Cross-Country Analysis of the Effects of Economic Freedom and Labor Force Quality on Foreign Direct Investment

ISM 6137 – Statistical Data Mining
Final Project

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Executive Summary

Foreign direct investment (FDI) refers to when a company or an individual invests in and takes controlling ownership of a business or entity in another country. This type of investment often involves direct involvement in the day-to-day operations of the foreign company, resulting in the transfer of capital, knowledge, skills, and technology. This could enhance the nation's overall economic health by fostering job growth, raising productivity, and boosting output. It may introduce new management techniques and technological advancements that could boost the productivity of regional industries.

According to the latest data from UNCTAD, the United States had the highest FDI inflows in 2020 with $156 billion, followed by China with $149 billion, Hong Kong (China) with $119 billion, Singapore with $58 billion and India with $57 billion. USA was able to attract such large investments due to its strong legal and regulatory framework, protecting investors' rights and providing a stable business environment. Furthermore, as home to many of the world's leading technology companies and research institutions, the US is an attractive destination for companies seeking to invest in innovation.

The growth of a nation's economy is greatly influenced by foreign direct investment (FDI). We examined the impact of economic freedom and the quality of the labor force based on education on FDI across 36 countries as part of our study. We combined FDI statistics of various nations during the last 15 years in order to examine the data, then we used Multilevel Statistical methods (LMER) for our analysis.

Our key findings showed that GDP, together with the protection of property rights and inflation in recent years, is a key factor in FDI. The net FDI rises by 72.2% with a 1% increase in GDP, while the inbound FDI rises by 11.2% with an increase in the index of property rights protection. In contrast, FDI reduces by 13.5% when a country's inflation index rises by one.

Based on our project analysis, we recommend policies and actions that a government of the nation might look into to make them a more lucrative destination for foreign investments. Some of the proposals include developing policies that support investment in vital sectors like infrastructure, education, and R&D to boost economic growth since GDP is a significant determinant. Countries should emphasize improving their legal and regulatory structure, which includes lowering trade barriers, enforcing contracts, and protecting property rights, as well as investing in upgrading the education and skill levels of their labor force.

In conclusion, our analysis emphasizes the significance of economic freedom and a skilled labor force in luring FDI, which ultimately helps countries' economies expand and develop. Implementing the suggestions and developing strategies will help countries become more enticing to foreign investors and boost FDI inflows.

Problem Statement

What makes the study of FDI so important?

Policymakers around the world seek to enhance the flows of FDI due to the many positive effects on countries. FDI is important for both the investing company and the recipient country. For the investing company, FDI can help to access new markets and resources, reduce production costs, and increase profitability. On the other hand, for the recipient country, FDI can lead to increased employment opportunities, access to new technologies, knowledge, and economic growth. (Research FDI, n.d.)

Foreign direct investment (FDI) has become an increasingly important driver of economic growth and development. The share of FDI stock in global GDP has risen significantly from 22% to 35% between 2000 and 2016, highlighting the increasing importance of FDI in the global economy. In the 1990s, developing countries that implemented FDI-attractive policies were able to attract significant FDI inflows, leading to high rates of economic growth and development.

However, the global financial crisis in 2007-2008 caused a sharp decline in capital flows, including FDI. Despite this setback, FDI inflows to developing countries recovered faster than other components of global capital flows, accounting for roughly 10% of gross fixed capital formation.

FDI can be a complex and risky undertaking. It involves establishing or acquiring operations, significant capital investment and a long-term commitment in a foreign country. Therefore, companies need to carefully evaluate the factors that could impact the success of their investment. Companies calculate risk by evaluating political instability, currency fluctuations, and changes in regulations. Therefore, identifying the factors that attract FDI inflows is crucial for developing countries to achieve sustainable economic growth and development.

What is the objective of our project?

This project's major aim is to look into various factors, notably those connected to the labor force and the economic freedom index, that affect foreign direct investment (FDI) inflows into the nation. The findings of this study can be used to help make policy choices that are meant to boost FDI inflows and encourage economic growth in the nation.

Prior Literature

Source	Research Question	Predictors	Findings
Sambharya & Rasheed (2015)	Does economic freedom in host countries lead to increased FDI?	Economic freedom Political freedom voice and accountability Trade and investment Economic management Extent of government Participation in the economy State interference and corruption Wages and prices FDI stock	Government participation in the economy has a significant influence over FDI inflows at -6.4. State interference and corruption (average of Property Rights, Regulation and the Informal Market) has the highest coefficient value of -8.03, which implies that lower level of state interference and corruption has a significant impact on higher FDI inflows. Conclusively, both economic and political freedom are important for FDI.
Elfakhani & Mackie (2015)	What are the drivers of net FDI in BRIC countries?	Market Size GDP growth rate Trade balance Currency rate risk National Debt Investment Climate GDP per capita	Social and economic/ financial factors such as number of post graduates, population growth and currency rate risk were the major influencing factors with coefficients value of 422.06, 1233.37, -152.33 resp. for inward FDI. Variables such as Democracy did not have any major impact on net FDI. Despite rising levels of corruption, India's improvements in health care as seen by longer life expectancies, continuous population growth, greater GDP per capita, and the preservation of property rights have made the country an appealing destination for FDI.

		Human Capital Development No. of college degree graduates Incremental Post graduates Level of restriction on capital repatriation Quality of life Life expectancy at birth Population size Democracy index Corruption index Civil Liberty International property protection index Degree of economic openness	China's one-party government and low inflation rates were the key contributing factors. For Brazil, democracy and its high degree of economic openness coupled with freedom from capital repatriation all worked in favor for attracting inward FDI The primary factors of FDI in Russia are the rise in GDP per capita and the improvement in living standards, despite the insufficient level of protection of property rights and civil liberties.
Nelson et al. (2021)	What is the effect of higher education, GDP/capita, trade, and interest on FDI?	Labor force with primary education Labor force with secondary education Labor force with tertiary education Gender GDP per capita Trade (% of GDP) Real Interest rate (%)	Education at all levels of an OECD country's labor force is positively associated with inward FDI. Tertiary education, on the other hand, has a greater impact on FDI than secondary and primary education. This is because primary and secondary education is primarily concerned with practical skills, whereas tertiary education is associated with advanced research programs requiring appropriate qualifications. FDI is positively related to both genders. However, a regression analysis of the entire population reveals that males with primary and secondary education outperform females, with a total level of significance of nearly 1% versus 5% for the latter.
Kobeissi	What is the impact of Governance, Legal System and Economic Freedom on FDI in the MENA Region?	Governance Index Common Law (Legal System) Economic Freedom Inflation Level Wages Rate Technological Infrastructure GDP Per Capita Education Composite Risk Population Time Trend	The study shows that there is a positive impact of governance, legal system and economic freedom on the flow of foreign investment in the MENA region. Among the three determinants, governance showed the most significant results followed by legal system and then economic freedom. The relatively lower importance of the last two determinants could be due to the fact that investors from different countries have varying degrees of tolerance for imperfections in the host country's investment environment. When compared education and economic freedom along other factors education (0.015) had more impact than economic freedom (-1.191). The most important factor in attracting foreign investors is profitable business opportunities.
Tag & Degirman (2022)	What is the relationship between economic freedom and foreign direct investment?	Economic freedom Government size Rule of law Sound money Life expectancy Trade freedom Regulations GDP growth FDI per capita	Economic freedom and Rule of law have a major influence on FDI inflow (co-efficient 26.6, 20.3) respectively. MNEs are attracted to countries having low restrictions on international trade, consistent with models of vertical FDI. Overall, our results indicate that institutions of economic freedom are among the key determinants of foreign direct investment flows.
Moussa et al. (2015)	What is the effect of Economic Freedom on FDI?	Growth Import Export Trade Inflation Rate Interest Rate Economic Freedom Index	This investigation aims at measuring the power of economic freedom on FDI inflows especially for often neglected and conflict regions. GDP growth appears as locomotive of FDI as it generates significant coefficients of 0.16.07 in Oceania, 0.3209 in Sub-Saharan, and 0.1251 in post-Soviet. As well as, the role of trade in OC and SS is also remarkable. The negative impact of inflation and interest rates on FDI make sense as foreign investors wish these two variables to be lesser and stable to initiating or continuing their investment activities in that country. Moreover, the analysis reveals that GDP growth has a significant (0.2031) on FDI, which is also desirable for foreign investors.

