct investment (FDI) and international knowledge transfers and spillovers on the long-run growth rate of the recipient economy. In the open economy, foreign investors may engage in FDI, bond acquisition, or both, such that the portfolio composition of the foreign investor is shown to affect the effective rate of time preference of the recipient economy and hence its growth rate in the long run.

   Author: L.R. De Mello

4. Foreign Direct Investment Inward and Foreign Direct Investment Outward: Evidence from Panel Unit Root and Cointegration Tests with a Certain Number of Structural Changes

   This article examines empirically the association between foreign direct investment inward and foreign direct investment outward. Using a panel data set for 35 economies over the period 1981-2004 as well as the methodology of panel unit root and panel cointegration tests with a certain number of structural changes, the empirical findings show that FDI inward does exhibit a significant (long-run) relationship with FDI outward.
   Author: Nicholas Apergis

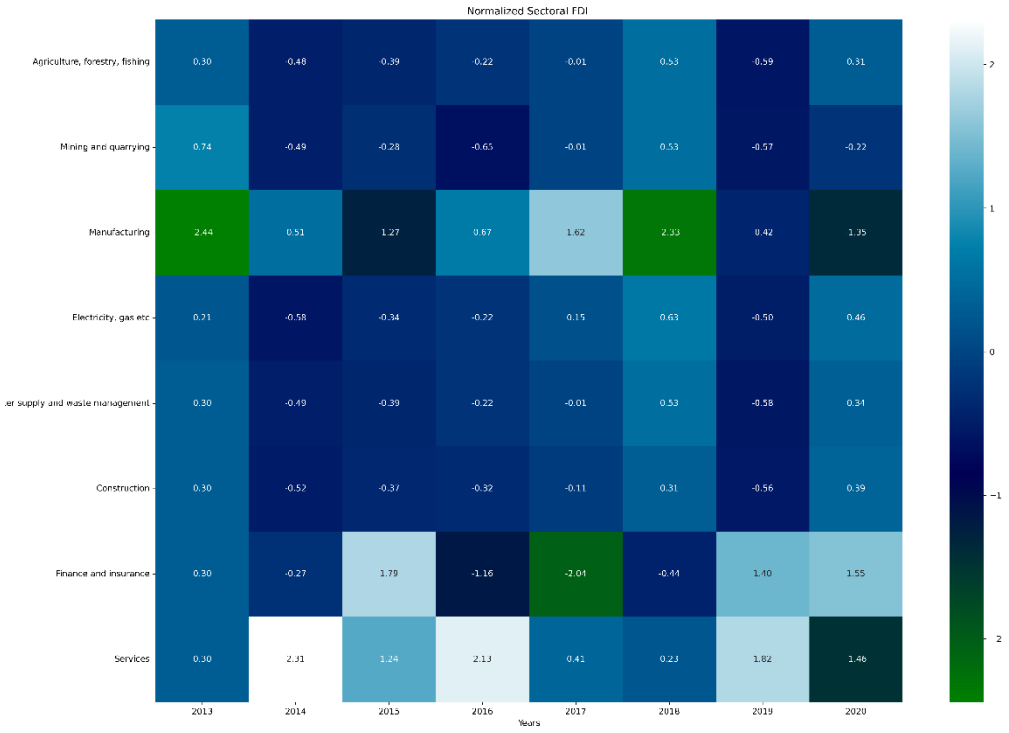
4.Foreign Direct Investment (FDI) in Finland

FDI is mainly considered as a tool to accelerate economic growth. It can raise an economy's productive capacity and thus help in the creation of employment. It assumes different roles in different sectors and helps in bringing development and a move towards sustainability. It also serves to promote the integration of an economy with international markets.

FDI can also have unwanted outcomes. The influx of foreign multinationals can sometimes raise concerns about their potential impact on society and the environment (especially given weakening labor standards and their contribution to the unsustainable use of natural resources).

Sectorwise FDI comparison

Note:
Heatmaps: A heatmap (aka heat map) depicts values for a main variable of interest across two axis variables as a grid of colored squares. The axis variables are divided into ranges like a bar chart or histogram, and each cell's color indicates the value of the main variable in the corresponding cell range.



From the given heatmap here we see that there is no general trend in the values of normalized sectoral net inward FDI for any particular sector throughout the time period of 2013-2020. All industries have seen their fair share of inward and outward FDI

The sectorwise analysis of FDI is as follows:

1) Agriculture, Forestry and Fishing: The Agriculture, Forestry and Fishing sector comprises establishments primarily engaged in growing crops, raising animals, harvesting timber, and harvesting fish and other animals on a farm, ranch, or from their natural habitats. FDI can play a critical role in raising farmers' income by bringing new technology, market knowledge, infrastructure and/or investing in agriculture-related manufacturing. During the years 2013 to 2020, this sector recorded the highest normalized inward FDI investment in the year 2018 and the lowest in 2019.

2) Mining and Quarrying: The mining and quarrying sector includes mining of fossil fuels (coal and lignite mining, oil and gas extraction), mining of metal ores, quarrying of stone, sand, and clay, and mining of phosphate and other minerals. FDI in this industry can have a major role in promoting environment-friendly and sustainable mining processes. In the years 2013-2020, this industry recorded the highest normalized FDI investment in year 2013 and the lowest in 2016.

3) Manufacturing: Manufacturing industries are those that engage in the transformation of goods, materials or substances into new products. The transformational process can be physical, chemical or mechanical. FDI in this industry is required to support the continuation of the manufacturing of unique products. Manufacturers often have plants, mills or factories that produce goods for public consumption. During the years 2013 to 2020, this sector recorded the highest normalized inward FDI investment in the year 2017 and the lowest in 2013.

4) Electricity, gas etc: The electricity, gas or in general the Power sector is the sector comprising of industries involved in the generation and distribution of power for commercial and household purposes. This industry witnessed highest normalized inward FDI investment in 2018 and lowest in 2014 during the time period of 2013-2020.

5) Water supply and waste management: The water supply, sewerage & waste management industry includes activities related to the management (including collection, treatment and disposal) of various forms of waste, such as solid or non-solid industrial or household waste, as well as contaminated sites. The output of the waste or sewage treatment process can either be disposed of or become an input into other production processes. Activities of water supply are also grouped in the water supply, sewerage & waste management industry, since they are often carried out in connection with, or by units also engaged in, the treatment of sewage. Investing in waste management and recycling provides investors with opportunities to generate solid returns and embrace sustainability, which explains investors' appetite for greenfield projects in this space. The highest normalized FDI investment in 2018 and lowest in 2019 in the years 2013-2020.

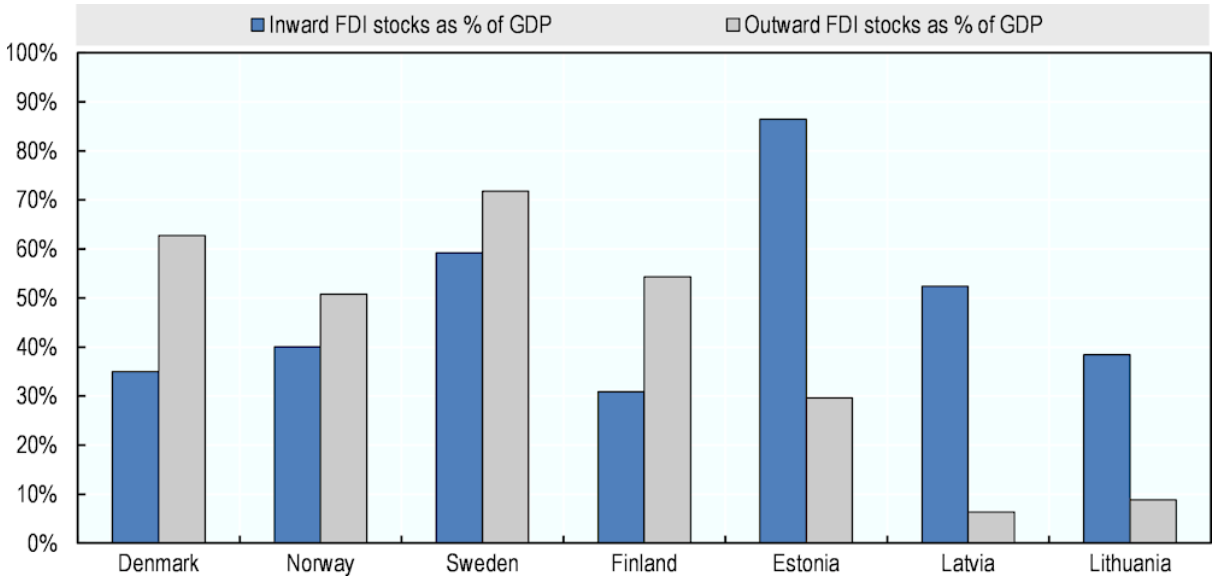
6) Construction: Construction is an industry that includes the erection, maintenance, and repair of buildings and other immobile structures, and the building of roads and service facilities that become integral parts of structures and are essential to their use. In its most widely used context, construction covers the processes involved in delivering buildings, infrastructure and industrial facilities, and associated activities through to the end of their life. This industry saw highest normalized inward FDI investment in 2020 and lowest in 2019 during the years 2013 to 2020.

7) Finance and Insurance: The finance and insurance sector is part of the financial activities supersector. The Finance and Insurance sector comprises establishments primarily engaged in financial transactions (transactions involving the creation, liquidation, or change in ownership of financial assets) and/or in facilitating financial transactions. Investors are pretty interested to invest FDI in this industry as it gives higher returns. During the years 2013-2020 highest normalized FDI witnessed by this industry was in 2015 and the lowest was in 2017.

8) Services: The service sector refers to the industry producing intangible goods, the services as output. In many countries, it is the largest and fastest-growing sector. It can be categorized into consumer, business, and public services. Examples include hospitality, education, information technology, media, and entertainment. During the years 2013-2020 highest normalized FDI witnessed by this industry was in 2014 and the lowest was in 2020.

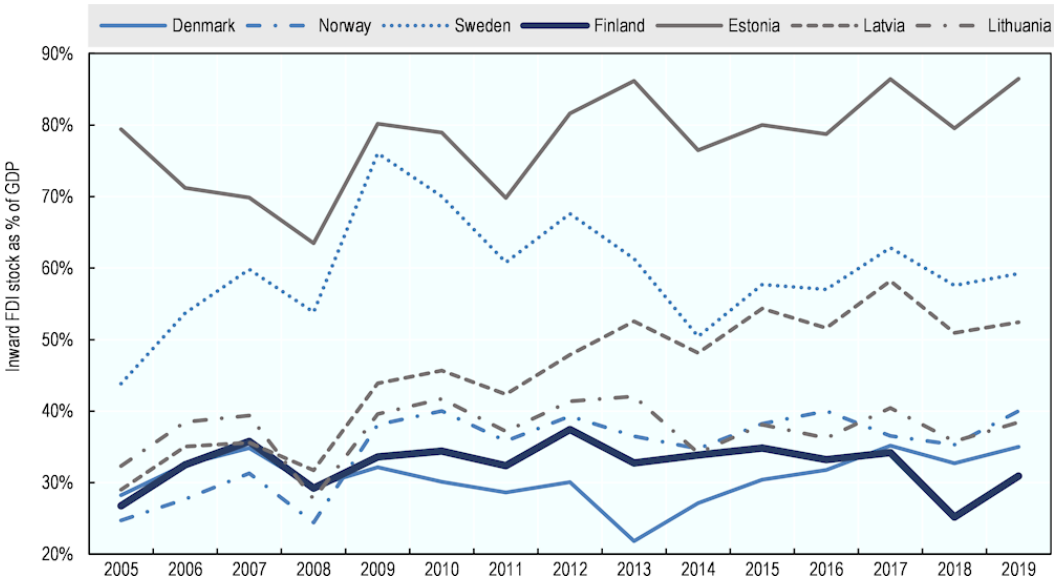
FDI investment of Finland in comparison to other nations:

FDI orientation in the Nordic and Baltic region, 2019



Source: OECD International Direct Investment Statistics database (BD4).

