Examining the Effect of COVID-19 on Foreign Exchange Rate and Stock Market
– An Applied Insight into the Variable Effects of Lockdown on Indian Economy

Indrajit Banerjee¹, Atul Kumar¹, Rupam Bhattacharyya², *

¹Department of Economic Studies and Policies, Central University of South Bihar
²Department of Biostatistics, University of Michigan

*Corresponding author. Address: 1415 Washington Heights, Ann Arbor, MI 48109, USA. Email ID: rupamb@umich.edu, Phone: +17348006834.
Abstract

The relationship between a pandemic and the concurrent economy is quite comparable to the relation observed among health and wealth in general. Since 25\textsuperscript{th} March 2020, India has been under a nation-wide lockdown. This work attempts to examine the effect of novel coronavirus 2019 and its resulting disease, the COVID-19, on the foreign exchange rates and stock market performances of India using secondary data over a span of 48 days.

The study explores whether the causal relationships and directions among the growth rate of confirmed cases (GrowthC), exchange rate (GEX) and SENSEX value (GSENSEX) are remaining the same across different pre and post-lockdown phases, attempting to capture any potential changes over time via the Vector Auto Regressive (VAR) models. A positive correlation is found between the growth rate of confirmed cases and the growth rate of exchange rate, and a negative correlation between the growth rate of confirmed cases and the growth rate of SENSEX value.

A naïve interpretation from this could be that with the rising growth rate of the number of confirmed cases, the economy took a toll, reflected by the Indian currency being depreciated while the stock exchange index suffered from a fall. However, on applying a VAR model, it is observed that an increase in the confirmed COVID-19 cases causes no significant change in the values of the exchange rate and SENSEX index. The result varies if the analysis is split across different time periods – before lockdown, first phase of lockdown and extension of lockdown.

To compare the three periods, we had undertaken five rounds of analyses. Nuanced and sensible interpretations of the numeric results indicate significant variability across time in terms of the relation between the variables of interest. This detailed knowledge about the varying patterns of dependence could potentially help the policy makers and investors of India in order to develop their policies to cope up the situation.
Introduction

A 55-year-old individual from Hubei province in China was reported to have been the first person to have contracted what is now called COVID-19, [Bryner, 2020] the disease caused by the new coronavirus spreading across the globe. In December 2019, a series of pneumonia cases of unknown cause emerged in Wuhan, with clinical presentations greatly resembling viral pneumonia. Deep sequencing analysis from lower respiratory tract samples indicated a novel coronavirus, which was named 2019 novel coronavirus (nCoV-2019). [Huang et al., 2020]

In India, the first case was reported on the 30th of January 2020 in Kerala. [“COVID-19 India”, 2020] Till 24th March 2020, total 536 COVID-19 cases were reported among which 10 were deceased and the number of recovered cases was 40. Total death per 1 million population in India was 0.01, whereas this number was 4 in USA, 2 in China, 136 in Italy, 104 in Spain, 3 in Germany and 28 in Iran, around that time. Since March 25, India has been under national lockdown, beginning at a time when 471,035 cases were reported worldwide to be infected by COVID-19 with 335,525 active cases and 114,228 cases having been discharged. 14,792 cases were marked as fatal or serious cases and total 21,282 are deceased due to this global epidemic throughout the world. The death rate was consistently increasing at 15.71% while the recovery rate was growing at 84.71%. Till 25th of March, China (21,285), Italy (74,386), USA (68,211), Spain (49,515), Germany (37,323) and Iran (27,017), were found as major active case bearers of COVID-19. [“Microsoft Bing COVID-19 Tracker”, 2020]

One of the controlling factors of any diseases scenario – quality of healthy life which includes purified water, sanitized housing, sufficient nutritious food, good health care etc. is essential in any economy, but the affordability depends on both financial stability and access to required knowledge to enhance and maintain one’s health. Thus, the relationship between a pandemic and the concurrent economy is exactly similar to the relation observed among health and wealth in general. [Bloom and Canning, 2020] Economic activities, efficient allocation of capital, mobilization of domestic savings, facilitation of exchange of goods and services can be improved in an economy by identifying and funding productive projects with better investment opportunities which is impelled by a well-governed stock market. [Nazir et al., 2010] It has also been observed that changes in monetary policy has surprisingly significant impact on the stocks of banking and financial services as well as the realty sector, but other sectors like media, metal, pharmaceuticals, information technology or fast-moving consumer goods appear to be unresponsive. [Prabu et al., 2020] The pandemic can hamper economic developments and trigger catastrophic events, thereby reducing the wealth of health and reducing protection against further health threats. [Bloom and Canning, 2020]