Majeed et al. (2008)	What is the effect of Human Capital Development on FDI in Developing Countries?	GDP Expenditures on defense Expenditures on health Illiteracy rate Expenditures by government on wages Official development assistance Indirect taxes as a percentage of GDP Real lending interest rate Urban population tonnage of goods transported x kilometers traveled per million dollars of GDP measured in PPP terms vehicles per 1000 people percentage of growth of roads pavement Remittances	The effect of health expenditures is significant in explaining FDI inflows. The effect of illiteracy is negatively associated as a literate population can be made to cooperate for beneficial economic activities more easily. Lower interest rates stimulate the investment opportunities for domestic investors. Higher domestic investment leaves little room for the foreign investors, so lending interest rate positively determine FDI flows. The policy implications that we are offered are: • Expenditures on health facilities and education financing programs may be increased in the host countries at the cost of military expenditures and other non-productive spending. • It is of critical importance to maintain a high and sustainable level of GDP. Evidence has shown that a sustainable level of GDP attracts FDI.

Data Source

The data was collected from 4 different sources namely OECD, PWT version, World Bank and Heritage Foundation. Detailed description is provided in the below:

1.**OECD**: https://data.oecd.org/emp/employment-by-education-level.htm#indicator-chart
OECD countries are the member nations of the intergovernmental Organization for Economic Co-operation and Development (OECD) to promote economic growth, trade, and development. We have considered 'Employment by education level' data from OECD. This indicator shows the employment rates of people according to their education levels: below upper secondary(primary), upper secondary(secondary) non-tertiary, or (advanced)tertiary. This indicator measures the percentage of employed 25–64-year-olds among all 25–64-year-olds (population of working age).

2. **PWT**: https://www.rug.nl/ggdc/productivity/pwt/?lang=en
Penn World Table is a database with information on relative levels of income, output, input, and productivity, covering 183 countries between 1950 and 2020. We have taken 'cgdpo' column which is Output-side real GDP at current PPPs, to compare relative productive capacity across countries at a single point in time.

3.**World Bank**: https://data.worldbank.org/indicator/BX.KLT.DINV.WD.GD.ZS
For FDI inflow, data is collected from the United Nations Conference on Trade and Development (UNCTAD) and official national sources. All the economic freedom factors that come under the umbrella of 'size of government', 'Legal System and Property Rights', 'Sound money',' Freedom to Trade Internationally', 'regulation' is taken from this dataset.

4.**Heritage Foundation**: https://www.heritage.org/index/explore?view=by-region-country-year
The Heritage Foundation, Washington's No. 1 think tank, publishes an annual guide: the Index of Economic Freedom, which is poised to help readers track over two decades of the advancement in economic freedom, prosperity, and opportunity and promote these ideas in their homes, schools, and communities. The Index covers 12 freedoms – from property rights to financial freedom. Through this, our data was referenced for selection of variables in world bank dataset.

Data Preparation

To ensure that our analysis was based on accurate and reliable data, we followed a thorough data preparation methodology. The data used in our analysis was pulled from four different sources as mentioned in the data source, and we took several steps to merge and clean the data. Some of the steps that we took for data merging are as follows:

- Economic Freedom, Labor Force, GDP, and FDI have two common columns, 3 letter country codes and year
- To make it easier to compare and analyze the data across the datasets, a new calculated column called "country_year" has been created by combining the values of the Country 3 Letter code and Year columns in each dataset
- Using the "country_year" column as a reference, a join was performed to combine all four tables. The type of join used between each pair of tables is different. (Refer ER Diagram)
- GDP and Labor Force tables have a one-to-one cardinality
- The Labor Force and Economic Freedom tables have a one-to-many cardinality
- Finally, the FDI and Labor Force tables have a many-to-many cardinality

After joining the tables, we removed the data of countries that had missing Economic Freedom Indicators, as this data was crucial for our analysis. We also excluded the fields that represented the GDP values in thousands of rupees, as our focus was on values calculated in millions of USD. Additionally, we filtered out the rows related to Outward FDI since it was outside the scope of our project. Refer the ER diagram below.

By following this methodology, we ensured that the data used for our analysis was accurate, complete, and relevant to our research objectives. This allowed us to draw meaningful insights and conclusions from the data.

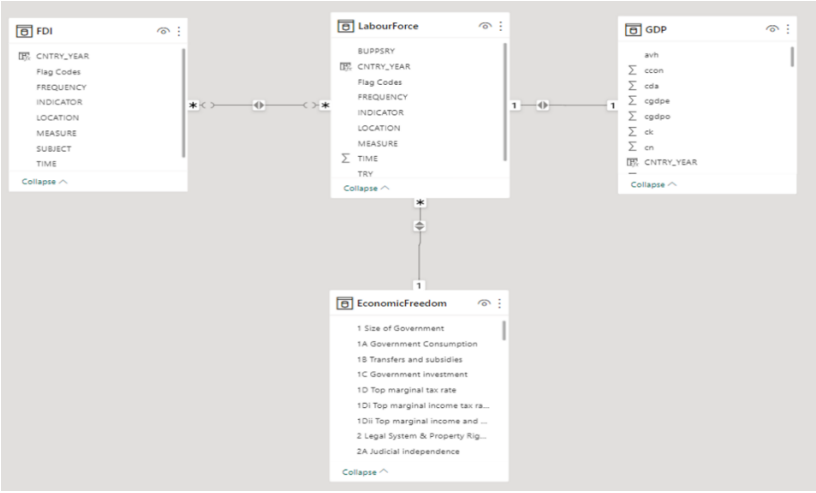


Fig: ER Diagram

Data Description

- Our final dataset consists of 61 columns, including country names, years, GDP, FDI, and various economic freedom and labor force indicators which are mentioned below.
- Our dataset consists of two different categories of factors that may impact FDI. The first category is the Economic Freedom Index and the second one is Labor Force along with GDP
- The age group under Labor force data belongs to the age group between 25-60 yrs.
- 36 major developed/developing countries have been taken for the FDI analysis
- FDI analysis is done for the years between 2005 to 2020
- 'FDI Inward' is the dependent variable for the analysis
- Values for Economic Freedom columns are the ratings from 10
- For comparison consistency the values for GDP and FDI Inflow are in USD

The Economic Freedom Index, which is a key predictor variable, is measured based on five different sectors: Size of Government, Legal Systems and Property Rights, Sound Money, Freedom to Trade Internationally, and Regulation. The indicators for each sector are as follows:

Economic Freedom:

I. **Size of Government**
   A. Government consumption
   B. Transfers and subsidies
   C. Government investment
   D. Top marginal tax rate
   E. State ownership of assets

II. **Legal System and Property Rights**
   A. Judicial independence
   B. Impartial courts
   C. Protection of property rights
   D. Military interference in rule of law and politics
   E. Integrity of the legal system
   F. Legal enforcement of contracts
   G. Regulatory costs of the sale of real property
   H. Reliability of police

III. **Sound Money**
   A. Money growth
   B. Standard deviation of inflation
   C. Inflation: most recent year
   D. Freedom to own foreign currency bank accounts

IV. **Freedom to Trade Internationally**
   A. Tariffs
   B. Regulatory trade barriers
   C. Black-market exchange rates
   D. Controls on the movement of capital and people

V. **Regulation**
   A. Credit market regulations
   B. Labor market regulations
   C. Business regulations

In addition to the Economic Freedom Index, our data set also has labor force based on education variable, which consists of the following variables.

