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**Determinant of Foreign Direct Investment**

1. **INTRODUCTION**
   1. BACKGROUND OF STUDY

Foreign direct investment (FDI) is a crucial economic tool for industrial development of both developed and developing countries. As said by (United Nations Industrial Development Organazation, 2009) FDI policy frameworks is a crucial part of a countries national strategy. For a country to make an efficient FDI policy, Identifying FDI determinant is one of the most important steps.

FDI is any project made by an investor, company or government from another country (Hayes, 2024) it is a key element of a country international economic integration. For an investment to be considered as FDI the investor need to obtain at least 10% of voting power in the firm he invests in (corporate finance institute, s.d.) .

There are three type which are horizontal FDI this is when a company move in another country to make the same operation it is already doing , vertical FDI this is when a business invest in a complementary business to his in another country and the last one is conglomerate FDI this occurs when a business invest in a field not related to its operations (Hayes, 2024).

**Benefit:**  FDI is highly important to countries as it stimulate the countries economies, it help in the development of human capital , it reduces unemployment rate as it create jobs, and it improve labor force skills and expertise, it also have a positive impact on the country access to technology (corporate finance institute, s.d.) .

FDI has many potential benefit but it can have many disadvantage if not monitored well by the host country those disadvantage can be exploitation and loss of control by the host country an example of that is shown (Hamid, et al., 1978) paper which show that despite Africa being rich in mineral and energy resources these mineral have been exploited for over century by other developed countries which invest in those countries, it can potentially disrupt local businesses as multinational companies usually have a vast economic power and operational facilities According to an Oxfam Report of 2017 the to 10 greatest company have a higher revenue compared to 180 countries combined. Another risk with foreign direct investment is the repatriation of income made in the host country to the investor country.

* 1. Problem statement

Many countries fail to attract sufficient FDI(foreign direct investment). 78 percent of the country's have a FDII(foreign direct investment index) lower than the average FDII in 2023. this slow down the economic growth , technology growth, infrastructural growth, industrial growth and many other indicator of country development (Tocar, 2018). All this impact negatively all 17 SDG (sustainable development goals) (United\_Nations, 2024). There are various factors that affect FDI , Identifying these factors is essential to improve FDI and foster sustainable development.

* 1. Research question

What are the most important factors affecting FDI?

* 1. OBJECTIVE OF THE STUDY

The study aims to develop a data driven model that determines the factors that have a significant impact on foreign direct investment.

1. **REVIEW OF LITERATURE**
   1. *Theoretical review:*

(Tocar, 2018) made a review on the determinant of foreign direct investment he claim that most studies focus only on economic factor and are underestimating the non-economic ones. He mentioned 11 factors which are: economic factors, Infrastructure, Technology, institutional-political factors, specific Risk, Human Factor, Legal Integration, Space factor, Entrepreneurial Matters, Cultural factors and Para cultural factors . His goal was to give a comprehensive review of these factors and propose potential hypothesis for future researches.

(Islam & Beloucif, 2023) made the Review of 112 empirical studies published from 2000 to 2018 using a systematic literature review methodology because like (A., 2001) he claim that because of wide difference in the perspectives, methodologies and analytical tools used in studies researchers and scholars do not agree on a consensus on determinants of FDI. The goal of his study is to give a clear understanding of the scope of the research about the determinant of foreign direct investment. He argue that market size is the most important determinant of FDI as it is highly significant in 82 studies followed by trade openness which is significant in 55 studies followed by infrastructure quality, labor cost, exchange rate , inflation rate , human capital, growth prospect and political stability respectively.

* 1. *Empirical review:*

(EL-Aal, et al., 2021) used 7 machine learning algorithms and ARIMA model to determine the primary determinant of FDI inflow to Egypt from (2020-2030), these machine learning algorithms are random forest, support vector machine, logistic regression, naïve bayes, k-nearest neighbor s, gradient boosting and neural network. The study approved gradient boosting model to be the most accurate algorithm and defend that the Human Development Index, followed by population size, gross domestic product per capita, lending rate, and gross domestic product value are the primary determinant of FDI inflow respectively.

