

Covid-19 Analysis with respect to Economic Exposure Index

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Abstract— The novel COVID-19 pandemic has taken a root in nearly every country of the globe, upending the operating exposure. COVID-19 is truly a global health issue and a massive reason that has rapidly affected the Economic exposure of every country which has a substantial impact on a company's market value since it has far-reaching effects and is long term in nature. While, the pandemic seems likely to remain a fact of life for the foreseeable future it is very important to analyse the trend of Covid-19 and its effect on the Economic Exposure Index, which will assist us in understanding and gaining insights regarding the same. The propounded report of exploration studies aims to evaluate the Economic Exposure Index and train Machine Learning model that will predict the value of the Economic Exposure Index when the respective prospective data is entered concerning the same. The principle focus is to perform data analysis and train a model using the most popular Machine Learning algorithm – Linear Regression in order to analyse the historical data that is present regarding the Economic Exposure Index (EEI) and its indicators.

Keywords: Covid19, Economic Exposure Index (EEI), Exploratory Data Analysis, Linear Regression

I. INTRODUCTION

A coronavirus is a kind of common virus that causes an infection in your nose, sinuses, or upper throat. In early 2020, after a December 2019 outbreak in China, the World Health Organization identified SARS-CoV-2 as a new type of coronavirus. The outbreak quickly spread around the world. COVID-19 is a disease caused by SARS-CoV-2 that can trigger what doctors call a respiratory tract infection. It can affect your upper respiratory tract (sinuses, nose, and throat) or lower respiratory tract (windpipe and lungs). It spreads the same way other coronaviruses do, mainly through person-to-person contact. Infections range from mild to deadly. SARS-CoV-2 is one of seven types of coronavirus, including the ones that cause severe diseases like Middle East respiratory syndrome (MERS) and sudden acute respiratory syndrome (SARS). The other coronaviruses cause most of the colds that affect us during the year but aren't a serious threat for otherwise healthy people. Economic exposure is a type of foreign exchange exposure caused by the effect of unexpected currency fluctuations on a company's future cash flows, foreign investments and earnings. The degree of the economic exposure is directly proportional to currency volatility. Economic Exposure Index increases as foreign exchange volatility increases and decreases as it falls.

II. RELATED WORK

The State-of the art study was done to gain insights regarding the previous related work such as

- Noy, I, N Doan, B Ferrarini and D Park[1] explained about the economic risk associated with coronavirus pandemic across the world.
- Peterson Ozili, Thankom Arun [2] have made a paper title” Spillover of COVID-19: impact on the Global Economy” which talked about the various spillovers on different countries and industries due to the pandemic.
- Saravam Mittal [3] interpreted the Exploratory data analysis of Covid-19 in India and drew a statistical model for better understanding of the spread of virus.
- Dey SK, Rahman MM, Siddiqi UR, Howlader A [4] briefed about the epidemiological outbreak of COVID-19 with visual exploratory data analysis approach.
- Asian Development Bank [5] briefs the economic impact of Covid-19 Outbreak on Developing Asia with some graphical interpretations and number figures

III. METHODOLOGY

Figure 1 depicts the methodology or work flow of the paper

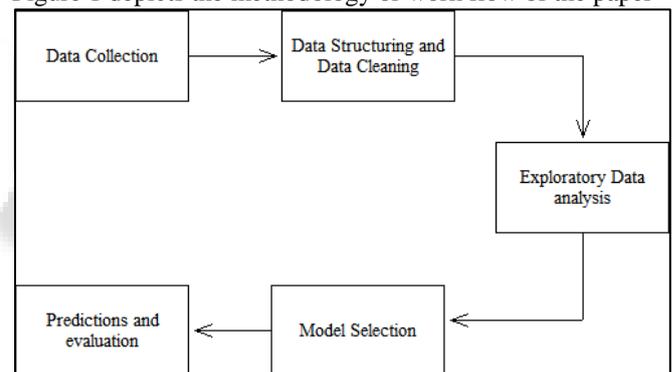


Fig.1: Workflow process

A. Data Collection

The considered dataset, has information of a country's economic exposure due to COVID-19 and composite indicator based on World Bank's datasets [6] on remittances, food import dependence, primary commodity export independence, tourism independence, government indebtedness and foreign currency reserves.