Labor Force:

A. Labor force with primary education
B. Labor force with secondary education
C. Labor force with tertiary education

Finally, we have countries name, year and GDP of the country.

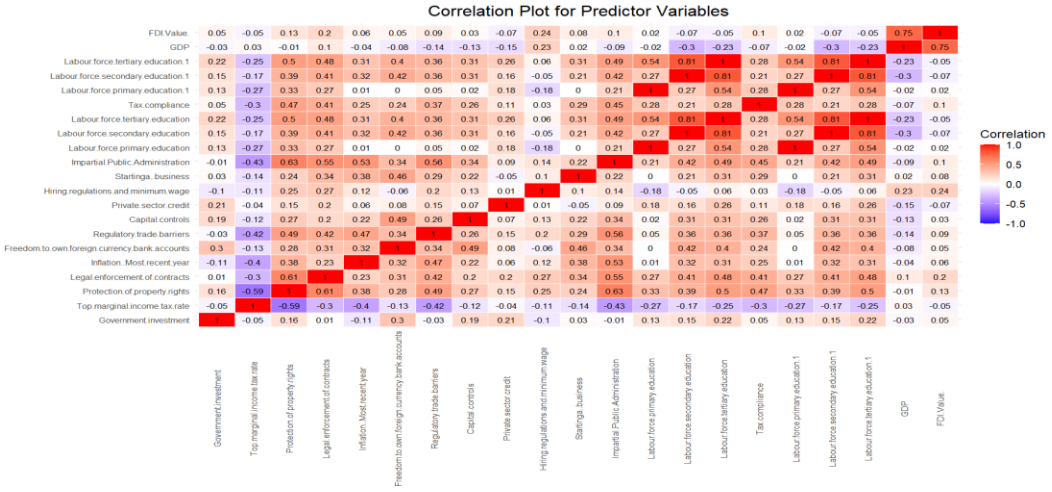
Countries
Year
GDP

Predictor table:

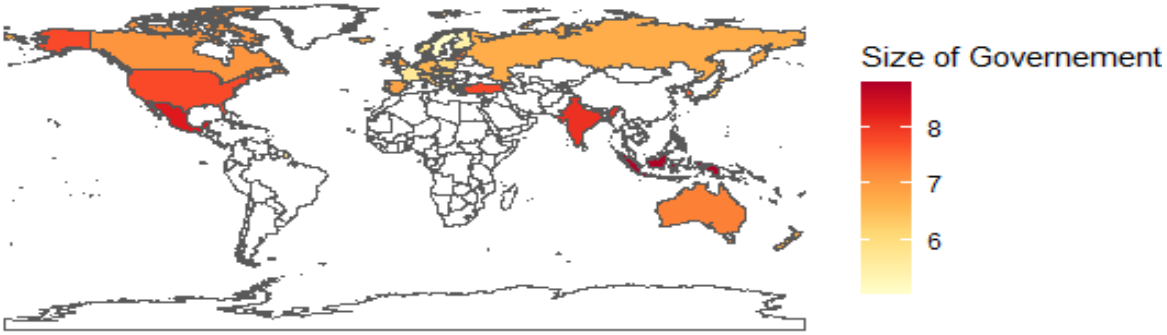
Variables	Effect	Description/ Impact Rationale
GDP	+	**GDP is the entire value of products and services generated inside the nation's boundaries** Strong and expanding economies with higher GDP can offer stable and beneficial business environments, which may affect foreign investment too.
Govt. Investment	+	**Government investment is the sum invested by the government in the economy of the nation**. The quality and availability of funds for infrastructure, education, and R&D may significantly impact a country's business environment and attract FDI
Top marginal income tax rate	-	**Top marginal income tax rate is the highest rate of income taxation** A lower top marginal income tax rate may make a country more attractive to foreign investors by reducing the tax burden on their profits.
Protection of property rights	+	**Protection of Property Rights is the degree to which ownership and usage of property are protected by the legal system.** Investors want to know that they can count on a fair legal system and know that their investments will be secure and not subject to arbitrary confiscation or seizure by the state or others.
Legal enforcement of contracts	+	**Legal enforcement of contracts is the degree to which contracts are upheld by the legal system** Investors need to know that their legal rights and contractual obligations will be upheld and enforced in a consistent and impartial manner.
Inflation: most recent year	-	**Inflation is the rate of growth in the overall level of goods and services' prices** High inflation rates can decrease the purchasing power of a country's currency, affect the cost of production and the prices of goods and services, reduce the profitability
Freedom to own foreign currency bank accounts	+	**Freedom to own foreign currency bank accounts is the extent to which people are allowed to possess and use foreign currency, which has an impact on capital movements.** Allowing foreign investors to hold bank accounts denominated in their home currency can make it easier for them to do business and manage their investments.
Capital Controls	-	**Capital Controls is the measures taken by the government to limit the flow of capital into and out of the nation** Limiting the inflow of capital, restricting repatriation of profits, increasing transaction costs might reduce investors' confidence.
Regulatory trade barrier	-	**Regulatory trade barrier is the extent to which trade regulations are enacted and have the potential to impede the free movement of goods and services.** When a country imposes regulatory trade barriers, it may limit the opportunities for foreign companies to access the domestic market & discourage them from investing in the country.
Private sector credit	+	**Private Credit is the accessibility and availability of financing for enterprises in the private sector** Access to credit can be an important factor for foreign investors, especially those who may need to borrow money to fund their investments.
Starting a business	+	**Starting a Business is the ease or complexity of business startup, which might impact entrepreneurship and job development.** It may have a significant impact on foreign direct investment (FDI) by influencing the ease of doing business in a country.
Impartial public Administration	+	**Impartial public administration is the level of impartiality, which has an impact on how transparent and effective services are provided by the government.** When government officials act in the public interest rather than serving the interests of specific individuals or groups, foreign investors are more likely to trust that their investments will be protected.

