THE ECONOMIC IMPACT OF COVID-19 IN A GLOBALIZED WORLD

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Over the past four months, an unprecedented crisis has befallen the world: the coronavirus pandemic. About a third of the world population is under lockdown as tens of thousands have succumbed to the virus around the world. As lamentable as the loss of human lives and freedom is, the impending economic recession might be equally devastating. Stakes are high for every citizen and not just the government as we witness the economy tumbling.

This data story will explore the ramifications of the pandemic on the global economy by analyzing data from the largest economies of three different continents: Germany, Argentina and the US. The data about coronavirus comes from Johns Hopkins University (JHU) whereas information regarding stock indices is extracted from Yahoo Finance. While we are confident that Yahoo Finance's data is accurate, there is uncertainty about the reliability of the JHU data. With different reporting methods and testing densities in each country, the accuracy of the coronavirus case numbers is limited. However, since companies and governments base their decisions on precisely this data, they still have a great impact on the markets.

The US and Germany are among the two worst hit countries as of mid-April. The graph shows exponential growth in the number of infected people over time. We can also observe that the number of cases in Argentina has not accelerated as in the other two countries, and the total number of cases in each of these countries as of April are drastically different.

How did the number of infections with COVID-19 in different countries develop over time?

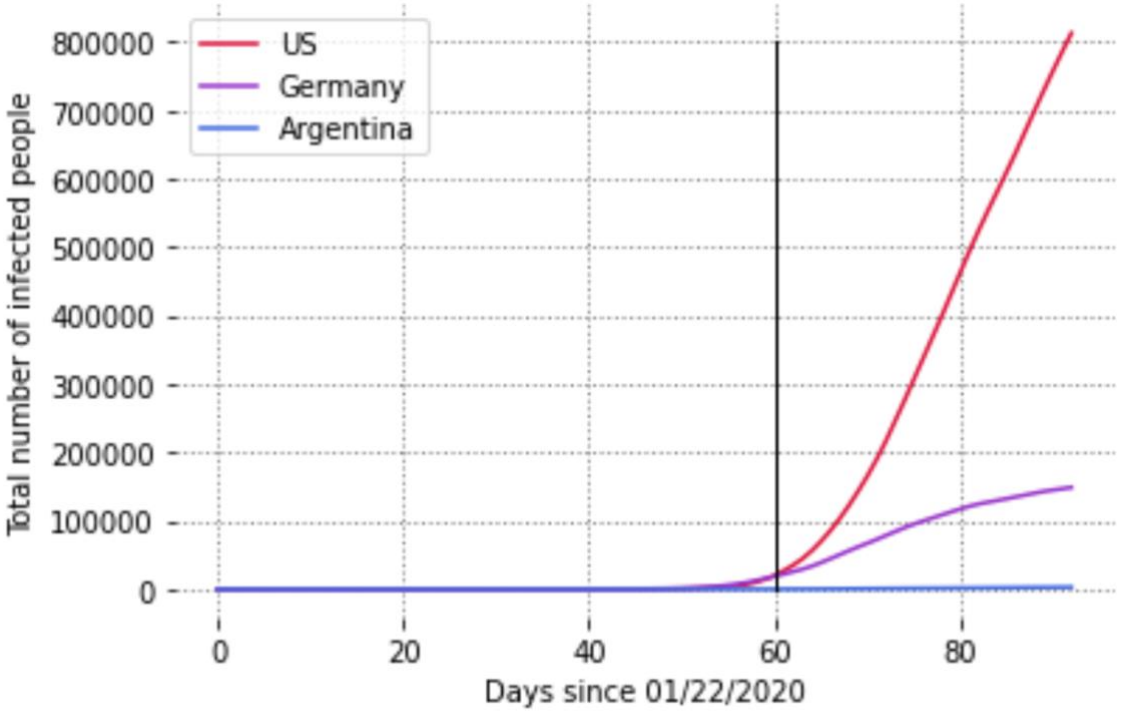

***Figure 1**: Accumulated sum of COVID-19 infections for the countries USA, Germany and Argentina over the time period from day zero (01/22/2020) until day 95 (04/24/2020) of the* JHU *data.*

As can be seen in the graphs, the number of infections in the US and Germany starts to explode at day 60 (mid-March), about two months after JHU started to publish coronavirus data on 22 January. A crucial question inevitably emerges: do fluctuations in economic variables mirror these developments? Let’s look at the plot for stock market indices to answer the question.

How did economic indices of different countries develop during the COVID-19 outbreak?