Original format of the dataset: XLSX

A brief explanation of every column in the dataset is as follows:

- GHRP – Global Humanitarian Response Plan for COVID-19 is the Inter-Agency Standing Committee (ISAC) initiative to address the risks and impact of Covid-19 pandemic on the most vulnerable people in countries affected by humanitarian crisis at high risk of facing humanitarian disaster. The GHRP was first launched on 25 th March 2020 and was updated first on 7th May 2020.
- Income classification according to WB (World Bank) – When it comes to income, the World Bank divides the

world's economies into four income groups: high, upper-middle, lower-middle and low. The income classification is based on a measure of national income per person on Gross National Income per capita, calculated using the ATLAS method.

- Net ODA received (% of GNI) – Net official development assistance consists of disbursements of loans made on concessional terms (net of repayments of principal) and grants by official agencies such as DAC-Development Assistance Committee (DAC), by multilateral institutions and by non-DAC countries to promote economic development and welfare in countries and territories in the DAC.
- Aid Dependence – refers to the proportion of government spending that is given by foreign donors. Heavy aid dependence can have significant effects on institutions and governance.
- Remittances and Volume of remittances (in USD) as proportion of total GDP - A remittance is a transfer of money, often by a foreign worker to an individual in their home country. According to the World Bank, in 2018 overall global remittance grew 10% to US\$689 billion, including US\$528 billion to developing countries. Remittances (money or goods) that migrants send back to families and friends in origin countries, are often the most direct and well-known link between migration and development.
- Food imports (% total merchandise exports) – this indicator provides a measure of vulnerability and captures the adequacy of the foreign exchange reserves to pay for food imports, which has implications for national food security depending on production and trade patterns.
- Food import dependence – all countries use imports to varying extents to satisfy the quantity and diversity of the food demands of their populations; for poor countries where food imports are a large share on country's total trade, food security is conditioned by capacity to obtain food through imports.
- > Fuel, ores and metals exports (% of total merchandise exports) – Ores and metals exports (% of merchandise exports) in World was reported at 3.9631%. According to World Bank collection of development indicators, compiled from officially recognized sources the ores and metals comprise the commodities in SITC section.
- Tourism Dependence – Tourism is an engine for jobs, exports, and investments. The tourism sector is also the largest market-based contributor to finance protected areas.
- General government gross debt (Percent of GDP) – General Government debt-to-GDP ratio measures the gross debt of general government as a percentage of GDP. It is a key indicator for the sustainability of government finance.
- Total reserves in months of imports – comprises holdings of monetary gold, special drawing rights, reserves of International Monetary fund members held by the IMF, a holding of foreign exchange under the control of monetary authorities.

- Government indebtedness – also known as public interest, public debt, national debt and sovereign debt, contrasts to the annual government budget deficit, which is a flow of variable that equals the difference between government receipts and spending in a single year.
- Foreign currency reserves – are the foreign currencies held by a country's central bank. They are also called foreign currency reserves or foreign reserves.
- Foreign direct investment net flows (% GDP) – are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor.
- Foreign direct investment (FDI) – is an investment in the form of a controlling ownership in a business in one country by an entity based in another country. It is thus distinguished from a foreign portfolio investment by a notion of direct control.
- Covid-19 Economic Exposure index – the target variable and the country's economic exposure due to COVID 19.
- Covid-19 Economic Exposure index [ex aid and FDI] – EEI taking into consideration the effect of the aid and FDI.
- Covid-19 Economic Exposure index [ex aid, FDI and Food imports] – EEI taking into consideration of all the three – aid, FDI and imports.

B. Data Structuring and Cleaning

Data Structuring is the process of structuring the unstructured data to the required format and Data cleaning involves fixing or removing incorrect, corrupted, incorrectly formatted, duplicate or incomplete data within a dataset. In this paper, the dataset was clear and some minor pre-processing techniques were applied i.e.