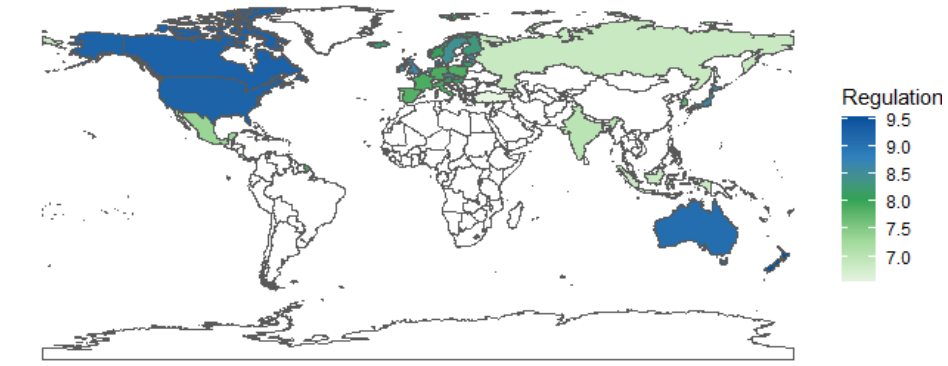
Hiring Regulations and minimum wage	-	**Hiring regulations and minimum wage are the laws governing hiring procedures and the minimum pay** Strict hiring policies make it difficult for foreign companies to hire and fire employees. Also, if a country sets minimum wages at a high level, this may increase labor costs and may deter FDI.
Countries, Year	NA	Countries and Year is taken as the random effect which is needed for the analysis of various factors of FDI for different countries over a time period of 15 years.
Labor Force with Primary Education **Labor Force with Secondary Education** **Labor Force with Tertiary Education**	+	**These three variables show how the labor force is distributed by level of education in a given country which is up to primary level, up to secondary level or under graduation and tertiary level.** Investors are often attracted to countries with skilled labor forces that can support the operations of foreign companies and thus labor force with education may impact FDI.
FDI	**Dependent Variable**	
Excluded Variables: The rest of the economic freedom index variables are dropped for one of the following reasons: 1. The variables were drop on the basis of high correlation with the selected variables 2. The variables were drop if that variable was either a subcategory or completely explained by the selected variable		

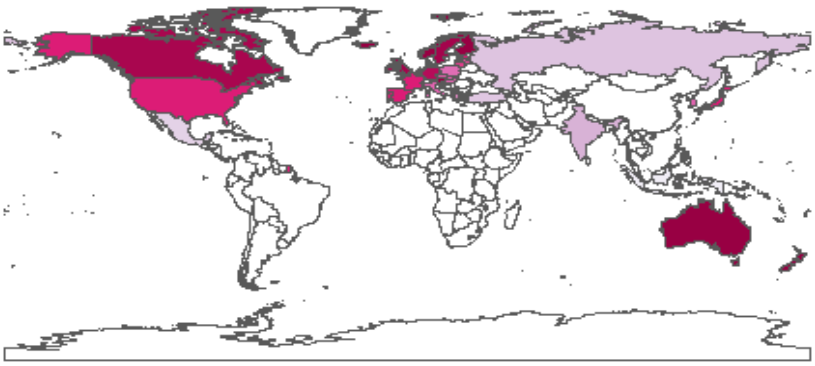
Exploratory data Analysis and Visualizations

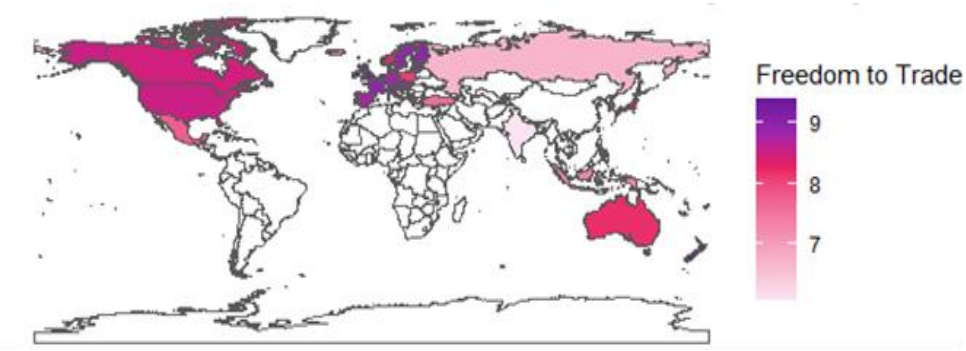


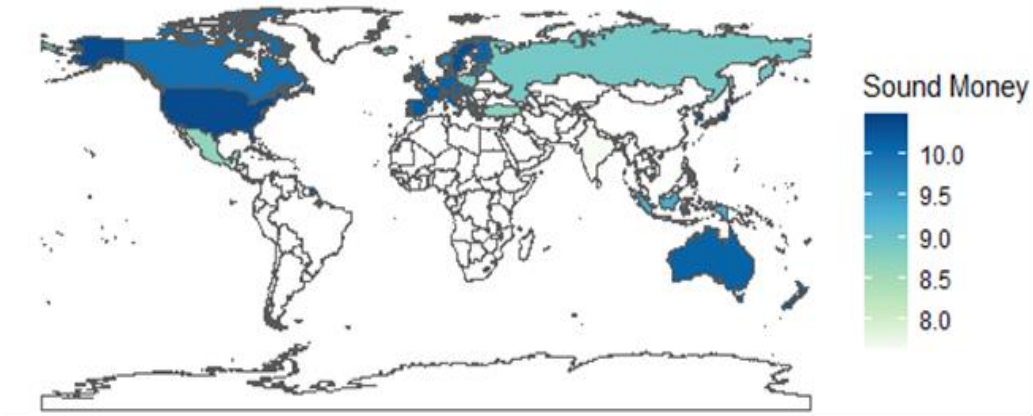
There seem to be correlation between two of our predictor variables: secondary and tertiary education which is quite expected as individuals who completed secondary education and are employed are more likely to get tertiary education, therefore there might overlapping. But we are considering both, as we need to find out which drives FDI more.