We notice that in comparison to other Nordic and Baltic countries, Finland has the lowest inward FDI stock in proportion to its size at 31%.Finland's inward stock of FDI in proportion to its size is also below the EU average of 61%



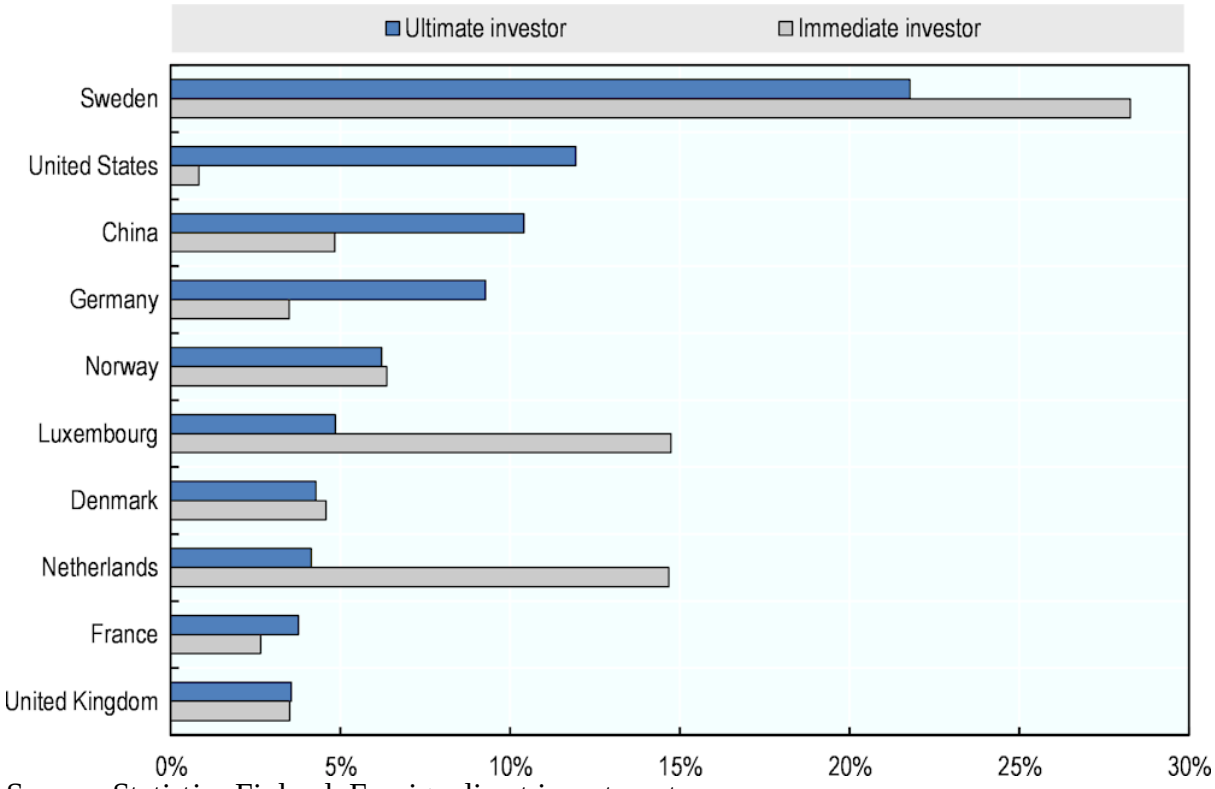
Source: OECD International Direct Investment Statistics database (BD4).

From the above graph we notice that Finland's gap with other economies in inward FDI has widened over the last decade. FDI in Finland dropped from 34% of its GDP (EUR 72.7 billion) in 2017 to 25% (EUR 60.7 billion) in 2018, mostly reflecting valuation changes. In 2019, Finnish inward FDI stocks showed some sign of recovery, bouncing back to 31% (EUR 74.1 billion).

Finland's investors for FDI

A significant share of FDI to Finland comes from a small set of countries. On a direct investor basis, 28% of inward foreign direct investment in 2019 came from Sweden. However, reclassifying data on the basis of Ultimate Investing Country (UIC) helps in identifying the ultimate origin of FDI. In fact, some of Sweden's investment comes from elsewhere, as the share drops to around 22% when looking at UIC-based FDI statistics. This trend is even more pronounced in the Netherlands and Luxembourg, which are often used as channels for FDI within the EU, and are therefore less noticeable when looking at the data from an investor's perspective. Similarly, EU28 as an immediate investor in Finland accounted for 78% of total inward FDI stocks in 2019, but this share dropped to 57% on a UIC basis, due to the use of complex investment structures that channel investment through third countries. Ultimate investor FDI statistics reveal that the United States and the People's Republic of China (hereafter China) are among the largest investors in Finland (besides Sweden and Germany), accounting for 12% and 10% of total inward FDI stocks in 2019, respectively.

1) Top 10 partners' share of inward FDI stock in Finland, 2019



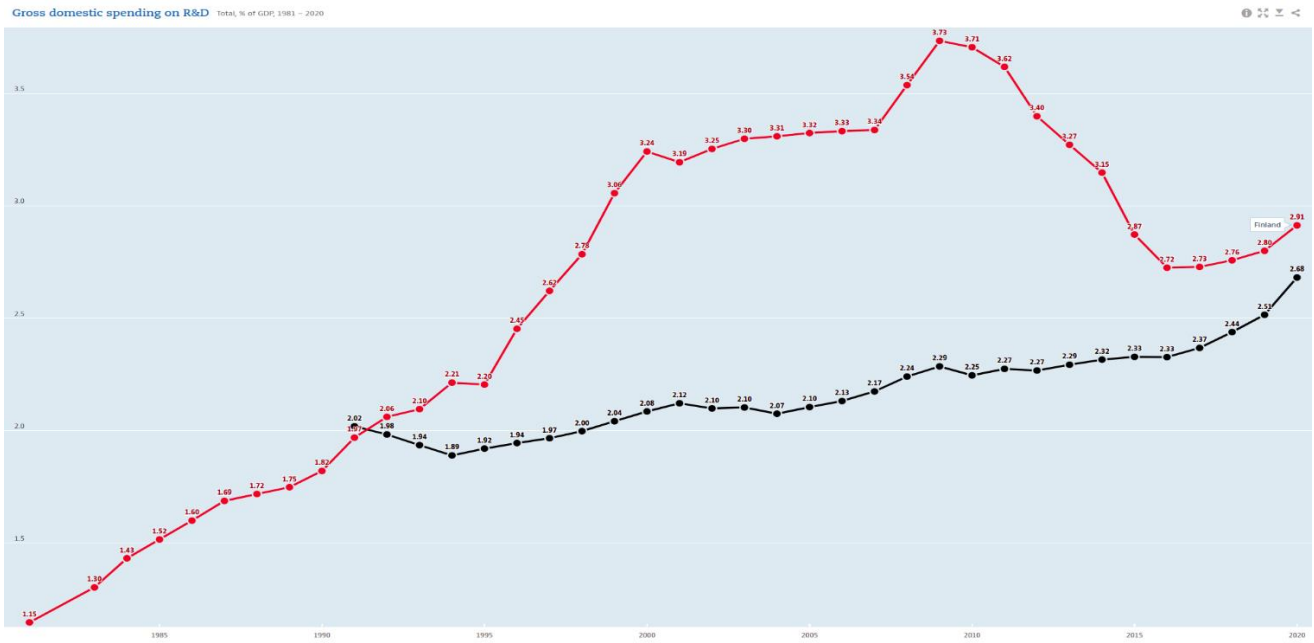
Source: Statistics Finland, Foreign direct investments

Reference link: https://www.oecd-ilibrary.org/sites/5453f3a1-en/index.html?itemId=/content/component/5453f3a1-en#figure-d1e1170

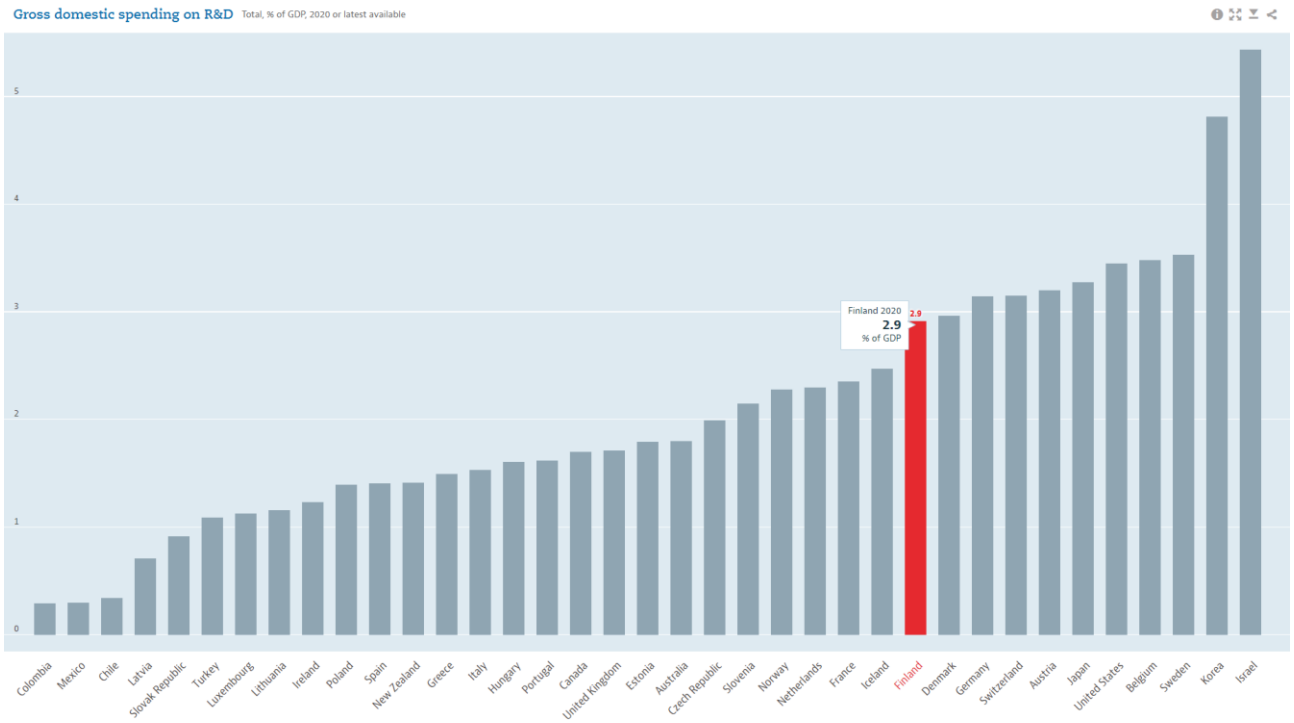
5.Research and Development in Finland

Robert Solow's seminal work from 1956 emphasised the importance of R&D as a driver of technological progress, innovation, and economic growth. It sparked a wave of theoretical and empirical research into the economic effects of R&D investments. Governments in OECD countries and partner economies use various financial and non-financial measures to stimulate R&D-induced innovation. A critical policy instrument is a public support for company R&D through direct funding (R&D grants, loans, and public procurement) and, in some situations, tax relief.