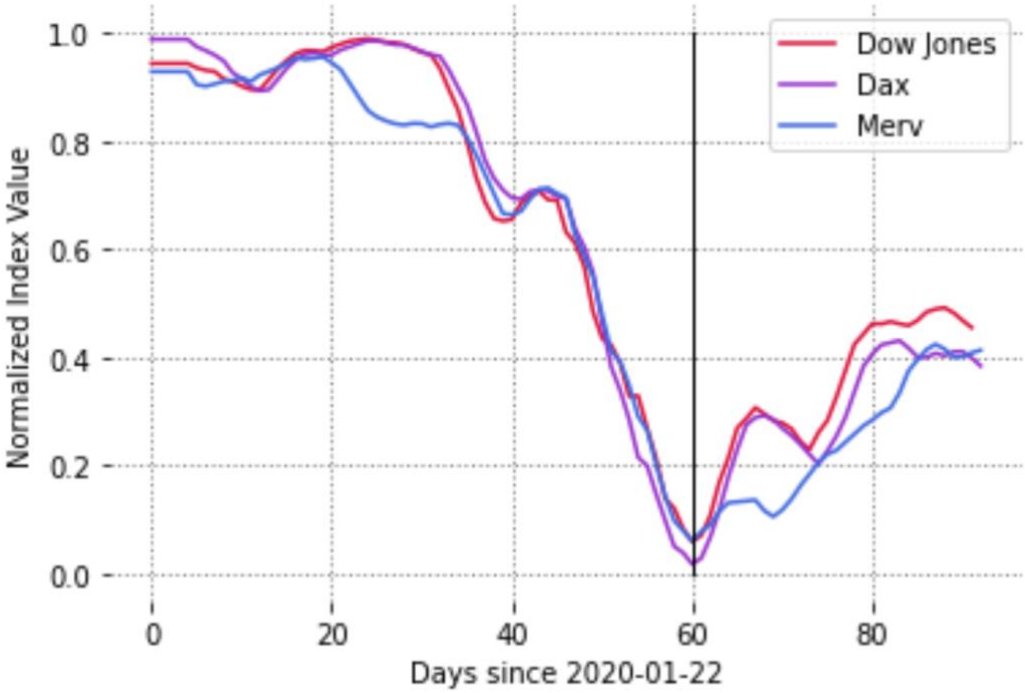

Figure 2: *Normalized index value of the Dow Jones, Dax and Merv as indicators of the economic performance of the USA, Germany and Argentina, smoothed with a running average of 5 days, over the time period from day zero (01/22/2020) until day 95 (04/24/2020) of the* JHU *data. Missing index data from weekends or holidays were replaced with index data from the previous day.*

Notably, despite the drastic difference in the number of cases among these countries, the trajectory of the stock indices mirror each other very closely. This goes to explain how interconnected economies are and presents strong evidence for a globalized economy. Even more notable is the fact that the indices, paradoxically, start rising at the 60-day mark, when the number of cases started exploding. One crucial reason for this could be associated with the growth rate of the virus:

How did the daily number of new infections change relative to the previous day over time?

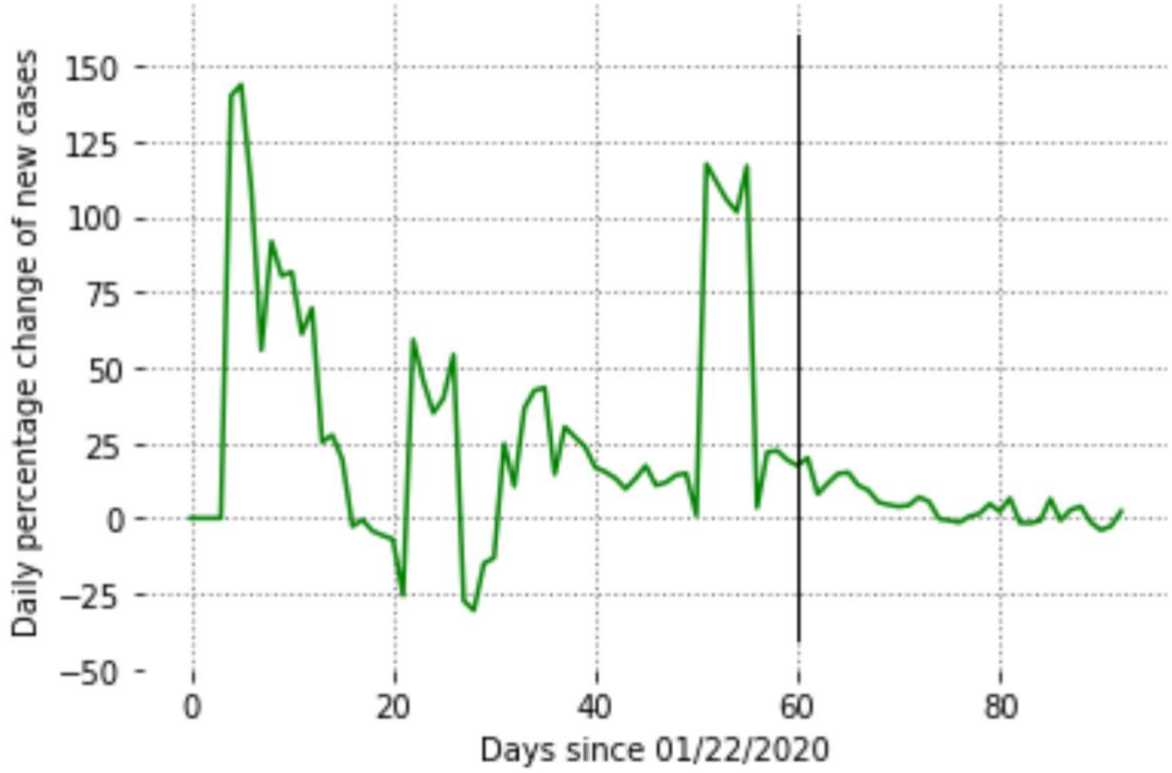

Figure 3: *Percentage change of daily new COVID-19 infections in the whole world relative to the previous day, smoothed with a running average of 5 days, over the time period from day zero (01/22/2020) until day 95 (04/24/2020) of the* JHU *data.*