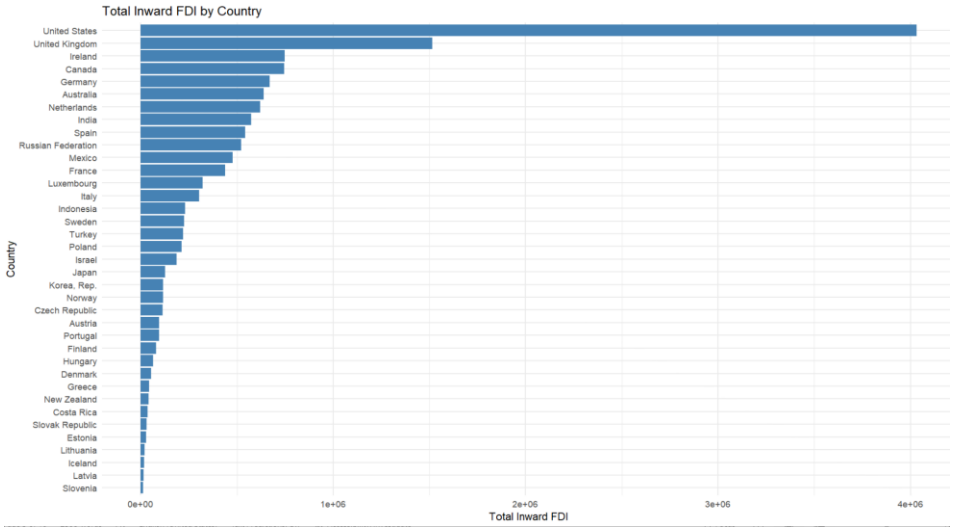

Regulation
9.5
9.0
8.5
8.0
7.5
7.0


Legal Rights
8
7
6
5

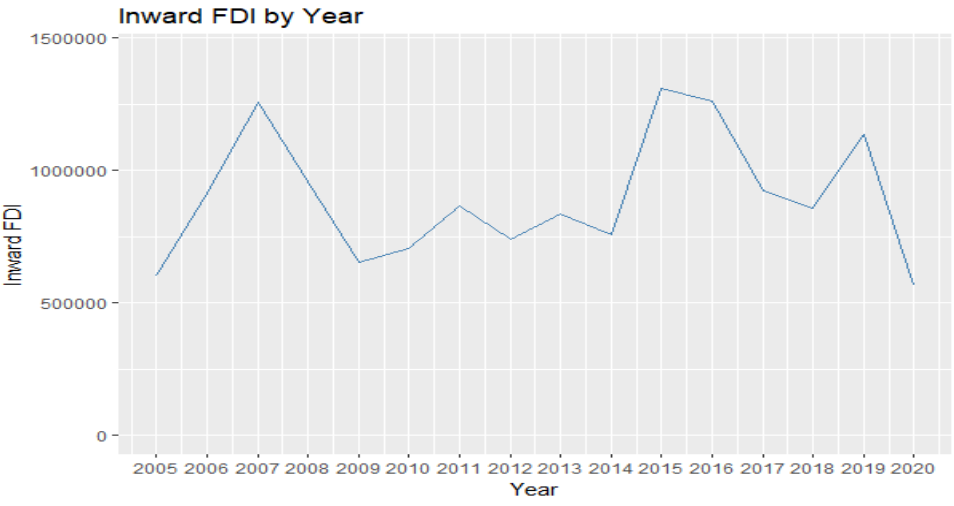

Freedom to Trade
9
8
7


Sound Money
10.0
9.5
9.0
8.5
8.0

Size of government, sound money, legal rights, regulation, and freedom to trade internationally are the five major factors that form the foundation of economic freedom. The heatmap above represents these factors across various countries, where darker hues denote higher value. As we can see from the heatmap, nations like the United States, Australia, and a few European nations have higher scores across the board, which helps explain why these nations have higher Economic Freedom indices, which in turn cause higher FDI.



This image represents the total inward FDI for countries for a collective of 15 years from 2005 to 2020. As we can see from the above graph, that developed countries like USA or UK and developing countries with higher GDP like India has been a favorable destination for foreign investments has higher FDI.



This image depicts the trend of global FDI over time. As we can see that there has been an upward trend with some fluctuations. From 2008 to 2009, the FDI plunges sharply due to the global financial crisis. Similarly, from 2019 to 2020, there was sharp decline due to COVID 19, which is the lowest level since 2005.

Models

Our data is multi-level and includes information at the 'Countries' and 'Years' levels. We have decided to use a multi-level mixed effect model in regard to this hierarchical structure since it can more accurately estimate the coefficients and standard errors and can take into consideration the distribution of observations within each level.

We used a histogram to examine the distribution of our dependent variable. Since, the original distribution looks skewed we used a log transformation. Post applying the log transformation, the data seems normally distributed with a skewness of -0.33.

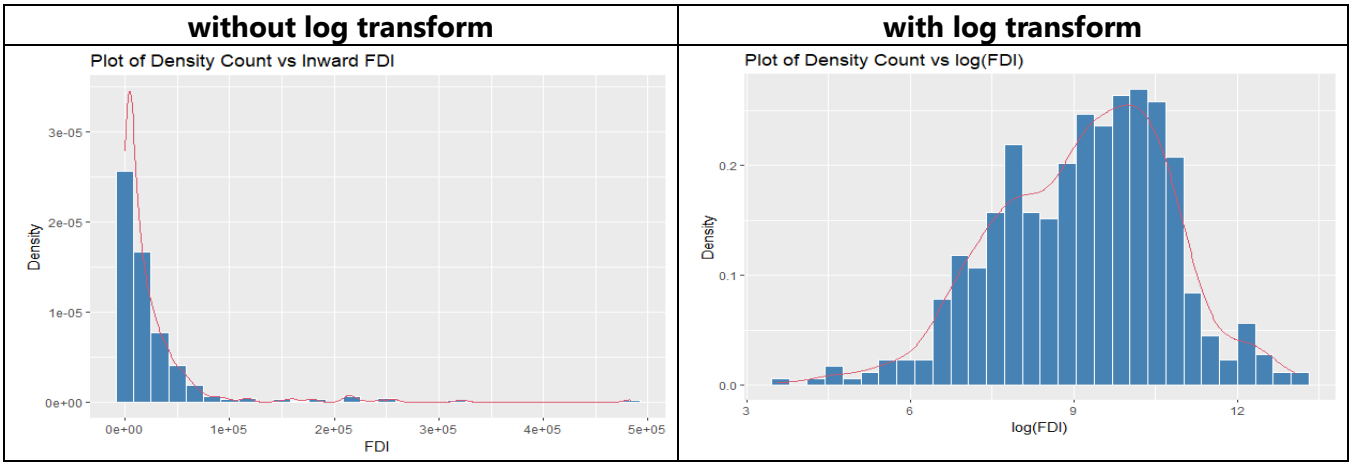


Fig: Distribution of Dependent Variable, FDI

We decided to create three models to study the impact of economic predictors and labor force predictors on FDI. For the first model, given that the data were normally distributed and multi-level, with countries and years acting as random effects, we used a linear mixed-effects regression model (lmer) to incorporate both economic and labor force factors alongside GDP. Finally, as time is the base level of our multilevel data, we decided to use panel model with random effect and fixed effect of countries and years.

LMER Model:

model_FDI= lmer(log_FDI ~ log_GDP + Government.investment + d$Top.marginal.income.tax.rate + Legal.enforcement.of.contracts + Protection.of.property.rights + Freedom.to.own.foreign.currency.bank.accounts + Inflation:.Most.recent.year + Capital.controls + Hiring.regulations.and.minimum.wage + Private.sector.credit + Regulatory.trade.barriers + Startinga..business + Impartial.Public.Administration + Labour.force.with.primary.education + Labour.force.with.secondary.education + Labour.force.with.tertiary.education + (1|Countries) + (1|Year), data=d, REML=FALSE)

Panel Model with random effect:

plm_FDI= plm (log_FDI ~ log_GDP + Government.investment + d$Top.marginal.income.tax.rate + Legal.enforcement.of.contracts + Protection.of.property.rights + Freedom.to.own.foreign.currency.bank.accounts + Inflation:.Most.recent.year + Capital.controls + Hiring.regulations.and.minimum.wage + Private.sector.credit + Regulatory.trade.barriers + Startinga..business + Impartial.Public.Administration + Labour.force.with.primary.education + Labour.force.with.secondary.education + Labour.force.with.tertiary.education , data=dp, index= c("Countries","Year"), model="random")

Panel Model with fixed effect:

plm_FDI= plm (log_FDI ~ log_GDP + Government.investment + d$Top.marginal.income.tax.rate + Legal.enforcement.of.contracts + Protection.of.property.rights + Freedom.to.own.foreign.currency.bank.accounts + Inflation:.Most.recent.year + Capital.controls + Hiring.regulations.and.minimum.wage + Private.sector.credit + Regulatory.trade.barriers + Startinga..business + Impartial.Public.Administration + Labour.force.with.primary.education + Labour.force.with.secondary.education + Labour.force.with.tertiary.education , data=dp, index= c("Countries","Year"), model="within")

Since, the beta coefficients of the lmer model and the panel model with random effect are nearly identical, we chose the **lmer** model for our interpretations. In addition, our dependent variable is normally distributed and our data is multilevel data and lmer is more suitable for this type of data. Additionally, lmer provides a robust framework, is more adaptable, intuitive, and enables us to account for the variation in the dependent variable brought on by the random effects. So, taking into account everything, we think the lmer model is the best fit for our dataset.