- Using pandas data frame, mean of every column is calculated
- By using the fillna function, all the cells with empty are filled
- While doing so, the countries having a zero value in their cells are not included
- Zeros in a column are manually filled with the mean of the column.
- The original format of the file was XLSX, which have been converted to CSV.

C. Exploratory Data analysis

Exploratory Data Analysis is introduced in the context of data mining and resampling with an emphasis on three goals: cluster detection, variable selection, and pattern recognition [7]. Exploratory Data Analysis is an approach of analysing datasets to summarize their main characteristics.

D. Model Selection and Predictions

Model selection is one of the methods of choosing a perfect machine learning model for the dataset, which predicts the given data accurately. Depending upon the various factors in the data, a suitable machine learning model is selected and the scores are evaluated based on different metrics and

hyper parameters to choose the best model. Here in this paper, Linear Regression [8] is used as our machine learning model for calculating and evaluating the metrics

IV. RESULTS AND DISCUSSIONS

A. Exploratory Data Analysis

After doing the pre-processing work, Exploratory Data Analysis was performed and some valuable patterns have been recognized.

Figure 2 represents the top 5 countries with highest EEI which is basically the fluctuation in the market value of company or a fluctuation in the economic value of a country caused due certain factors. Companies can hedge against the unexpected currency fluctuations by investing in foreign exchange (FX) trading. The more the economic exposure index the more fluctuations and less flexibility to adapt to changes.

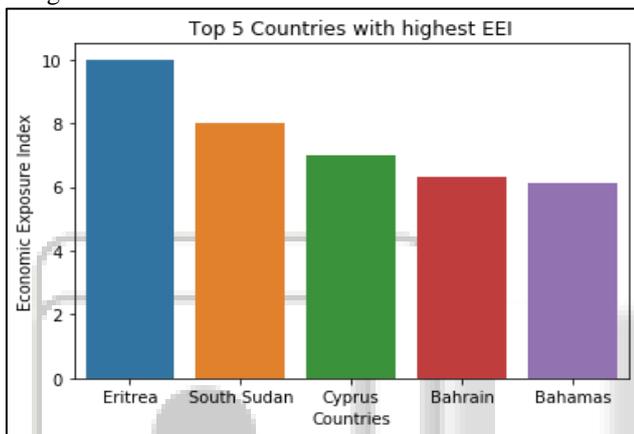


Fig. 2: Top Five Countries with Highest EEI

Tourism based countries had a majority of their GDP collected from tourists around the world.

As it can be observed, from the Figure 3 graph that, Bahamas is one of the among the top five countries having the highest EEI with a tourism GDP. Hence, what we analyse from this graph is that Tourism industry is massively hit by the global pandemic. The other countries which thrive on income made out of tourism don't have the EEI as it is based on a number of factors. There might be possibilities that these tourism-based countries could have adapted to the new normalcy and thus don't have a low EEI.

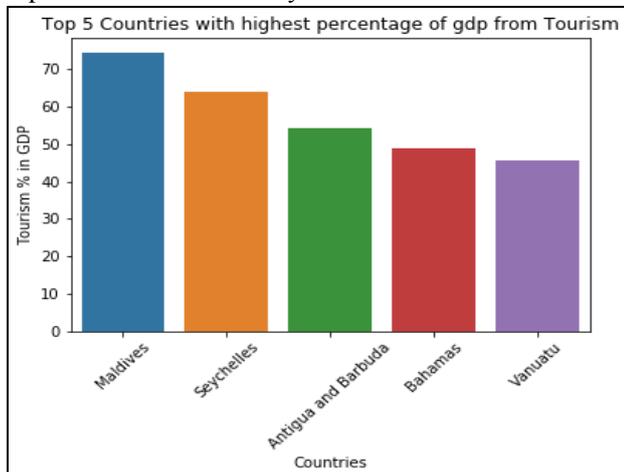


Fig. 3: Top Five Countries with Highest Percentage of GDP from Tourism

Figure 4 plot represents the top 5 countries that are heavily dependent on the Food import.

Here, are the top 5 countries which have the lowest food import dependence. Countries having low EEI also have low Covid-19 EEI.