Finland has nearly 50 years of research and development (R&D) intensity target setting expertise. In 1973, a 1.7 per cent target for 1980 was set, and since then, it has gradually risen to the present 4 per cent aim set in 2005. Finland's progress toward these goals fluctuates throughout time and maybe roughly separated into two periods. Between 1973 and 2004, when R&D intensity targets were initially created, the level of R&D intensity climbed steadily, and all but one of the criteria were met. However, the 4% R&D intensity targets set between 2005 and 2019 have never been met. R&D intensity began to fall after peaking at 3.73 per cent in the recession year of 2009, eventually reaching 2.72 per cent in 2016. There has been no significant change since then. With these dynamics and uncertainties, it is unclear whether the current 4% target will be met by 2030 and, if so, under which economic growth scenario. The most current 4% target was set in 2019, but only a few policy steps have been implemented to make it a reality. Since the early 2010s, official 4% targets have been difficult to reach because of the realities of the political, economic, and social operating contexts. Science, technology, and innovation (STI) policy variables such as the deterioration of collaborative culture and policy advice channels, but increasingly contextual issues such as the status of the economy, hampered the favourable evolution of R&D performance. The key Finnish economic sectors of information and communication technology (ICT) and forestry began to lose ground in global marketplaces and value chains by the end of the 2000s. The trade balance deteriorated dramatically, and government foreign debt nearly doubled from €54 billion to €100 billion between 2008 and 2015. From the commencement of the financial crisis in 2008 to 2017, when GDP in real terms was for the first time higher than in 2008, the economy remained stagnant. The preconditions for meeting the R&D intensity objective of 4% slipped away as a result of these and other circumstances, and STI policy steadily lost its priority status. We can see from the chart below that Finland never reached its target of 4%GDP, and with the graph going down over the years, it seems bleak that Finland will be able to reach its 4% goal in the near future.

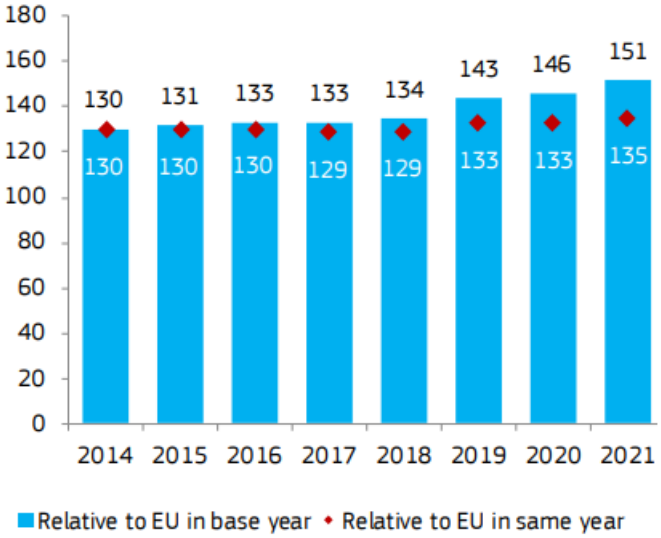


Finland has consistently ranked at the forefront of innovation investment and performance, and innovation policy is at the heart of public policy. Finland used to be among the top five countries in OECD in terms of R&D intensity, but in recent years due to the reasons stated above, Finland now ranks eleventh in the OECD in terms of R&D intensity (at 2.9% of GDP) and aims at 4% of GDP.



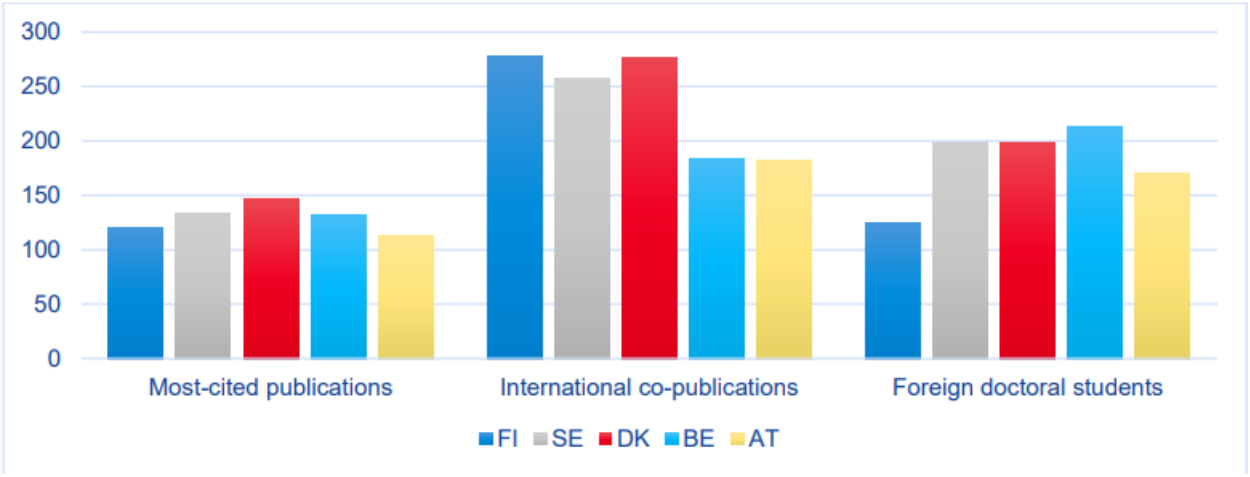
This vital investment in R&D is reflected in robust scientific and technological performance. According to European Innovation Scoreboard (EIS 2021), "Finland is an Innovation Leader.

Over time, performance relative to the EU has increased, in particular in the last three years."



Source- European Innovation Scoreboard 2021

In terms of researchers, Finland is ranked second among OECD countries. Finland has an 'attractive research system' that is pretty attractive. Finland is ranked tenth in the European Union in terms of most-cited publications' (share of these in total publications), 8th in terms of 'International co-publications per million population,' and 14th in terms of 'Foreign doctoral students as a share of total doctoral students,' according to the European Innovation Scoreboard (EIS) 2021. Finland leads the category in terms of 'international co-publications when compared to the benchmark countries. Indeed, since 2009, the number of collaborative publications with other ERA nations (per 1000 researchers) has risen (ERA Progress Report 2018). However, Finland could do better in terms of most-cited articles, and it also lacks foreign doctorate students.



Source- European Innovation Scoreboard 2021

Finland also ranks above average in the number of triadic patents per capita. Finnish companies, huge firms, also rank high in new-to-market product innovations and obtain a substantial share of their turnover from these advances. Finland's strong performance in both innovation inputs and outputs has been matched by strong economic performance. However, Finland's investment in R&D and innovation has not yet been converted, to the expected extent, into new innovations, jobs and exports.

Companies are essential research partners for universities and research institutes. One of the priority areas in the National Roadmap for Research, Development, and Innovation, issued in 2020, is more private sector partnership. The new partnership model responds to the private sector's desire for a fundamental rethinking of how public funds are used for ecosystem development (research, development, and growth) and the development of new operational models for testing and piloting, and scaling innovations. The new approach will also improve the coordination of national programme funding with the EU and other foreign funds. Partnerships are formed to focus on significant growth areas, and recognised

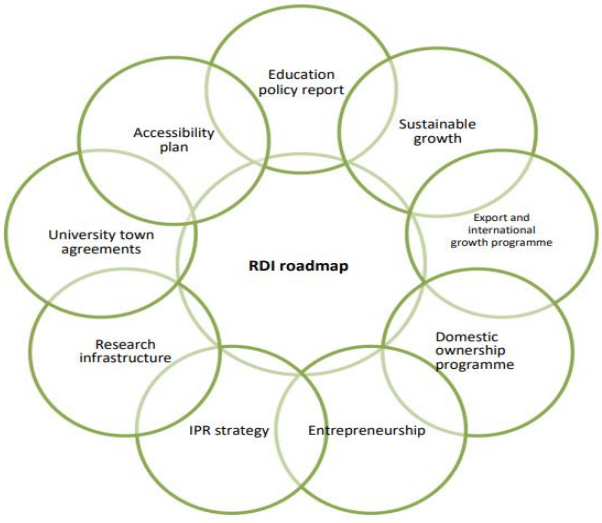


Figure 1. RDI roadmap and other current policies and processes related to research and innovation policy.

ecosystems, and funding is awarded on a competitive basis. The Finnish Government also made a Research, Development and Innovation (RDI) Roadmap.

Comparing R&D Funding provided to the top 5 sectors in Finland

The R&D funding which comes into a country and are mainly from these sources namely:

- External Funding
- Internal Funds and Budget funding
- Public Sector Funding
- Government Administrative sectors funding
- Total rest of the world funding

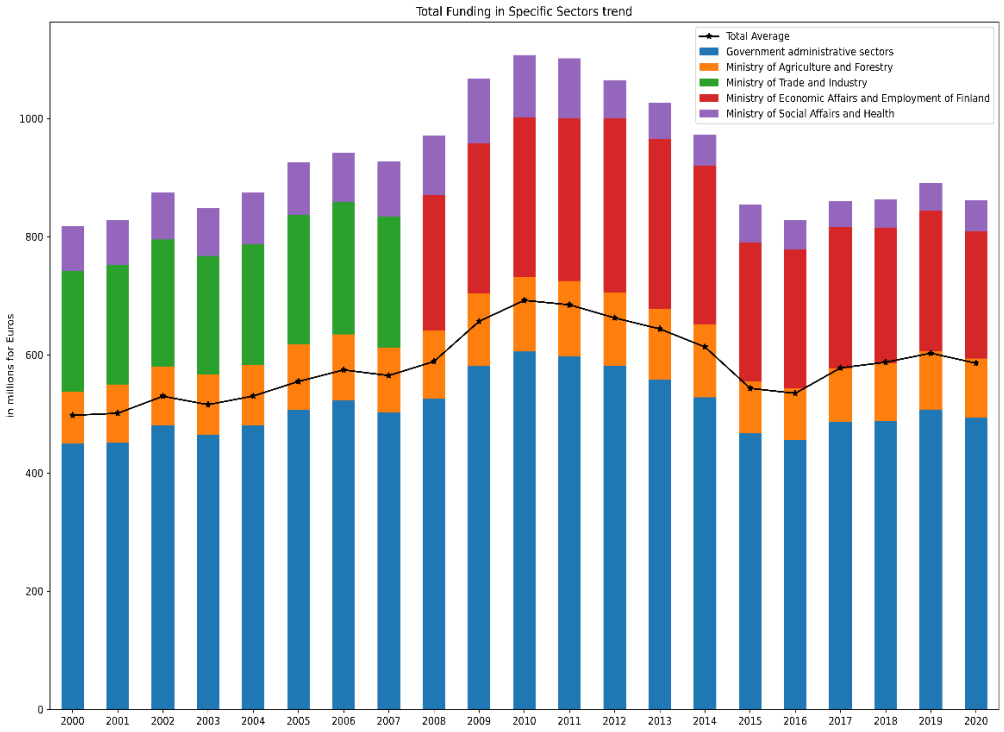
Sector	Funding	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
TOTAL	Total	692	684.4	662.3	643.6	613.1	543.1	534.6	577.7	587.2	602.6	585.6
	External funding, total	317.9	332.8	313	328.7	302.3	288.4	293.9	288.6	299.7	295.2	276.9
	Internal funds and budget funding	374.1	351.6	349.3	315	310.7	254.7	240.7	0	0	0	0
	Public sector funding	154.9	165.8	158.3	163.6	156	149.3	147.9	143.2	140.9	133.7	135.1
	Government administrative sectors funding	142.9	152	145.6	146.5	138	134.1	133.1	127	121.3	114.8	118.3
	Total rest of the world funding	81.3	79.1	77.6	88.5	81.8	79.3	85.8	90.7	102.7	103.5	93.2