Quality Checks

Since we are using LMER model which uses MLE estimation technique which doesn't require normality and homoscedasticity assumption. However, we have to check for multicollinearity. The values of VIF tests shows GVIF^(1/(2*Df)) values of all variables below 5. Hence, there is no multicollinearity. For LMER models, the Durbin-Watson test of independence is not defined. There were undoubtedly some connected inaccuracies in the data, but we anticipate that our multi-level definition will eliminate the majority of them.

```
> vif(model_FDI)
                                    d$log_GDP                                 d$Government.investment
                                     1.204072                                                1.175537
                  d$Top.marginal.income.tax.rate                  d$Legal.enforcement.of.contracts
                                     1.216141                                                1.422504
               d$Protection.of.property.rights d$Freedom.to.own.foreign.currency.bank.accounts
                                     1.431547                                                1.497093
               d$`Inflation:.Most.recent.year`                                d$Capital.controls
                                     1.316671                                                1.175532
          d$Hiring.regulations.and.minimum.wage                          d$Private.sector.credit
                                     1.123015                                                1.148822
                    d$Regulatory.trade.barriers                             d$Startinga..business
                                     1.150578                                                1.425816
             d$Impartial.Public.Administration           d$Labour.force.with.primary.education
                                     1.386559                                                2.031945
       d$Labour.force.with.secondary.education           d$Labour.force.with.tertiary.education
                                     2.380573                                                3.601326
>
```

Interpretations and Marginal Effect Analysis

According to the stargazer output of the models which are attached in the appendix, the marginal effect analysis of all the predictor variables is as shown below:

- With an increase of 1% GDP of the country, the net FDI increases by 72.2%, which means that higher the GDP of a country more attractive it becomes for foreign investors which is a major reason why developed and developing country with high GDP like India attracts so much FDI
- Protection of Property Rights and Inflation in the recent years are two most significant predictors of FDI. With an increase in index of Protection of Property Rights, the inward FDI increases by 11.2%. Whereas, with an increase in index of Inflation in a country, the FDI decreases by 13.5%. This implies that countries with better property protection rights and lower inflation are an attractive destination for investments.

- The amount of investment made by the government in the country and legal enforcement of contracts are a positive indicator of FDI, which means if the index of government investment and legal enforcement increases by 1, then the FDI increases by 3.3% and 7.5% respectively. This implies that foreign investors prefer a country with better legal enforcement of contracts and where the government is actively investing in the development of the country.
- With an increase in index for Hiring Regulations and minimum wages of the country, the FDI decreases by 5.5% which means that the countries with lesser hiring regulation and lesser minimum wages may be preferred by the investors.
- Starting a business or ease at which, a company can be started in a country is also an important factor and with an increase in index for Starting a Business of the country, the FDI increases by 3.3%. Therefore, countries like Singapore which is known for its business-friendly environment and ranked second in the World Bank's Ease of Doing Business Index in 2021 attracts a lot of investors and has considerable amount of FDI.
- Capital control, or how much the government regulates the movement of capital into and out of the economy, also influences FDI. With an increase in index for Capital Control, the FDI decreases by 1.3%. Thus, a nation with less capital control allows for greater freedom of movement of resources and capital, which in turn draws more investors.
- On the other hand, the labor force by education predictors is essentially divided into three different variables: the labor force with up to primary education, the labor force with up to secondary education, and the labor force with tertiary education. The results show that the FDI grows by 1.2% with an increase in the index for the labor force with secondary education, while it falls for the other two. This demonstrates that investors like nations where the majority of the labor force has at least a secondary education, or under graduation, as opposed to nations where the labor force has only a primary education.

Insights and Recommendations

For countries that aim to boost their FDI inflows, the following policy recommendations can be made based on the marginal effects analysis of the determinants of FDI:

- The best way for nations to attract FDI is by focusing on growing their GDP. To achieve this, policies that encourage investment in crucial industries like infrastructure, education, and research and development can be used to stimulate economic growth.
- To draw more FDI, countries should invest in raising the education and skill levels of their work force. This can be accomplished by implementing policies that broaden access to education and training, support entrepreneurship and innovation, and foster cooperation between business and academia.
- Countries should prioritize enhancing their legal and regulatory framework, which includes trade barrier reduction, contract enforcement, and the protection of property rights. As a result, foreign investors may feel more confident in the nation and find it easier to conduct business.
- The government of the nation can consider providing incentives for private sector credit. This can be accomplished by adopting laws that encourage banks to lend to companies and entrepreneurs, offer loan guarantees, and develop initiatives to aid small and medium-sized firms.
- Reducing governmental control and corruption can be a successful strategy for making sure that foreign investors are protected from unfair treatment. This can be done by establishing an independent judicial system, streamlining bureaucratic procedures, and instituting open rules and regulations. Countries may attract more international investment and create a welcoming environment for domestic businesses by promoting political and economic freedom.

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Appendix

OUTPUT

> stargazer(model_FDI,plm_FDI, plm_fe_FDI, type="text")

	Dependent variable:		
	log_FDI	log_FDI	
	linear	panel	
	mixed-effects	linear	
	(1)	(2)	(3)
log_GDP	0.722***	0.704***	0.181
	(0.086)	(0.094)	(0.331)
Government.investment	0.034	0.040	0.043
	(0.043)	(0.044)	(0.046)
Top.marginal.income.tax.rate	0.034	0.071*	0.072
	(0.038)	(0.041)	(0.046)
Legal.enforcement.of.contracts	0.076	0.081	0.051
	(0.081)	(0.081)	(0.102)
Protection.of.property.rights	0.112*	0.136**	0.148***
	(0.061)	(0.060)	(0.064)
Freedom.to.own.foreign.currency.	0.059*	0.064*	0.093**
bank.accounts	(0.034)	(0.035)	(0.037)
`Inflation:.Most.recent.year`	-0.136	-0.196**	-0.172
	(0.099)	(0.096)	(0.098)
Capital.controls	-0.014	-0.020	-0.030
	(0.032)	(0.033)	(0.037)
Hiring.regulations.and.	-0.055*	-0.052	-0.073*
minimum.wage	(0.033)	(0.034)	(0.041)
Private.sector.credit	0.083***	0.093***	0.100***
	(0.023)	(0.022)	(0.023)

Regulatory.trade.barriers	0.079	0.126*	0.127
	(0.072)	(0.073)	(0.080)
Startinga..business	0.033	0.003	0.082
	(0.110)	(0.104)	(0.129)
Impartial.Public.Administration	0.080	0.081	0.065
	(0.063)	(0.065)	(0.078)
Labour.force.with.primary.education	-0.009	-0.012	-0.018
	(0.011)	(0.012)	(0.016)
Labour.force.with.secondary.education	0.013	0.013	0.013
	(0.018)	(0.019)	(0.021)
Labour.force.with.tertiary.education	-0.010	-0.005	0.010
	(0.020)	(0.020)	(0.023)
Constant	-3.039	-3.045	
	(2.098)	(2.073)	
Observations	542	542	542
R2		0.171	0.111
Adjusted R2		0.145	0.016
Log Likelihood	-659.709		
Akaike Inf. Crit.	1,359.418		
Bayesian Inf. Crit.	1,445.323		
F Statistic		112.655***	3.806*** (df = 16; 489)
Note:	*p<0.1; **p<0.05; ***p<0.01		