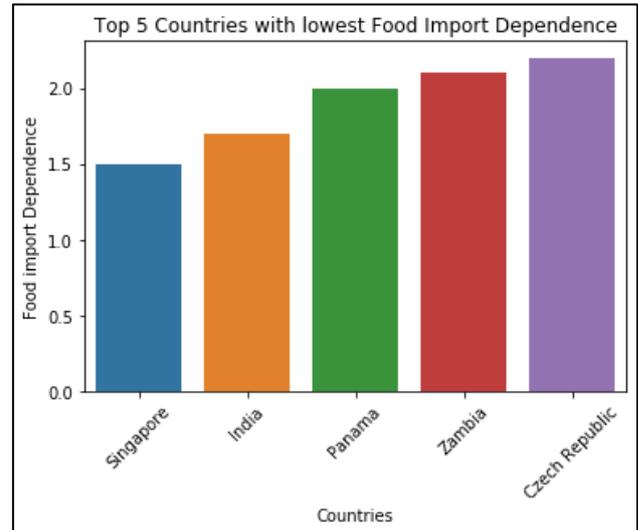


Fig. 4: Top Five Countries with Lowest Food Import Dependence

Figure 5 plot shows that countries with lowest tourism dependence. The COVID-19 EEI is not affected in these countries as EEI and Tourism dependence are correlated.

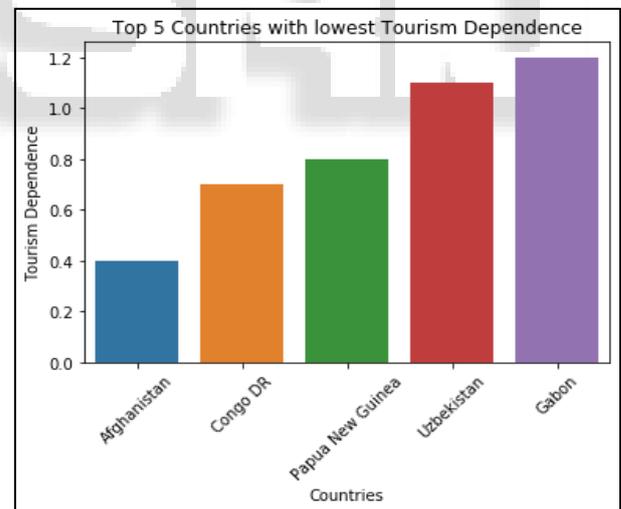


Fig. 5: Top Five Countries with Lowest Tourism Dependence

Figure 6 interactive plot shows that countries are dependent on the aid globally. Initially, foreign aid negatively impacts the countries' growth and over a period of time, it positively contributes to economic growth.