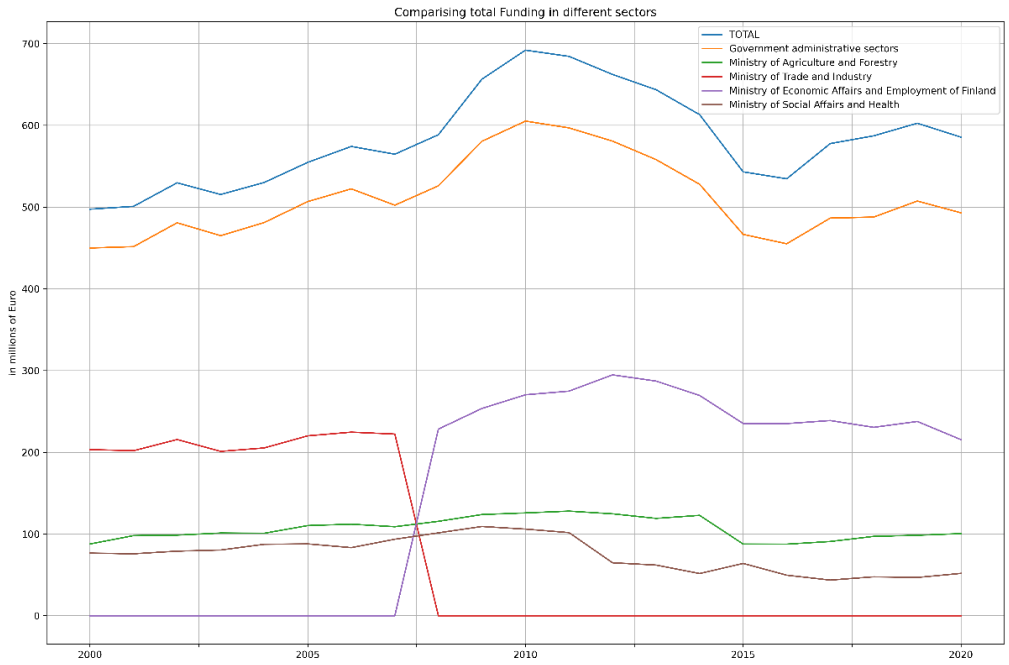
Data of only 10 years shown due to insufficient space

To analyse these different types of funding into different sectors in the Finnish Economy we extracted data about these funding from

After that we cleaned and organized the data of non-reported fundings from different sectors and calculated the total funding from different sources and also extracted the funding of these sources into top five sectors in the Finnish economy. The charts of these data which is from year 2000-2020 have been shown below.

Shown below are 2 charts, a bar chart and a line chart for the same.





Through these charts we can see that the top 5 sectors for which R&D funding was provided were:

- Government Administrative Sectors
- Ministry of Agriculture and Forestry
- Ministry of Trade and Industry
- Ministry of Economic Affairs and Employment of Finland
- Ministry of Social affairs and health

From the charts shown above we can clearly see that R&D funding peaked in these sectors in 2010-2012 period and have remained fairly constant around 500mn to 600mn before and after this period. We can further see that the most R&D funding is provided to the government administrative sectors which is denoted by blue bar and the least funding is received by Ministry of Social Affairs and Health, further we can see that the blue bar has been over the years moving away from the total average line indicating that the proportion of funding to this sector has been decreasing. Further we can that the R&D funding to the ministry of agriculture and forestry has been fairly constant over the years in spite of the booms in the R&D funding. The ministry of Social affairs and wealth have also been getting constant R&D funding over the years and has not changed much overall but recently funding have been decreasing due to general decline in R&D funding to all sectors. The major thing we can see from the line graph is that the ministry of trade and industry which had a major portion of R&D funding had suddenly closed down and remarkably at the same time a new

industry had been formed i.e the Ministry of Economic Affairs and Employment of Finland. Further research into this we found that on January 1, 2008, the Ministry of Economic Affairs and Employment (formerly the Ministry of Employment and the Economy) began operations. The Government Programme of Prime Minister Matti Vanhanen's second Government, dated 19 April 2007, included a decision to create a new ministry that would "assume responsibility for the duties of the existing Ministry of Trade and Industry, the tasks of the Ministry of Labour, excluding migration and integration matters, and the functions of the Ministry of the Interior's Department for Regional Development and Public Administration, excluding the Regional and Local Governments."

6. Regression Models

6.1 Model 1

6.1.1 Methodology

we capture the correlation between the Foreign Direct Investment (FDI) and Research and Development (R&D). We claim that there is negative correlation between FDI_t and $R\&D_t$ and we do the following analysis to prove/disprove our claim. Our motive is to fit the variables as fine as we can subject to several constraints. We start with our first empirical model,

$$\boldsymbol{fdi_t = \beta_t + \beta_t \times RnD_t + \mu_t}$$

Here, the variables mean as follows:

- **fdi_t**: inward foreign direct investment for a given year (in millions of euros, 2020)
- **RnD_t**: Gross domestic expenditure on Research and Development (R&D) (GERD), as a percentage of Gross Domestic Product (GDP)

This Ordinary Least Squared Model doesn't fit the data properly. There are high evidences that means, variances, and covariances change over time i.e., non-stationarity in the time series data.

We further, analyse the data using polynomial regressions of various degrees. The empirical model being,

$$\boldsymbol{fdi_t = \beta_t + \sum_{i=1}^{d} \beta_i \times RnD_t^{\,i} + \mu_t}$$

Using polynomial regression improves the fit of the model i.e., reduces the mean squared error of the model. Polynomial regression also tends to remove the problem of non-stationarity in the dataset.

6.1.2 Data

The Data is yearly, and spans a long period from 2000 to 2020.

Table 4a show the dataset and table 4b shows the summary of the dataset.

The general definition of FDI is as investment that "reflects the objective of obtaining a lasting interest by a resident entity in one economy ('direct investor') in an entity resident in an economy other than that of the investor ('direct investment enterprise')" (OECD, International direct investment database, Metadata).

Foreign direct investment is calculated as the sum of equity capital, long term capital, and short-term capital as reflected in the balance of payments. FDI is characterized by a participation in management, joint-venture, transfer of technology and expertise.

Stock of foreign direct investment is the net (i.e., the outward FDI minus inward FDI) cumulative FDI for any given duration. However, we do not use Net inward FDI in this case in order to prevent negative datapoints to form. Negative datapoint acts as outliers and tends to form clusters above and below the x-axis. Clustered dataset can be fitted using Gaussian Mixture models (GMMs). Use of GMMs was avoided since the dataset does not have endogeneity problem.

Table 1a explains the data and enlists the source of the data.

The data on sectoral FDI inflow to mining, manufacturing, aggregate services, and financial services. FDI data represent a unique data set compiled by United Nations Conference on Trade and Development (UNCTAD), Division on Investment and Enterprise Data Extraction Service. The data was cross-referenced with Organization for Economic Cooperation and Development (OECD), The Association of Southeast Asian Nations (ASEAN)

Table 1a:

Definitions and Sources of the variables

Variables	Full name	Definition	Sources	Original series name in source
$\boldsymbol{fdi_t}$	Foreign Direct Investment	FDI is an investment made by a resident enterprise in one economy with the objective of establishing a lasting interest in an enterprise that is resident in another economy	United Nations Conference on Trade and Development (*UNCTAD*) Division of Investment and Enterprise, Data Extraction Service.	Balance of payment => Foreign direct investment: Inward and outward flows and stock, annual

RnD_t	Gross domestic expenditure on research and development as a percent of GDP	Total intramural expenditure on R&D performed during a specific reference period and reported in current national currency (i.e., expenditure at current prices in national currency).	UNESCO Institution for Statistics (UNESCO UIC)	GERD as percent of GDP