(Walsh & Yu, 2010) emphasized on the macroeconomic, developmental, and institutional/qualitative factor that have an impact on , primary , secondary and tertiary sector FDI. He used data of 27 advanced and emerging countries from 1985 to 2008. The variable used for macroeconomic factors are The variables include openness, the log level of the multilateral real exchange rate, trailing 3-year moving average inflation, the stock of FDI, real GDP growth and the log level of GDP per capita. For institutional and qualitative factors he used variable such as labor market flexibility, infrastructure quality, judicial independence, legal system efficiency, and financial depth. School enrollment at the primary, secondary and tertiary levels is also included. He used Arellano-Bond methodology GMM dynamic estimator to identify the most important features for each type of FDI. He concluded that these factor have no significant impact on primary sector FDI. Macroeconomy and institutional indicators impact both secondary and tertiary sector FDI, labor market and financial market attraction have a high positive impact on secondary sector FDI while infrastructure and judiciary independence have a high impact on the tertiary sector FDI.

1. **METHODOLOGY**

In this studies to examine which factors have the strongest impact on impact on foreign direct investment I used 6 machine learning model and correlation approach .

* 1. *Data collections:*

The data used below are Foreign Direct Investment data and factor to be considered as its determinant for 140 different countries from 2000 to 2023. The sampling of the country was made based on the availability of the data needed. These data where collected from world development indicators data of the World Bank Group (Group, 2024) .The dataset contain 3119 rows and 13 columns after data cleaning .

* 1. *Dependent Variable*

In this study we use Dimension index formular to calculate countries Foreign direct investment index the variable on which we use it is Foreign direct investment, net inflows (BoP, current US$) (Programme, 2018).



* 1. *Independent variable*

this study use some of the factors mentioned by (Tocar, 2018) because some of the factors he mentioned are overlapping . the factor use are economic indicator, infrastructure, technology, political factors, human factor and space factor as (Tocar, 2018). The variable used to represent those factors are :

ECONOMIC INDICATOR

* + - GDP (current US$)
    - Inflation, consumer prices (annual %)
    - Liquidity: Domestic credit to private sector by banks (% of GDP)\*GDP

INFRASTRUCTURE

We use Dimension index formular to calculate Electricity Index and Water Index and from that we derive an infrastructure index variable use are

* + - Ei=Dimension index of Access to electricity (% of population)
    - Wi= Dimension index of People using at least basic drinking water services (% of population)
    - Infrastructure index =

TECHNOLOGY

* + - High-technology exports (current US$)

INSTITUTIONAL-POLITICAL FACTORS

* + - Political Stability and Absence of Violence/Terrorism: Estimate
    - Control of Corruption: Estimate

HUMAN FACTOR

* + - Labor force, total
    - Population

SPACE FACTOR

* + - Surface area (sq. km)

1. **RESULT AND DISCUSION** 
   1. *Model evaluation*

The first step of this section is to determine the best model. I processed the collected data using the following machine learning model: gradient boosting, random forest , Support Vector Machines(SMV), linear regression , ridge and lasso. These model are evaluated using as principal metric Root Mean Squared Error (RMSE) as it show the magnitude of the error penalizing larger errors and as secondary metrics R²and Symmetric Mean Absolute Percentage Error (SMAPE) metrics as shown in Table 1.

As shown in Table 1 the best model is random forest with 0.043 RMSE closely followed by gradient boosting with 0.046 RMSE and Lasso as the 3rd best model with 0.048 RMSE. Random forest will be the preferred model for prediction of FDI in this study as shown in table 3. For evaluating the most important features this study makes use of random forest feature importance, gradient boosting feature importance and lasso model for regression coefficient.