Strikingly, one can notice that the growth rate of new cases in the world is quite volatile prior to the 60 day mark, and is relatively stable and rather low after that point. Could this explain the sudden uptick in the market indices? It is worth noting, however, that there might be confounding factors that could be responsible for a part of the trend we observe; for instance, it was around the 60-day mark that the US Congress announced the two trillion dollar fiscal stimulus bill which might have restored public faith in the markets.

The interconnections between coronavirus data and the indices seem to be complex and one might ask to which extent the coronavirus data can be used to explain the changes in the indices. Fortunately, we can use machine learning algorithms which are very good at recognizing complex patterns to answer this question:

How well does the coronavirus data predict different market indices?

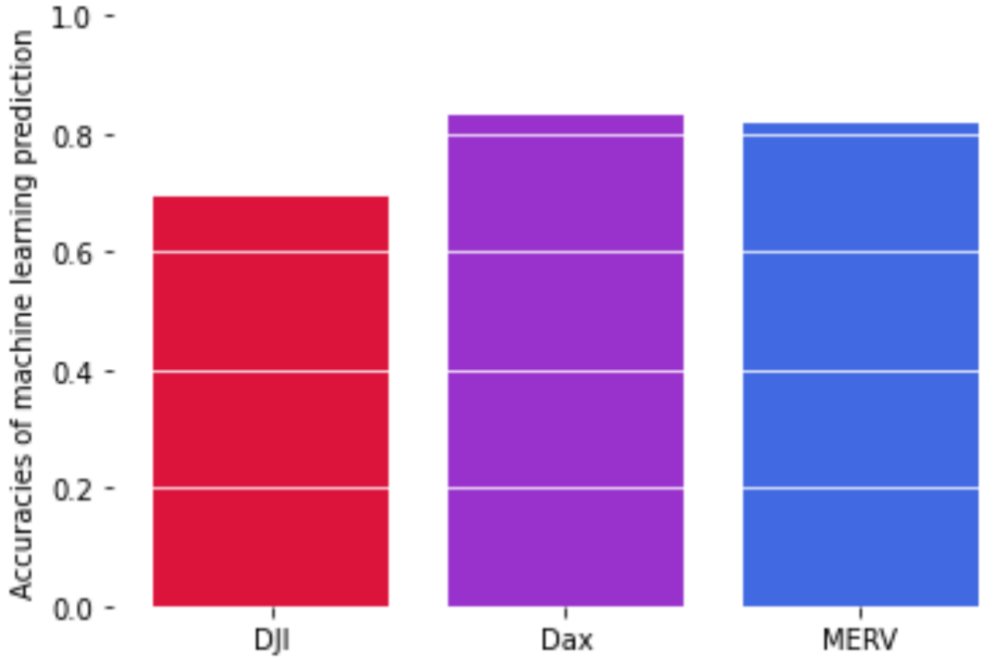

Figure 4: *R-squared* of the resulting predictive models when using a random forest regression algorithm to predict the normalized daily changes of index data, smoothed with a running average of 10 days. [The coronavirus input data consists of different (equally smoothed) features: daily new infections, total change of daily new cases, percentage change of total infections and percentage change of daily new infections.]*

The models created by the machine learning algorithms use the coronavirus data to predict fluctuations of the economic indices. In all three countries the models can explain a good amount of variation in the index data. For Germany and Argentina, they even reach R-squared* values of 0.8, meaning that the models can explain 80% of the index data variation. The US also is not too far behind; hence, it can be said that the coronavirus data wields significant predictive power for stock market fluctuations.

In the wake of the crisis and the subsequent market crash, it is obvious that the pandemic has impacted the economy quite severely. Our analysis shows that a straightforward measure like the number of infections over time seems to have an impact on the market; however, the relationships on the surface do not appear to be obvious and seem paradoxical. Furthermore, the index data is distorted by external interventions like governmental fiscal stimulus. We have shown, however, through machine learning that coronavirus data has significant potential in predicting market fluctuations. What exactly the links are should be subject to further analyses. In addition, data on political emergency regulations and their impact on the economy could be analysed to determine which interventions work best.

With this predictive data, the rescue of the economy could be handled more proactively. Knowing in advance when markets might collapse would give the government a strategic advantage in managing the crisis.

Explanation: The **R-squared is a statistical measure that describes how close the predictions of the model are to real world data. Technically, it measures how much percent of the total variation can be explained by the model e.g. if the R-squared would be 100%, the model could perfectly predict the real world data.*

Data Sources:

- *Novel Coronavirus (COVID-19) Cases Data*
- *Yahoo Finance API*
- *Article about Machine Learning*