Source: compilations from UNCTAD, and UNESCO UIC

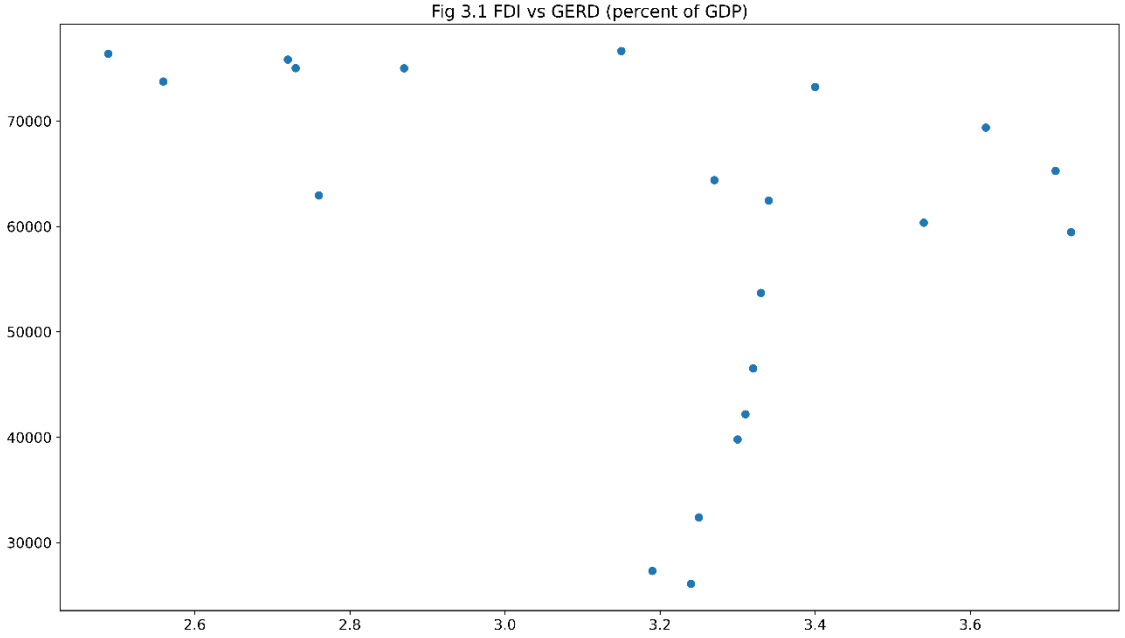
6.1.3 Stylized facts

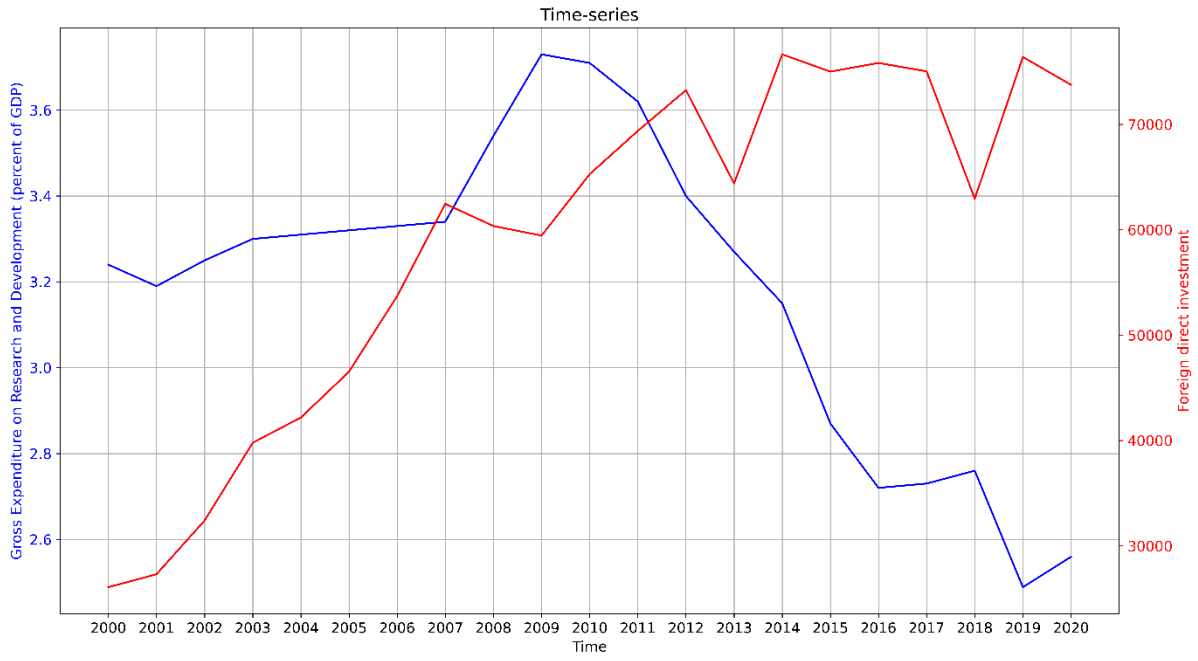
Figure 3.1 shows the scatter plot of FDI_t vs $R\&D_t$ followed by the Time-series plot of the variables. Initial observation was the there is almost negative correlation between the selected variables. This can be seen in scatter plot of the variables as well. The correlation coefficient between FDI and GDP is in fact -0.34191 which shows moderate negative correlation between them.

Another observation can be made for the time series plot of GERD (blue). There was a sudden downward trend in the GERD since 2007. Finland was losing competitiveness from the year 2007 – 2017. This was because of many reasons including demise of Nokia (2008-2014), recession that hit the pulp and paper industry in 2008. Moreover, Finland is characterised by the low diversification of its economy and export destinations, was the second from the last among European economies to recover from the crisis and named the "sick man of Europe" (European Commission 2015; BBC 2016).

Foreign Direct investment (FDI) can be seen in a general primary uptrend over for the past two decade.

Fig 3.1 FDI vs GERD (percent of GDP)





6.1.4 Empirical results

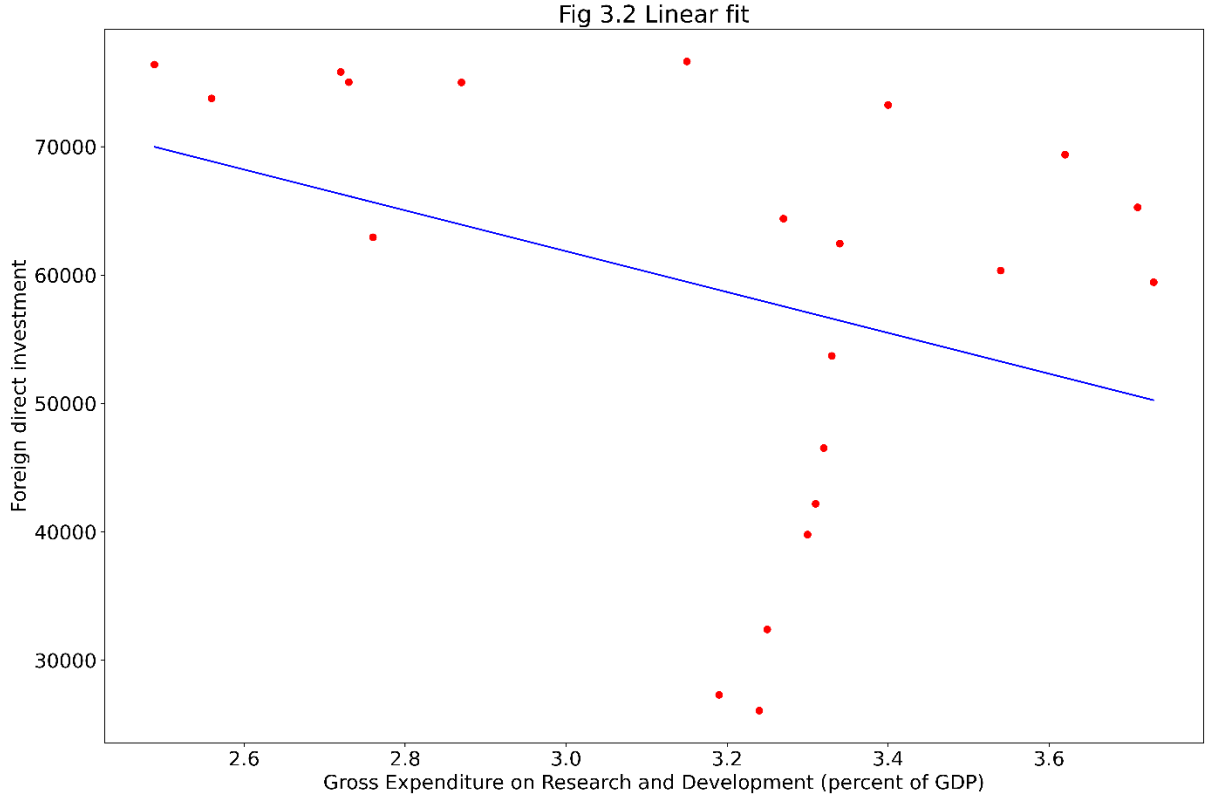
The key empirical results are summarized in table 2 and 3.

Table 2 summarize the OLS linear model and Table 3 summarized the Polynomial regression model.

The linear regression model suggests the marginal effect of $GERD_t$ with respect to FDI_t to be --1.59e+04. This is significant at a 15% level of significance. The slope coefficient is indeed negative with supports our claim the FDI and R&D are inversely related. Foreign R&D investment typically discourages R&D activity because it serves as a substitute for domestic R&D efforts. This suggests that firms in Finland are more inclined to imitate existing products than to innovate new technologies. Domestic R&D activity, on the other hand, appears to benefit from machinery and equipment imports, stronger legal protections, better human capital, and higher economic growth.

Fig 3.2 shows the scatter plot of FDI_t and GDP_t with the respective linear regression model. It clearly shows negative correlation between the endogenous variables. Thus, supporting our claim once again. The Blue line represents the Linear model Fit of the Dataset. It is evident that even though this model correctly shows the primary trend of the dataset, the standard error is very high. The coefficient of determination (R^2) of the model is as low as 0.117, which means this model only explains 11.7% of the data using the endogenous variables.

Fig 3.2 Linear fit



Since the data cannot be fitted linearly. Thus, we think of using non linear approach. For instance, a cubic polynomial model can be checked for the same datapoints. Table 3 shows the summary of this cubic model. Here we can observe that the coefficient of determination has increased to 0.361; which means now 36.1% of the data can be explained using the endogenous variable. This is an improvement as compared to our previous model however here the slope coefficients are not significant and the F-stat value is quite high. Fig 3.3 shows the scatter plot of FDI_t and GDP_t with the respective linear regression model. We can see that the cubic model better fits the data as compared to linear model.

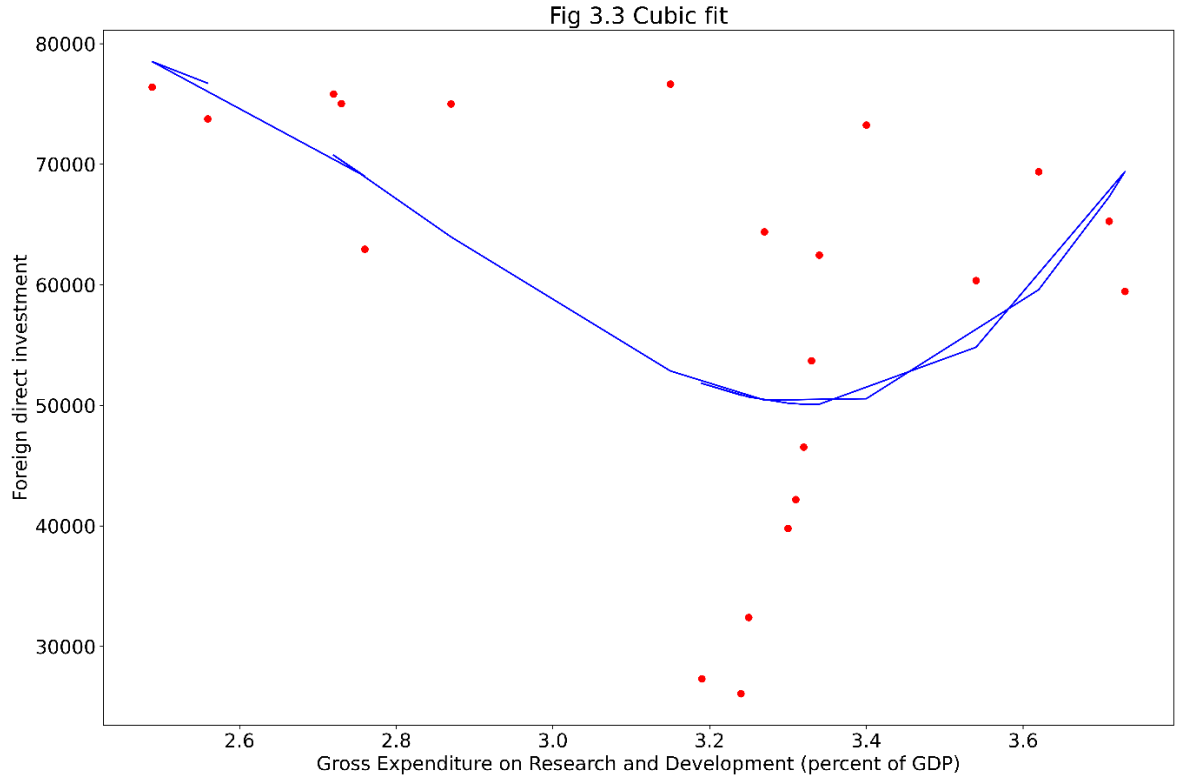
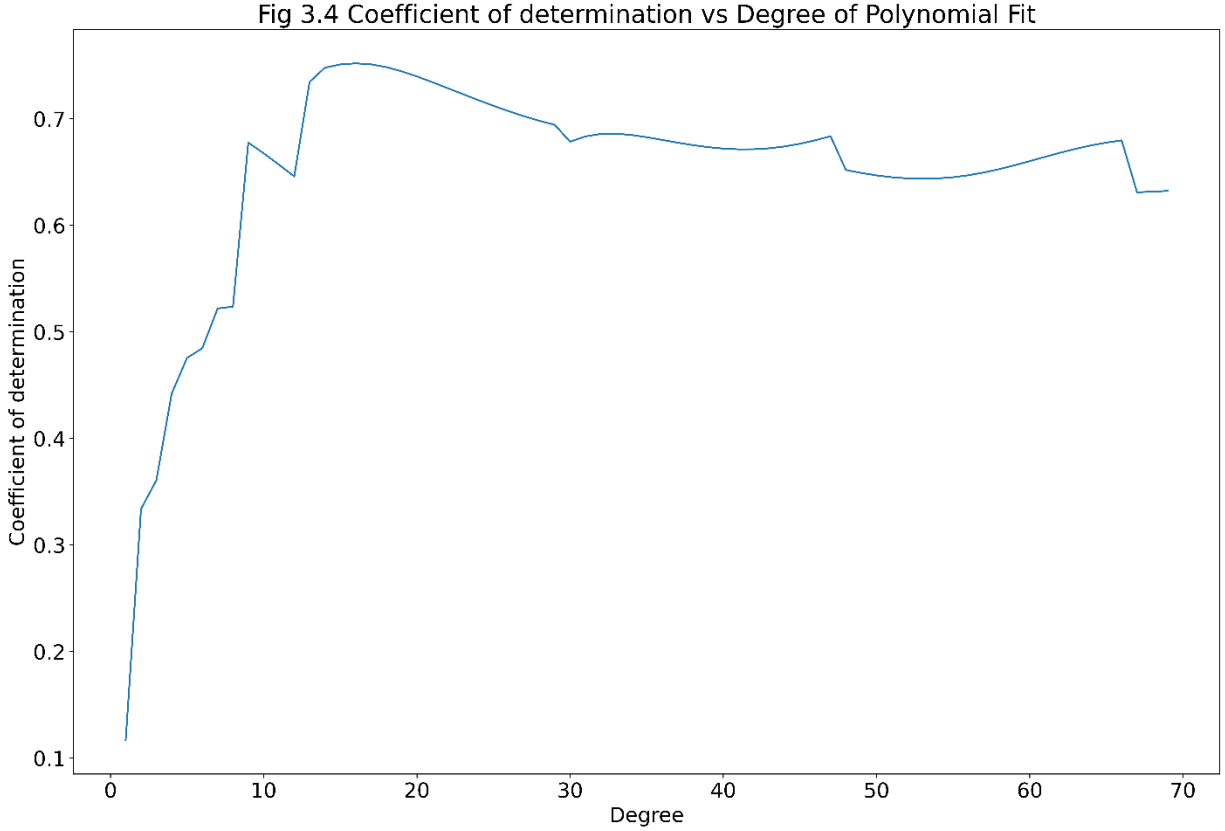