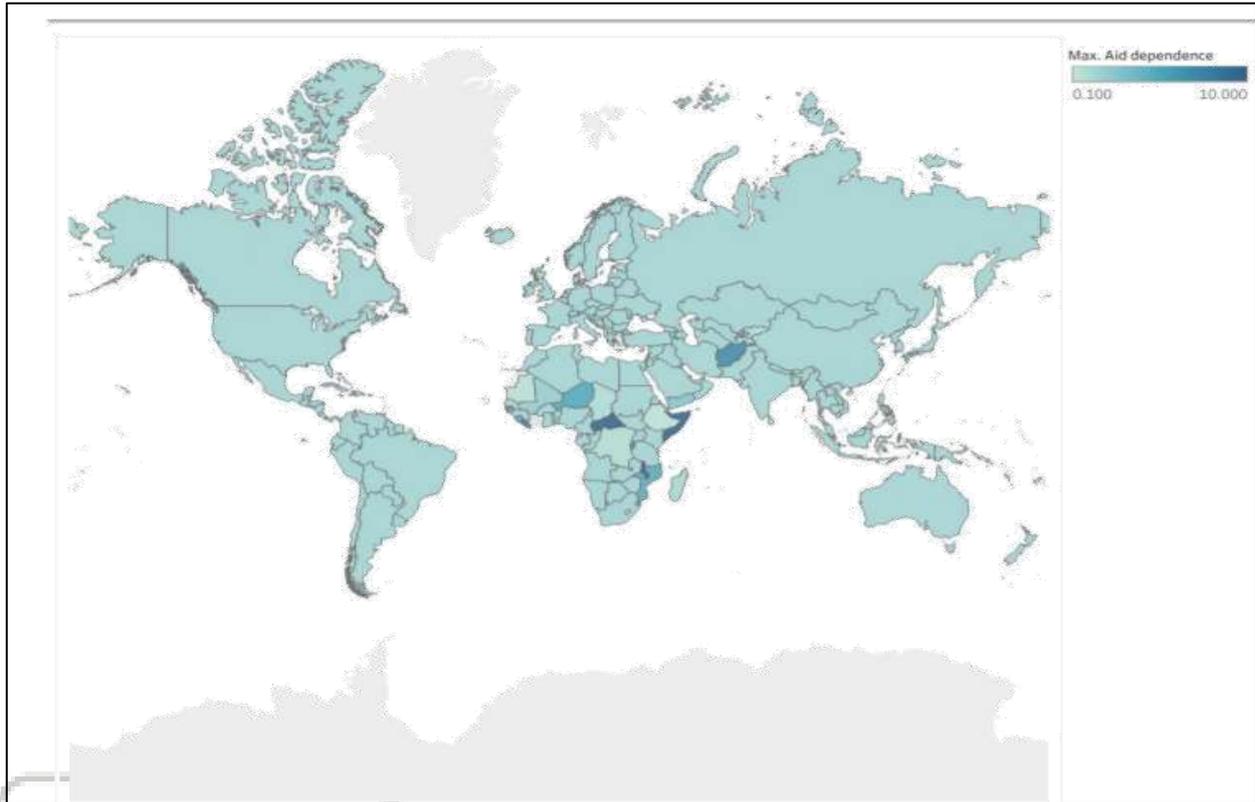


Fig. 6: Countries dependent on aid globally.

Figure 7 plot represents the maximum COVID-19 Economic Exposure Index continent wise. European countries have the highest EEI and there are no countries around the globe that aren't having any economic fluctuations.