Ranef Model Output for Random Effect

```
$`d$Countries`
                (Intercept)
Australia        0.7118131575
Austria         -0.5082782641
Canada           0.6891089479
Costa Rica       0.1553381900
Czech Republic  -0.1542357727
Denmark         -0.7915603684
Estonia         -0.5167505486
Finland         -0.6054989185
France          -0.7081534776
Germany         -0.3674020623
Greece          -0.2981248144
Hungary         -0.0000424259
Iceland          0.6870753861
India            0.5609824825
Indonesia       -0.3030994231
Ireland          2.0339959349
Israel           0.7316552224
Italy           -0.1293445777
Japan           -1.3760003682
Korea, Rep.     -1.1772013697
```

```
$`d$Year`
     (Intercept)
2005 -0.04704131
2006  0.15574117
2007  0.21592157
2008  0.09066854
2009 -0.09514387
2010 -0.12953663
2011  0.11336739
2012 -0.11549475
2013 -0.04658099
2014 -0.01109894
2015 -0.15865939
2016 -0.05296941
2017 -0.01768741
2018 -0.03908300
2019  0.11336639
2020  0.02423062
```

```
Latvia          -0.9001629072
Lithuania       -0.6554997520
Luxembourg       1.8142346222
Mexico           0.9588868494
Netherlands      0.8416759120
New Zealand     -0.4209490203
Norway          -0.3243075592
Poland           0.4163395328
Portugal         0.0129186891
Russian Federation  0.1285716716
Slovak Republic -0.5932741582
Slovenia        -1.1553466329
Spain            0.1252226335
Sweden          -0.1659233529
Turkey          -0.2901607263
United Kingdom   0.9196621474
United States    0.6538351212
```