Fig 3.4 shows how the coefficient of determination (R^2) changes as the degree of the polynomial model is increases. This graph increases at first, reaches a maximum and then gradually decreases. The peak is observed at degree = 16 and the corresponding coefficient of determination (R^2) is 0.752. which means now 75.2% of the data can be explained using the endogenous variable. This is a drastic improvement as compared to both linear and cubic model above. The corresponding slope coefficients and intercepts of 16-degree model is,

$$[\ \beta_i\ ]_{1\times 18} = 46226416842.90476\ [\ 0.00000000e+00\ -4.03430929e+09\ -1.12966891e+10\ -1.30985877e+10\ -7.58178943e+09\ 3.79450805e+09\ 1.13636676e+10\ 4.23539193e+09\ -1.03804690e+10\ -4.97538737e+09\ 1.38674705e+10\ -9.84375245e+09\ 3.78409655e+09\ -8.86456035e+08\ 1.27202619e+08\ -1.03405184e+07\ 3.66491363e+05]$$

Fig 3.4 Coefficient of determination vs Degree of Polynomial Fit



An increase in the degree of polynomial model improves the fit of the data, however it comes with a loss of significance of slope coefficients. One of the major problems with using higher polynomial model is the problem of overfitting. Overfitting mean estimating the endogenous variable too precisely at the cost of statistical significance of the slope coefficients. Thus, keeping this in mind, the cubic polynomial model provides a fair trade-off between the statistical significance and coefficient of determination (R^2).

Table 2: summary of OLS Linear regression model

Linear OLS Regression Results

Dep. Variable:	y	R-squared:	0.117
Model:	OLS	Adj. R-squared:	0.070
Method:	Least Squares	F-statistic:	2.515
Date:	Sun, 01 May 2022	Prob (F-statistic):	0.129
Time:	07:04:47	Log-Likelihood:	-232.33
No. Observations:	21	AIC:	468.7
Df Residuals:	19	BIC:	470.8
Df Model:	1		
Covariance Type:	non-robust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	1.095e+05	3.21e+04	3.413	0.003	4.24e+04	1.77e+05
x1	-1.59e+04	1e+04	-1.586	0.129	-3.69e+04	5083.107

Omnibus:	3.364	Durbin-Watson:	0.159
Prob (Omnibus):	0.186	Jarque-Bera (JB):	2.780
Skew:	-0.854	Prob(JB):	0.249
Kurtosis:	2.490	Cond. No.	31.8

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Table 3: Summary of Polynomial OLS model

Polynomial OLS Regression Results

Dep. Variable:	y	R-squared:	0.361
Model:	OLS	Adj. R-squared:	0.248
Method:	Least Squares	F-statistic:	3.198
Date:	Sun, 01 May 2022	Prob (F-statistic):	0.0500
Time:	07:19:56	Log-Likelihood:	-228.94
No. Observations:	21	AIC:	465.9
Df Residuals:	17	BIC:	470.1
Df Model:	3		
Covariance Type:	non-robust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-1.325e+06	2.38e+06	-0.556	0.585	-6.35e+06	3.7e+06
x1	1.556e+06	2.31e+06	0.675	0.509	-3.31e+06	6.42e+06
x2	-5.626e+05	7.37e+05	-0.763	0.456	-2.12e+06	9.93e+05
x3	6.584e+04	7.8e+04	0.844	0.410	-9.86e+04	2.3e+05

Omnibus:	0.120	Durbin-Watson:	0.390
Prob(Omnibus):	0.942	Jarque-Bera (JB):	0.302
Skew:	-0.135	Prob(JB):	0.860
Kurtosis:	2.478	Cond. No.	3.91e+04

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

[2] The condition number is large, 3.91e+04. This might indicate that there are

strong multicollinearity or other numerical problems.

Table 4a: Data for FDI and GERD (percent of GDP)

Time	RND (percent of gdp)	fdi (inwards) (million eur,2020)
2000	3.240000	26085
2001	3.190000	27312
2002	3.250000	32409
2003	3.300000	39791
2004	3.310000	42183
2005	3.320000	46533
2006	3.330000	53702
2007	3.340000	62458
2008	3.540000	60355
2009	3.730000	59449
2010	3.710000	65276
2011	3.620000	69380
2012	3.400000	73246
2013	3.270000	64394
2014	3.150000	76643
2015	2.870000	75005
2016	2.720000	75830
2017	2.730000	75031
2018	2.760000	62945
2019	2.488565	76394
2020	2.559396	73758

Table 4b: Summary of dataset

	GDP (current US$)	Foreign direct investment, net inflows (BoP, current US$)	RND (percent of gdp)	fdi (inwards) (million eur,2020)	ln(fdi inwards)
count	21.000000	21.000000	21.000000	21.000000	21.000000
mean	26.137151	12.178998	3.182284	58960.904762	10.935154
std	0.257912	19.862362	0.362031	16832.453318	0.343566
min	25.557217	-23.081446	2.488565	26085.000000	10.169116
25%	26.045344	21.894109	2.870000	46533.000000	10.747917
50%	26.254663	22.636815	3.270000	62945.000000	11.050017
75%	26.320186	23.471284	3.340000	73758.000000	11.208545
max	26.374189	23.813369	3.730000	76643.000000	11.246914

6.2 Model 2

6.2.1 Methodology

We capture the effect of FDI on industrial energy consumption by controlling for GDP per capita and energy prices. Our model is influenced by the studies of Sadorsky, 2010, 2011, which are among the few studies that use panel data to investigate the question. Our empirical model is,

$$GDP_t^k = \beta_0 + \beta_1 \times inFDI_t^k + \beta_2 \times outFDI_t^k + \beta_3 \times RnD_t + \beta_4 \times gpc_t + \beta_5 \times T + \varepsilon_t$$

Here, the variables mean as follows:

- **GDP^k_t:** Gross domestic product of sector 'k' for year 't'
- **$inFDI^k_t$:** stock inward Foreign direct investment in sector 'k' for year 't' (in millions of euros)
- **$outFDI^k_t$:** stock outward Foreign direct investment in sector 'k' for year 't' (in millions of euros)
- **T:** Time dummy for the time-series data
- **gpc:** Gross domestic product per capita (in current USD)
- **RnD_t:** Gross domestic expenditure on Research and development (GERD) for year 't'

This multivariable linear regression model is used to fit growth as a function of Foreign Direct Investment (FDI) and Research and Development (R&D).

We investigate the dataset further in order to improve the statistical significance of all variables and reduce the number of independent variables to only relevant ones.

We eventually conclude that the best fit model for our topic is

$$GDP_t^k = \alpha_0 + \alpha_1 \times inFDI_t^k + \alpha_2 \times outFDI_t^k + \alpha_4 \times gpc_t + \varepsilon_t$$

We use another approach in order to analyse the data by using dummy variable for each sector. We define variable D_k for sector k such that

$$D_k = \begin{cases} 1 & for\ sector\ k \\ 0 & otherwise \end{cases}$$

The empirical model 4 is

$$GDP_t^k = \gamma_0 + \sum \gamma_{1t}^{(k)} \times inFDI_t^{(k)} + \sum \gamma_{2t}^{(k)} \times outFDI_t^{(k)} + \gamma_3 \times RnD_t + \gamma_4 \times gpc_t + \gamma_5 \times T + \varepsilon_t$$

6.2.2 Data

The data is yearly and span the time period of 2015-2020.

The sectors are divided on the according to International Standard Industrial Classification of All Economic Activities (ISIC). ISIC is a standard classification of economic activities arranged so that entities can be classified according to the activity they carry out. The categories of ISIC at the most detailed level (classes) are delineated according to what is, in most countries, the customary combination of activities described in statistical units and considers the relative importance of the activities included in these classes. While the latest version, ISIC Rev.4, continues to use criteria such as input, output and use of the products produced, more emphasis has been given to the character of the production process in defining and delineating ISIC classes.

The table below shows the code of the sectors according to ISIC-Rev.4 standard.

Aggregate Economic Activity			Sections ISIC- Rev. 4
Agriculture			A
Non Agriculture	Industry	Manufacturing	C
		Construction	F
		Mining and quarrying; Electricity, gas and water supply	B, D, E
	Services	Market Services (Trade; Transportation; Accommodation and food; and Business and administrative services)	G, H, I, J, K, L, M, N
		Non-market services (Public administration; Community, Social and other services and activities)	O, P, Q, R, S, T, U
Not elsewhere classified			X

For Foreign direct investment, we have used 5 sectors namely, Agriculture, forestry and fishing (A), Mining and quarrying (B), Manufacturing (C), Construction (F), Services (G-U)

out of the major 6 sectors in Finland. We dropped the sector: Water supply; sewerage, waste management and remediation activities (E) because of its small contribution to the overall Foreign direct investment.

For Research and Development, the values are calculated using the output approach instead of expenditure or income approaches. For each sectoral contribution, only Gross value added at basic prising (excluding FISIM) is used. Financial intermediation services indirectly measured is excluded as there are no transaction to tract per say.