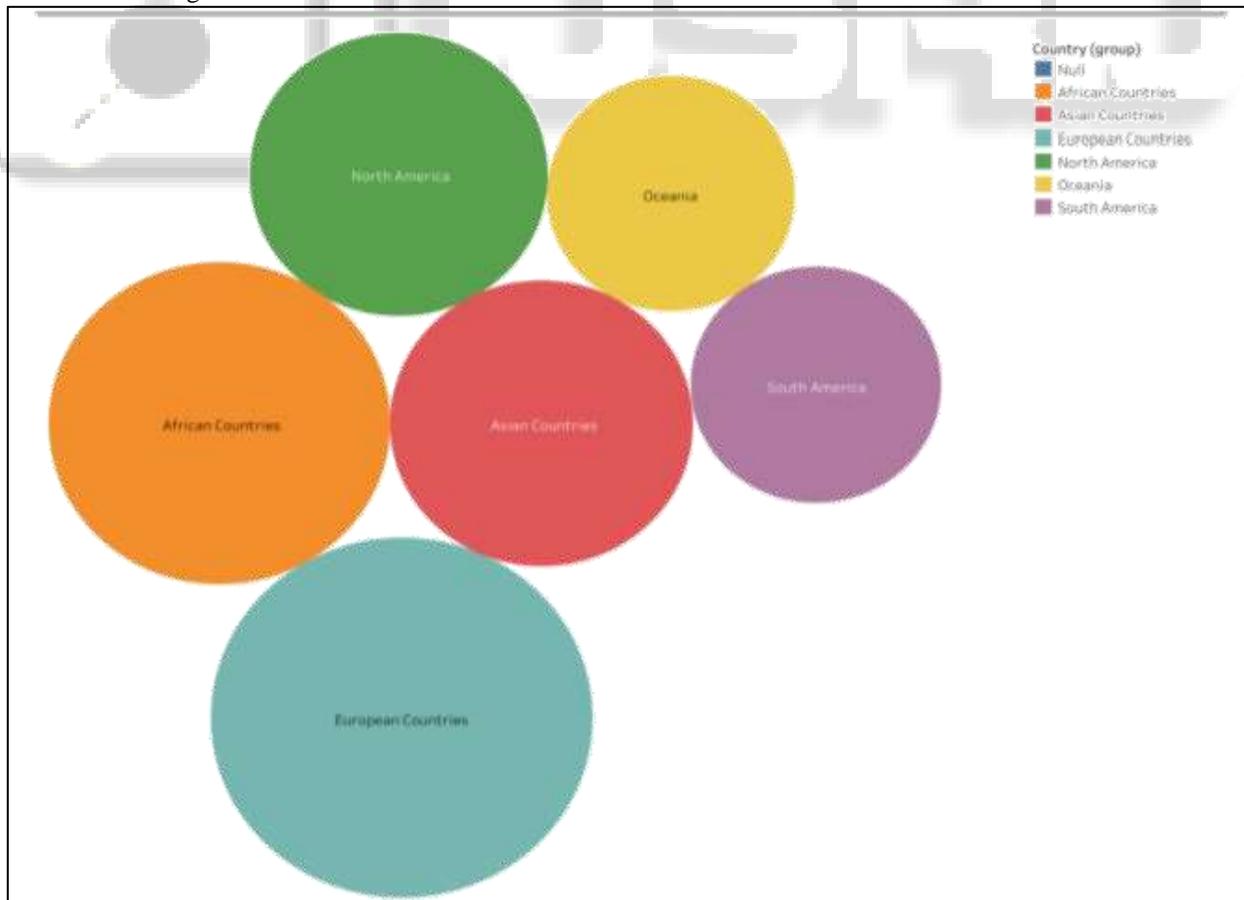


Fig. 7: Maximum COVID-19 Economic Exposure Index continent wise

Figure 8 interactive plot shows how the global pandemic has affected the FDI and Food imports. The COVID-19 has impacted the global food supply. Majority of the world is found resilient to food supply shocks. Mostly food import-dependent nations are vulnerable to food supply shocks. We can conclude that the current pandemic has

caused transitory food insecurity across such vulnerable countries. The effects of the pandemic FDI and food import may persist longer as a combined effect of economic exposure index showdown and increase in poverty limiting food supply and import and its access beyond 2020.



Fig. 8: Effects of the pandemic on FDI and food import

B. Training the Model

Globalization and the rapid integration of markets due the COVID-19 pandemic have a prominent effect on the EEI which aims to reflect the performance of the companies with significant exposure to specific regions or countries, regardless of their domicile.

This paper aims to train 3 models for -

- 1) COVID-19 EEI
- 2) COVID-19 EEI [based on aid and FDI]

3) COVID-19 [based on aid, FDI and Food imports]

As a part of feature selection, only the features with good correlation values are selected. Figure 9 depicts the plot of the features with correlation values.