##### Table 1: MODEL EVALUATION

|  |  |  |  |
| --- | --- | --- | --- |
| Models | Root Mean Squared Error | R² | Symmetric Mean Absolute Percentage Error (SMAPE) |
| Gradient Boosting | 0.045567 | 0.275363 | 3.734444 |
| Random forest | 0.043648 | 0.335109 | 3.626260 |
| SMV | 0.058075 | -0.177053 | 10.228591 |
| Linear regression | 0.052347 | 0.043682 | 4.930466 |
| ridge | 0.052346 | 0.043692 | 4.930386 |
| Lasso | 0.051529 | 0.073343 | 4.002892 |

* 1. Features evaluation

Correlation matrix in figure 1 show the most powerful factor which impact FDII using correlation as metric is GDP (current US$), followed by liquidity which have respectively 0.67 and 0.6 correlation with FDII , it also show that Inflation, consumer prices (annual %) have a negatively weak impact on of FDII and the rest of the factors have a Modest positive impact on FDII.

##### FIGURE 1:

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Table 2 show that the most important factor that impact FDI is the liquidity which is Domestic credit to private sector by banks(current US$), it have a strong and positive impact on FDI with a 0.48 for random forest importance , 0.51 for XGB importnce and a positive regression coefficient it also have a relatively strong correlation with FDI . GDP (current US$) is the second most important factor that impact positively FDI with a random forest importance of 0.12, a positive regression coefficient and a correlation of 0.66 but a very low XGB importance of 0.036. Another factor which have a Slight beneficial influence FDI is the population, it has a random forest importance of 0.064 and a positive regression coefficient but a very low XGB importance of 0.016 . features like Surface area (sq. km) and Labor force, total have a modest negative effect on FDI as they have a feature importance of 0.043 and 0.1and a negative regression coefficient. Feature such as corruption and year have a very slight impact on foreign direct investment as the have 0 for the regression coefficient and a very low correlation but they have decent feature importance for both random forest 0.05, 0.43 and XGB model 0.044 , 0.083 respectively. Features such as Inflation, consumer prices (annual %), Political Stability and Absence of Violence/Terrorism: Estimate and infrastructure index have Negligible effect with 0 for regression coefficient, a relatively low random forest and XGB importance and a low correlation.

##### Table 2: FACTOR IMPORTANCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Features | Correlation | random forest model feature Importance | Feature importance (XGB) | Regression Coefficients(Lasso model) |
| GDP (current US$) | 0.671931 | 0.117787 | 0.035594 | 1.513988e-14 |
| liquidity | 0.597558 | 0.481666 | 0.505895 | 4.384567e-17 |
| Labor force, total | 0.302224 | 0.094994 | 0.169509 | -1.626553e-10 |
| Surface area (sq. km) | 0.302341 | 0.043162 | 0.068104 | -2.282365e-10 |
| Population, total | 0.277519 | 0.063754 | 0.016061 | 5.245468e-11 |
| Control of Corruption: Estimate | 0.206075 | 0.051210 | 0.044298 | 0.0 |
| infrastructure index | 0.143912 | 0.025364 | 0.037797 | 0.0 |
| Political Stability and Absence of Violence/Terrorism: Estimate | 0.093438 | 0.042778 | 0.024587 | 0.0 |
| Inflation, consumer prices (annual %) | -0.053738 | 0.030101 | 0.015367 | 0.0 |
| Year | 0.131789 | 0.049184 | 0.082787 | 0.0 |

1. **CONCLUSION**

This study gives policymakers and government an empirical literature about attracting foreign direct investment. The key insight provided by this study is the determinant of foreign direct investment. The result above show that policymaker and government have to put high focus on improving Domestic credit to private sector by banks(current US$) and GDP (current US$) as those two have strong positive impact on FDI , this support literatures which claim that economic indicators are the main determinant of FDI . The result of this study contradict (Islam & Beloucif, 2023) and (EL-Aal, et al., 2021) on their claim that market size and population size have a very strong impact on FDI. It also identifies labor force and surface area to have a "Slight negative influence on FDI. it also contradicts (EL-Aal, et al., 2021),which claim that XGB was the best model for prediction of FDI, in this study the best model is the random forest model. Liquidity and GDP Are the factors policymakers, and the government should prioritize when making decisions to enhance foreign direct investment.

1. **Links**

***Project link:*** https://github.com/juniorskg/foreign-direct-investment-determinants

***Video link***: https://youtu.be/yuNClDED5\_k

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