Table 1a explains the data and enlists the source of the data.

Table 1a:

Definitions and Sources of the variables

Variable	Full name	Definition	Sources	Original series name in source
$\mathbf{GDP^k_t}$	Gross domestic product	Gross domestic product (GDP) is the standard measure of the value added created through the production of goods and services in a country during a certain period	Organisation for Economic Co-operation and Development (OECD database)	GDP
$\mathbf{inFDI^k_t}$	Inward foreign direct investment		Statistical Finland (statfin)	Foreign direct investment by immediate target
$\mathbf{outFDI^k_t}$	outward foreign direct investment		Statistical Finland (statfin)	Foreign direct investment by immediate target
T	Time dummy	--	--	--
$\mathbf{gpc_t}$	GDP per capita	GDP per capita, purchasing power parity (PPP) (current international $) - This is the GDP divided by the midyear population, where GDP is the total value of goods and services for final use produced by resident producers in an economy, regardless of the allocation to domestic and foreign claims	World bank	GDP per capita

RnD_t	Gross domestic expenditure on Research and development (GERD)	Gross domestic expenditure on R&D (GERD) as a percentage of GDP is the total intramural expenditure on R&D performed in the national territory during a specific reference period expressed as a percentage of GDP of the national territory.	UNESCO Institution for Statistics (UNESCO UIC)	GERD

Source: compilations from world bank, OECD database, , and UNESCO UIC

6.2.3 Stylized facts

Fig 3.1 shows the stacked bar graph of inward Foreign direct investment which shows the contribution of each sector to the total FDI for a given year. We can observe that the proportion of each sector more-or-less remains the same.

Fig 3.2 shows the stacked bar graph of outward Foreign direct investment which shows the contribution of each sector to the total FDI for a given year. We can observe that the proportion of each sector more-or-less remains the same.

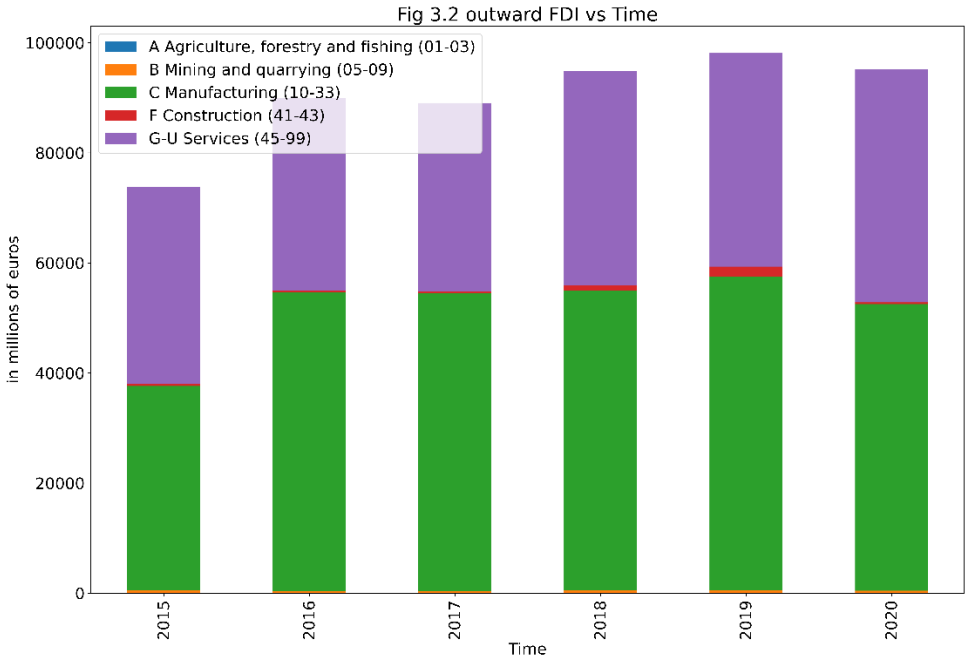


Fig 3.3 shows the stacked bar graph of sectoral GDP which shows the contribution of each sector to the total GDP for a given year. We can observe that the proportion of each sector more-or-less remains the same.

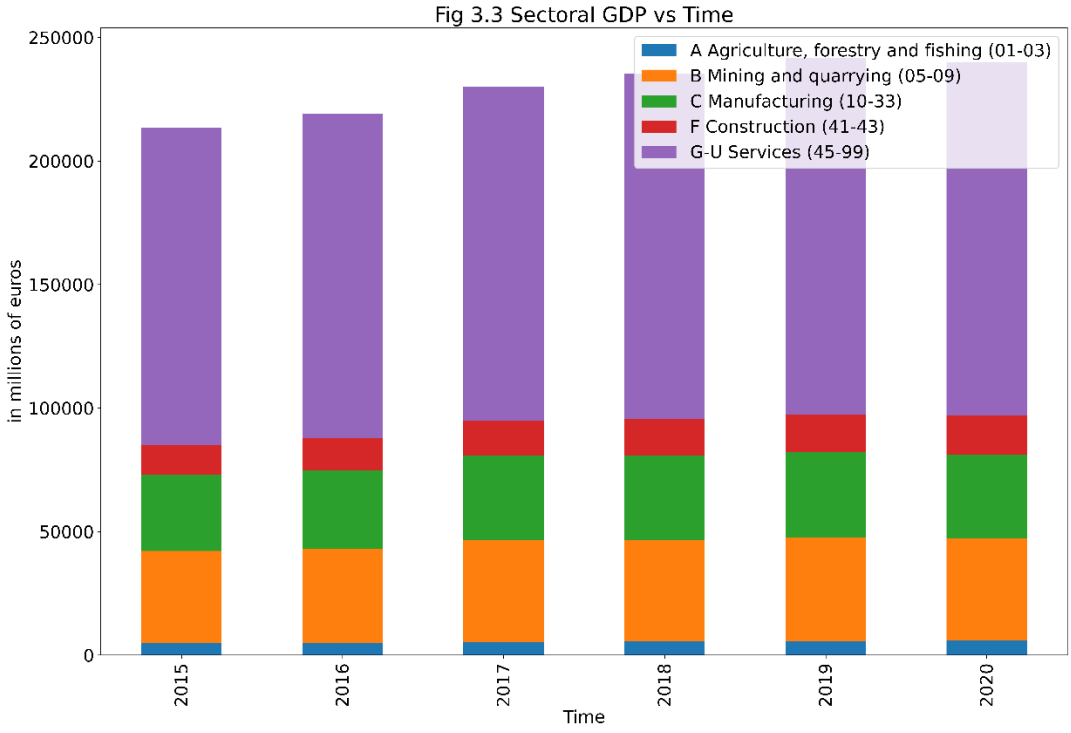
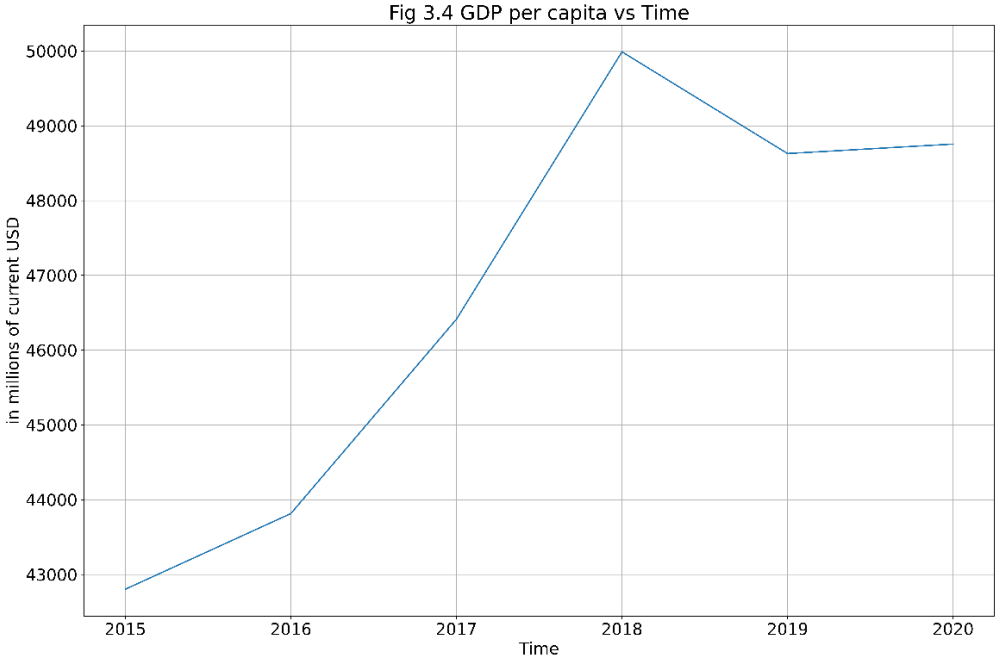


Fig 3.4 shows a line plot of GDP per capital vs Time. We can see a primary general uptrend in GDP per capita.

Fig 3.4 GDP per capita vs Time



6.2.4 Empirical results

The key empirical results are summarized in table 2a. It is the anova table for the regression model. The coefficient of determination of the model is quite high (0.9305) which means almost 93% percent of the data is explained by the exogeneous variables.

On further inspection, we notice that the signs of slope coefficients of inward sectoral FDI and outward sectoral FDI is opposite. This is consistent with the economic interpretation. Increase in inward FDI should increase the growth and increase in outward FDI will reduce the GDP. We notice that the slope coefficient of inward FDI is extremely significant, followed by slope coefficient of outward FDI.

The key conclusion of this model is that "Time" variable is extremely statistically insignificant. Thus, we can drop this variable in order to improve the model.

Table 2a:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.964665164
R Square	0.930578879
Adjusted R Square	0.919008692
Standard Error	23217.99876
Observations	36

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	5	2.16787E+11	4.34E+10	80.42903	1.87E-16
Residual	30	16172263987	5.39E+08		
Total	35	2.32959E+11			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	102291.1425	1057582.092	0.096722	0.923591	-2057580	2262162	-2057580	2262162
S_FDI_I	3.523012425	0.397898213	8.854054	7.19E-10	2.710396	4.335629	2.710396	4.335629
S_FDI_O	-0.507183551	0.272532055	-1.86101	0.072569	-1.06377	0.049401	-1.06377	0.049401
RnD_T	-579.9622009	2119.434637	-0.27364	0.786236	-4908.43	3748.501	-4908.43	3748.501
gdp per capita	5.026807135	4.005019846	1.255127	0.219122	-3.15253	13.20615	-3.15253	13.20615
Time	-4049.831218	7711.043091	-0.5252	0.603305	-19797.9	11698.22	-19797.9	11698.22

We investigate the data even further. We consider dropping the variable "Time" all together. In this model, the absolute value of t-stat of slope coefficient of Time is less than 1 ($|t_{Time}| < 1$). Thus, we speculate that dropping this variable will increase adjusted R^2. Which indeed happens. Adjusted R^2 indeed increases from 0.919 to 0.921. Due to this, the statistical significance of some variable (like per capita GDP) increased.