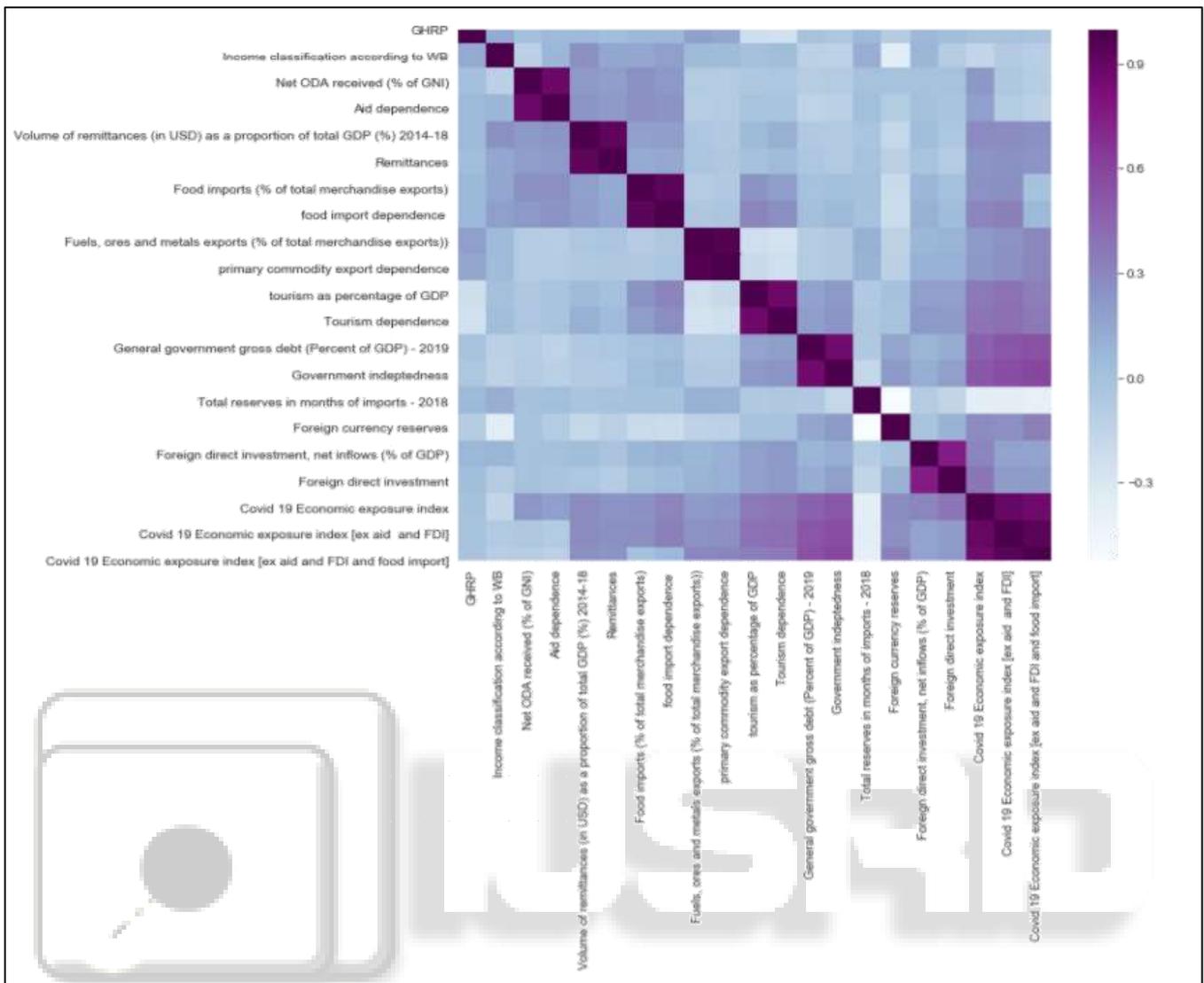


Fig. 9: Relationships among variables with correlation

We have used correlation in order to select the columns to train the model and columns which had a correlation of 0.2 and above were used.

Linear regression attempts to model the relationship between two variables by fitting a linear equation to observed data. Linear regression follows the linear mathematical model for determining the value of one dependent variable from value of one given independent variable.

$$Y = mx + c$$

where y is the dependent variable, m is slope, x is the independent variable and c is the intercept for a given line.

As, we are dealing with multiple features here multiple linear regression technique is used, which is represented as

$$Y = b_0 + b_1X_1 + b_2X_2 + \dots + b_nX_n$$

Where Y is the predicted or expected value of the dependent variable. X_1 through X_n are n distinct independent variables, b_0 is the value of Y when all of the independent variables (X_1 through X_n) are equal to zero, and b_1 through b_n are the estimated regression coefficients.

The accuracy scores of the data with the correlated features are:

SNo.	Data	Accuracy score
1.	COVID-19 EEI	78%
2.	COVID-19 EEI [aid and FDI]	80%
3.	COVID-19 EEI[aid, FDI and Food imports]	81%

Table 1: Accuracy Scores of the Data

V. CONCLUSION

The highest economic risks are in countries and regions that do not get much global attention even in normal times and get even less in the midst of the frantic reporting on the pandemic's spread now. This is unfortunate, as ultimately, the economic costs will be borne there, away from the public eye. Although healthcare systems are better equipped to handle the crisis than in previous pandemics, the globalisation of trade and labour flows will likely amplify the risks to the global economy. As a result it implies how important it is to analyse the data and to make predictions.

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