R CODE

```
rm(list=ls())
library(rio)
library(moments)
library(corrplot)
library(ggplot2)
library(dplyr)
library(tidyverse)
library(lmtest)
library(plm)
library(car)

#importing the file
getwd()
setwd("C:/Users/risha/OneDrive/Desktop/BAIS/SDM/GroupProject")
d=import("SDM_Project_FDI_Dataset.csv")
str(d)

#removing the index from the column
colnames(d) <- sub("^\\d+\\s*[A-Za-z]*\\s*", "", colnames(d))

#renaming the column BUPPSRY_UPPSRY_NTRY and TRY
new_names <- c("Labour force with primary education", "Labour force with secondary education", "Labour force with
tertiary education","FDI")
colnames(d)[colnames(d) %in% c("BUPPSRY", "UPPSRY_NTRY", "TRY","FDI(Value)")] <- new_names

colnames(d) <- gsub(" ", ".", colnames(d))

#removing negative values in FDI
d = subset(d, d$FDI >= 0)

#factorizing the variables
d$FDI=as.integer(d$FDI)
d$Countries=as.factor(d$Countries)
d$Year=as.factor(d$Year)

#checking null values by columns
colSums(is.na(d))


#performing log transform on FDI and checking skewness
d$log_FDI=log(d$FDI)
skewness(d$log_FDI)
```

```
#taking log of GDP
d$log_GDP=log(d$GDP)

#data visualizations
library(lattice)

#histogram of FDI
ggplot(data = d, aes(x = FDI)) +
  geom_histogram(fill = "blue", color = "black") +
  labs(title = "Histogram of FDI", x = "FDI", y = "Frequency")

#histogram of Log of FDI
ggplot(data = d, aes(x = log_FDI)) +
  geom_histogram(fill = "blue", color = "black") +
  labs(title = "Histogram of Log of FDI", x = "Log of FDI", y = "Frequency")


# Corrplot for predictor Variables
d6<-cor(d[,c(7,9,14,17,23,24,30,36,41,44,53,54,57,58,59,56,57,58,59,60,61)])

# Convert the correlation matrix to a data frame
df_corr <- as.data.frame(as.table(d6))
names(df_corr) <- c("Variable 1", "Variable 2", "Correlation")

# Create a ggplot object
ggplot(df_corr, aes(x = `Variable 1`, y = `Variable 2`, fill = `Correlation`, label = round(`Correlation`, 2))) +
  geom_tile(color = "white") +
  geom_text(size = 3) +
  scale_fill_gradient2(low = "blue", high = "red", mid = "white",
                       midpoint = 0, limit = c(-1,1),
                       name = "Correlation") +
  theme_minimal() +
  labs(title = "Correlation Plot for Predictor Variables") +
  theme(plot.title = element_text(hjust = 0.5, size = 16),
        axis.text.x = element_text(angle = 90, vjust = 0.5, size = 8),
        axis.text.y = element_text(size = 8),
        legend.title = element_text(size = 12),
        legend.text = element_text(size = 10))



#net fdi by country
net_fdi_country <- d %>%
  group_by(Countries) %>%
  summarize(net_fdi = sum(ifelse(Sign == "Positive", FDI , - FDI)))
```

```
# order the data by net investment
net_fdi_country <- net_fdi_country[order(-net_fdi_country$net_fdi), ]


ggplot(net_fdi_country, aes(x = reorder(Countries, net_fdi), y = net_fdi)) +
  geom_bar(stat = "identity", fill = "steelblue") +
  scale_fill_manual(values = c("#2C3E50", "#E74C3C", "#3498DB", "#F1C40F", "#27AE60")) +
  labs(x = "Country", y = "Total Inward FDI", title = "Total Inward FDI by Country") +
  theme_minimal() +
  coord_flip()


##-----------------------------------------------Maps-----------------------------------------
##--------------------------------------------------------------------------------------------
#install.packages("maps")
#install.packages("mapdata")
#install.packages("rnaturalearth")
#install.packages("rnaturalearthdata")
#install.packages("sf")
#install.packages("countrycode")
#install.packages("patchwork")
library(maps)
library(mapdata)
library(mapdata)
library(ggplot2)
library(tidyverse)
library(sf)
library(rnaturalearth)
library(rnaturalearthdata)
library(countrycode)
library(patchwork)

# Load world map data
world <- ne_countries(scale = "medium", returnclass = "sf")

#Map: Size of govt
area1_country <- d %>%
  group_by(Countries) %>%
  summarize(sog = (sum(Size.of.Government)/15)) %>%
  mutate(iso_a3 = countrycode::countrycode(Countries, "country.name", "iso3c"))

world_area1 <- left_join(world, area1_country, by = c("iso_a3" = "iso_a3"))

ggplot() +
  geom_sf(data = world_area1, aes(fill = sog)) +
```

```
  scale_fill_gradientn(colors = c("#ffffcc", "#ffeda0", "#fed976", "#feb24c", "#fd8d3c", "#fc4e2a", "#e31a1c", "#b10026"),
na.value = "transparent", name = "Size of Governement")  +
  theme_void() +
  ggtitle("Size of Govt Indicator by Country") +
  theme(legend.position = "right", plot.title = element_text(size = 15, face =
                                                             "bold"))

#Map: Legal rights
area2_country <- d %>%
  group_by(Countries) %>%
  summarize(lspr = (sum(Legal.System...Property.Rights)/15)) %>%
  mutate(iso_a3 = countrycode::countrycode(Countries, "country.name", "iso3c"))

world_area2 <- left_join(world, area2_country, by = c("iso_a3" = "iso_a3"))

ggplot() +
  geom_sf(data = world_area2, aes(fill = lspr)) +
  scale_fill_gradientn(colors = c("#f1eef6", "#d7b5d8", "#df65b0", "#dd1c77", "#980043"), na.value = "transparent", name =
"Legal Rights")  +
  theme_void() +
  ggtitle("Legal Rights Indicator by Country") +
  theme(legend.position = "right", plot.title = element_text(size = 15, face =
                                                             "bold"))
#Map: Sound money
area3_country <- d %>%
  group_by(Countries) %>%
  summarize(sm = (sum(Sound.Money)/15)) %>%
  mutate(iso_a3 = countrycode::countrycode(Countries, "country.name", "iso3c"))

world_area3 <- left_join(world, area3_country, by = c("iso_a3" = "iso_a3"))

ggplot() +
  geom_sf(data = world_area3, aes(fill = sm)) +
  scale_fill_gradientn(colors = c("#f7fcf5", "#ccebc5", "#a8ddb5", "#7bccc4", "#4eb3d3", "#2b8cbe", "#0868ac", "#084081"),
na.value = "transparent", name = "Sound Money")  +
  theme_void() +
  ggtitle("Sound Money Indicator by Country") +
  theme(legend.position = "right", plot.title = element_text(size = 15, face =
                                                             "bold"))
#Map: Freedom to trade
area4_country <- d %>%
  group_by(Countries) %>%
  summarize(free = (sum(Freedom.to.trade.internationally)/15)) %>%
  mutate(iso_a3 = countrycode::countrycode(Countries, "country.name", "iso3c"))

world_area4 <- left_join(world, area4_country, by = c("iso_a3" = "iso_a3"))
```

```
ggplot() +
  geom_sf(data = world_area4, aes(fill = free)) +
  scale_fill_gradientn(colors = c("#fce4f3", "#f8bbd0", "#f48fb1", "#f06292", "#e91e63", "#9c27b0", "#6a1b9a"), na.value =
"transparent", name = "Freedom to Trade")  +
  theme_void() +
  ggtitle("Freedom to Trade International Indicator by Country") +
  theme(legend.position = "right", plot.title = element_text(size = 15, face =
                                                "bold"))

#Map: Regulation
area5_country <- d %>%
  group_by(Countries) %>%
  summarize(reg = (sum(Regulation)/15)) %>%
  mutate(iso_a3 = countrycode::countrycode(Countries, "country.name", "iso3c"))

world_area5 <- left_join(world, area5_country, by = c("iso_a3" = "iso_a3"))

ggplot() +
  geom_sf(data = world_area5, aes(fill = reg)) +
  scale_fill_gradientn(colors = c("#e5f5e0", "#a1d99b", "#31a354", "#3182bd", "#08519c"), na.value = "transparent", name =
"Regulation")  +
  theme_void() +
  ggtitle("Regulation Indicator by Country") +
  theme(legend.position = "right", plot.title = element_text(size = 15, face =
                                                "bold"))

#Labor force by education
#install.packages("cowplot")
library(cowplot)

# Calculate means for each country and year
df_mean <- aggregate(d[,c("Labour.force.primary.education",
                    "Labour.force.secondary.education",
                    "Labour.force.tertiary.education")],
                  by = list(country = d$Countries, year = d$Year ),
                  FUN = mean)
# Create boxplots
p1 <- ggplot(df_mean, aes(x = country, y = Labour.force.primary.education, fill = country)) +
  geom_boxplot() +
  ggtitle("Avg Labour force with primary education") +
  theme(legend.position = "none")  +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))
p1

p2 <- ggplot(df_mean, aes(x = country, y = Labour.force.secondary.education, fill = country)) +
```

```
  geom_boxplot() +
  ggtitle("Avg Labour force with secondary education") +
  theme(legend.position = "none")  +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))
p2

p3 <- ggplot(df_mean, aes(x = country, y = Labour.force.tertiary.education, fill = country)) +
  geom_boxplot() +
  ggtitle("Avg Labour force with tertiary education") +
  theme(legend.position = "none")  +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))
p3

# Combine plots using cowplot
plot_grid(p1, p2, p3, ncol = 3)

#----------------------------------------Models---------------------------------

#models
#lmer models
library(lme4)
model_FDI= lmer(d$log_FDI~ d$log_GDP +d$Government.investment+ d$Top.marginal.income.tax.rate
            +d$Legal.enforcement.of.contracts+d$Protection.of.property.rights
            +d$Freedom.to.own.foreign.currency.bank.accounts+d$`Inflation:.Most.recent.year`
            +d$Capital.controls +d$Hiring.regulations.and.minimum.wage
            +d$Private.sector.credit+d$Regulatory.trade.barriers
            +d$Startinga..business+d$Impartial.Public.Administration
            +d$Labour.force.with.primary.education
            +d$Labour.force.with.secondary.education+d$Labour.force.with.tertiary.education
            +(1|d$Countries)+(1|d$Year),REML=FALSE
            )
summary(model_FDI)
#checking multicollinearity
vif(model_FDI)
ranef(model_FDI)

#PLM models
dp <- pdata.frame(d, index=c("Countries", "Year"))
colSums(is.na(dp))

# plm random model with Economic Index and Labour Force
plm_FDI <- plm(dp$log_FDI ~ dp$log_GDP+dp$Government.investment+dp$Top.marginal.tax.rate
        +dp$Legal.enforcement.of.contracts+dp$Protection.of.property.rights
        +dp$Freedom.to.own.foreign.currency.bank.accounts+dp$Inflation..Most.recent.year
        +dp$Capital.controls+dp$Hiring.regulations.and.minimum.wage
        +dp$Private.sector.credit+dp$Regulatory.trade.barriers
```

```
        +dp$Startinga..business+dp$Impartial.Public.Administration
        +dp$Labour.force.with.primary.education+dp$Labour.force.with.secondary.education
        +dp$Labour.force.with.tertiary.education, index= c("Countries","Year"),data=dp,model="random"
)
summary(plm_FDI)
#checking multicollinearity
vif(plm_FDI)

plot(model_FDI)

# plm fixed effect model with Economic Index and Labour Force
plm_fe_FDI <- plm(dp$log_FDI ~ dp$log_GDP+dp$Government.investment+dp$Top.marginal.tax.rate
          +dp$Legal.enforcement.of.contracts+dp$Protection.of.property.rights
          +dp$Freedom.to.own.foreign.currency.bank.accounts+dp$Inflation..Most.recent.year
          +dp$Capital.controls+dp$Hiring.regulations.and.minimum.wage
          +dp$Private.sector.credit+dp$Regulatory.trade.barriers
          +dp$Startinga..business+dp$Impartial.Public.Administration
          +dp$Labour.force.with.primary.education+dp$Labour.force.with.secondary.education
          +dp$Labour.force.with.tertiary.education, index= c("Countries","Year"),data=dp,model="within"
)
summary(plm_fe_FDI)

library(stargazer)
stargazer (model_FDI, plm_FDI, plm_fe_FDI, align=TRUE, no.space=TRUE, type = "text")
```