Table 2b:

SUMMARY OUTPUT for model 2

Regression Statistics	
Multiple R	0.964334272
R Square	0.929940589
Adjusted R Square	**0.920900665**
Standard Error	22945.20771
Observations	36

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	4	2.16638E+11	5.42E+10	102.8704	1.96E-17
Residual	31	16320959257	5.26E+08		
Total	35	2.32959E+11			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	-298008.8205	724564.0009	-0.41129	0.683687	-1775767	1179749	-1775767	1179749
S_FDI_I	3.522707667	0.393222841	8.958553	4.14E-10	2.720724	4.324691	2.720724	4.324691
S_FDI_O	-0.509248954	0.269302002	-1.891	0.068003	-1.05849	0.039996	-1.05849	0.039996
RnD_T	299.1250431	1284.854276	0.232809	0.81744	-2321.35	2919.603	-2321.35	2919.603
gdp per capita	3.101303701	1.593167162	1.946628	0.06069	-0.14798	6.35059	-0.14798	6.35059

Next, we see the slope coefficient of Research and development and notice that it is highly insignificant. In fact, the insignificance of this variable increases when we move from unrestricted model to restricted model. Thus, we need to drop this variable as well.

Further, we regression the variables $inFDI_t^k, outFDI_t^k, gpc$ against GDP_t^k. The result of our final model can be seen in table 3c. We notice that adjusted R^2 value has gone up to 0.923 and the significance of Variables have improved. Now we can say that the variables are significant in the neighbourhood of 5% level of significance. We can observe that dropping variable will not improve the fit of this model. This is because absolute value of t-stat of all

the dependent variables is greater than one ($|t_{stat,i}| > 1$). Any further modification will leading to overfitting, which is not ideal in this case.

The summary of model 4 (using dummy variables) can be seen in table 4d. We see that this has a very high coefficient of determination (R^2). However, the variables are not statistically significant at ever 25% level of significance. This is a perfect example of overfitting of data. the approach of dropping least significant variables does not work in this case. Applying linear transformations to variable matrix doesn't help either because of the exogeneous nature of the data.

Table 4 explains enlists the summary of all the models. We conclude that model 3 is the best fit model for our data.

Model 3 concludes the following relations:

- $\eta_{GDP,inFDI} = \frac{\Delta GDP_t^k}{\Delta inFDI_t^k} = 3.519,$
- $\eta_{GDP,outFDI} = \frac{\Delta GDP_t^k}{\Delta outFDI_t^k} = -0.507,$
- $\eta_{GDP,gdc} = \frac{\Delta GDP_t^k}{\Delta gpc} = 2.976$

Here $\eta_{i,j}$ means the marginal rate of i with respect to j.

We observe that *gpc* and *inFDI* have a positive relation with GDP but outFDI have negative relation with GDP.

Fig 3.5 shows the fit of model 3. We see that the later section of time-series data is being adapted by the model. Since the standard deviation of our dependent variable (GDP_t) is quite high, in order to check for variation of predicted values from actual values, we have take natural logarithm of all the values. Some of the values predicted by the model is negative which means taking logarithm was not possible. To overcome this, we change the definition of natural logarithm to,

$$\ln\theta = signum(\theta) \times \ln|\theta|$$

$$signum(\theta) = \begin{cases} -1, & x < 0 \\ 1, & x \geq 0 \end{cases}$$

Apart form few outliers, the fit seems quite accurate.

`

Fig 3.5 Comparing Predicted value from Model 3 and Actual value of GDP

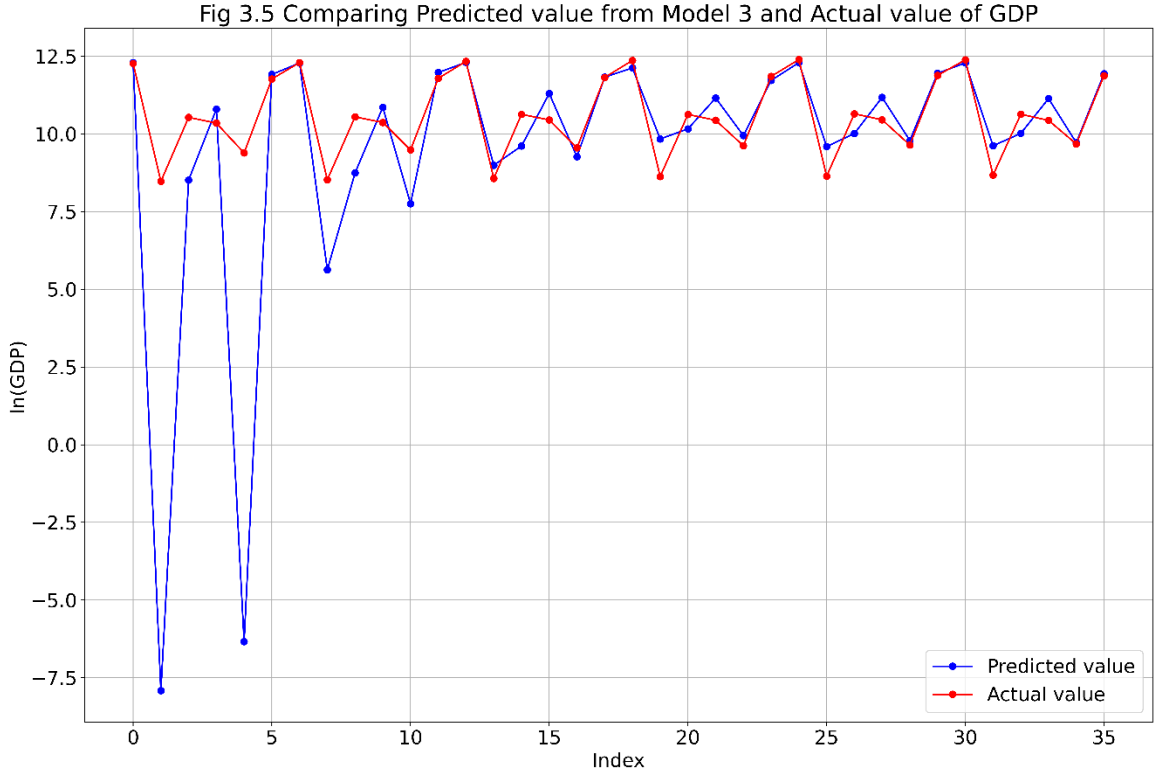


Table 4:

	Model 1	Model 2	Model 3	Model 4
Multiple R	0.964665164	0.964334272	0.96427076	0.998225957
R Square	0.930578879	0.929940589	0.929818098	0.996455061
Adjusted R Square	0.919008692	0.920900665	0.923238545	0.993574797
Standard Error	23217.99876	22945.20771	22603.57723	3856.714706
Significance F	1.86661E-16	1.96177E-17	1.54614E-18	4.87596E-17
Observations	36	36	36	30

Table 3c:

SUMMARY OUTPUT for model 3

Regression Statistics	
Multiple R	0.96427076
R Square	0.929818098
Adjusted R Square	0.923238545
Standard Error	22603.57723
Observations	36

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	3	2.16609E+11	7.22E+10	141.3193	1.55E-18
Residual	32	16349494514	5.11E+08		
Total	35	2.32959E+11			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	-130120.776	69287.8006	-1.87798	0.069524	-271255	11013.86	-271255	11013.86
S_FDI_I	3.519091624	0.387065846	9.091713	2.21E-10	2.730664	4.307519	2.730664	4.307519
S_FDI_O	-0.506921126	0.265109449	-1.91212	0.064849	-1.04693	0.033089	-1.04693	0.033089
gdp per capita	2.976172608	1.477433875	2.01442	0.052435	-0.03326	5.985607	-0.03326	5.985607

Table 3d:

SUMMARY OUTPUT for model 4

Regression Statistics	
Multiple R	0.998225957
R Square	0.996455061
Adjusted R Square	0.993574797
Standard Error	3856.714706
Observations	30

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	13	66896578204	5.1E+09	345.96	4.87596E-17
Residual	16	237987973.1	1.5E+07		
Total	29	67134566177			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	-121116.361	204314.6332	-0.59279	0.56161	-554244.0344	312011	-554244	312011
S_FDI_I A	0	0	65535	#NUM!	0	0	0	0
S_FDI_I B	15.48580915	9.42297872	1.64341	#NUM!	-4.490013372	35.4616	-4.49001	35.4616
S_FDI_I C	0.844118817	0.651740965	1.29518	0.21364	-0.537510308	2.22575	-0.53751	2.22575
S_FDI_I F	14.08339964	5.589807798	2.51948	0.02276	2.23353647	25.9333	2.23354	25.9333
S_FDI_I G	0.494743185	0.274750736	1.8007	0.09063	-0.087702357	1.07719	-0.0877	1.07719
S_FDI_O A	0	0	65535	#NUM!	0	0	0	0
S_FDI_O B	3.038624044	43.57905983	0.06973	#NUM!	-89.34485583	95.4221	-89.3449	95.4221
S_FDI_O C	0.136404717	0.294623892	0.46298	0.64961	-0.488170033	0.76098	-0.48817	0.76098
S_FDI_O F	-4.29150891	4.611786533	-0.93055	0.36591	-14.06805962	5.48504	-14.0681	5.48504
S_FDI_O G	2.894600028	0.324856642	8.91039	1.3E-07	2.205934711	3.58327	2.20593	3.58327
RnD_T	205.0643853	408.2037051	0.50236	0.62226	-660.2888122	1070.42	-660.289	1070.42
gdp per capita	0.342570158	0.774531693	0.44229	0.6642	-1.299363682	1.9845	-1.29936	1.9845
Time	97.25835141	1466.782734	0.06631	0.94795	-3012.182138	3206.7	-3012.18	3206.7

Table 2

OLS Regression Results

Dep. Variable:	y	R-squared:	0.931
Model:	OLS	Adj. R-squared:	0.919
Method:	Least Squares	F-statistic:	80.43
Date:	Sun, 01 May 2022	Prob (F-statistic):	1.87e-16
Time:	17:42:27	Log-Likelihood:	-409.70
No. Observations:	36	AIC:	831.4
Df Residuals:	30	BIC:	840.9
Df Model:	5		
Covariance Type:	non-robust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	1.023e+05	1.06e+06	0.097	0.924	-2.06e+06	2.26e+06
x1	3.5230	0.398	8.854	0.000	2.710	4.336
x2	-0.5072	0.273	-1.861	0.073	-1.064	0.049
x3	-579.9622	2119.435	-0.274	0.786	-4908.425	3748.501
x4	5.0268	4.005	1.255	0.219	-3.153	13.206
x5	-4049.8312	7711.043	-0.525	0.603	-1.98e+04	1.17e+04

Omnibus:	0.144	Durbin-Watson:	2.832
Prob(Omnibus):	0.930	Jarque-Bera (JB):	0.307
Skew:	-0.123	Prob(JB):	0.858
Kurtosis:	2.621	Cond. No.	1.97e+07

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

[2] The condition number is large, 1.97e+07. This might indicate that there are

7.Conclusion

In result of our analysis, we find that Finland has the lowest inward FDI stock in proportion to its size. We also notice that Finland's gap with other economies in inward FDI has widened over the last decade. The FDI investment into different sectors of Finland did not follow any particular trend. It was pretty low in some years for some sectors while pretty high in some sectors.

We gained a conclusion from analysing the R&D sector of Finland that it's down in recent years as compared to per capita growth (GDP), this is mainly because of covid effecting its economy and due to large financial crisis from 2008-2017 during which the economy remained stagnant and this was also due to long term corruption happening in Finland

We show that there is almost complete negative correlation between the Foreign direct investment and the Gross domestic expenditure on Research and development. Then we show, there exists statistical evidence that the growth (GPD) is positively related to Sectoral FDI inflow and negatively with the Sectoral FDI outflows and positively with GDP per capita.

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