Past works have observed that education, health and social service, insurance received a large amount of loss to GDP in UK, France, Belgium and the Netherlands due to the effects of influenza outbreaks. [Keogh-Brown et al., 2010] According to conjectures and calculations provided by the rating agency S&P, COVID-19 can slow down the growth rate of baseline GDP for the world by 0.3 percentage point (ppt), for China by 0.7 ppt; for Asia-Pacific by 0.5 ppt; and for the USA and Europe by 0.1 to 0.2 ppt. [Bloom and Canning, 2020] IMF predicted that the growth rate of GDP in India can be more than 7% in April 2021 if the nation can control the coronavirus outbreak, but the growth rate could come down to as low as 1.9% in March 2021, depending on the control of the disease and stimulating monetary and fiscal policies immediately ending up the lockdowns. In this regard, lower oil price may help India becoming a favourable situation. [Choudhury, 2020] Another study using data on Kuala Lumpur Stock Exchange (KLSE) and exchange rate of the currency of Malaysia (MYR) found a significant effect on equity market and on exchange rate. The study also mentioned that the outbreak of
COVID-19 is creating an insecure feeling to investors in equity market and the exchange rate is also getting affected due to market sentiment. [Bakar & Rosbi, 2020] A study on the effect of COVID-19 on financial volatility index (VIX) concluded that the spread of coronavirus is increasing the financial volatility. [Albulescu, 2020] Another study to see the short-run effect of COVID-19 on the 21 leading stock markets in the world a sharp decline in the stock markets since the virus outbreak. [Liu et al., 2020]

In any economy, both the supply and the demand are affected by the epidemic which may result a persistent and large economic catastrophe all over the world. [Eichenbaum et al., 2020] However, according to McKenzie, there is no substantial relationship between Foreign Exchange volatility and international trade. [McKenzie, 1999] Vaguely, this means that at a standard scenario, the fluctuations in the foreign exchange rate do not affect the international trade. Bahmani-Oskooee and Saha investigated the link between exchange rate and stock prices using timeseries data of 24 countries and found that there may be a short-run relationship between these two variables, but the relationship doesn’t hold longer. [Bahmani-Oskooee & Saha, 2018] This work aims to find out whether the fluctuations in international trade of India, caused by the pandemic, is reflected in the foreign exchange rate of the country. To India, a disease outbreak and its impacts on the national economy is not a completely new experience. In 1918, “The Bombay Influenza” was spread from seven police sepoys in Bombay to Uttar Pradesh and Punjab through railway services by two weeks, which appeared to cause the highest number of deaths in one nation, the estimated number being 10-20 million. [Acharjee, 2020] During the Spanish flu, India experienced the lowest GDP growth rate (-10.5%) forever and an all-time high level of inflation, with a resulting supply side shock. The situation was worse compared to the first world war and the Bengal famine, as corroborated by future investigators. [Sreevatsan, 2020]

The stock market acts as an important ingredient of an open-market economy. In this study, we consider SENSEX value to analyse the market performance of India’s stock market because since 1989 when it had been set up, it has become the basic representative of the Bombay Stock Exchange (BSE) and has been considered as “Barometer” of Indian economy. The top 30 listed companies (blue chips) are the main components of BSE Sensex. Instability of market condition results in volatility of the stock market, and the price of BSE Sensex and stock of major companies on BSE prices have previously been reported to be positively related. [Challa et al., 2018] Behaviour of experienced and smart investors have been indicated to lead to a high return. [Kaufman, 1995] A study conducted by Ramelli and Wagner found the market as a respondent of the potential economic outcome under the pandemic, COVID-19. [Ramelli & Wagner, 2020] International trade-focused reaction was observed primarily but at the end of February and the beginning of March, a big price movement took place because the investors started to exhibit concerns regarding the COVID-19 shock via financial ways.

This study explores the impact of COVID-19 on the stock market of India and attempts to explore their causal relationship with direction using Vector Autoregressive (VAR) models. [Pfaff et al., 2008] The VAR model is treated as a standard tool in determining inter-dependencies and dynamic relationships among the variables in time-series econometrics. The VAR models are able to explain the endogenous variables solely based on their historical values, apart from the deterministic regressors.

**Methods**

Secondary data were collected for the number of infected cases from COVID-19, the stock market value and exchange rate from different sources. Supplementary Table 1 reports the
complete data collected and used for this study. We have divided our work into five Rounds considering the following five time periods based on the decisions of government and WHO.

a. 11th March to 15th April 2020: 35 days (Declaration of pandemic and lockdown 1.0),
b. 25th March to 15th April 2020: 21days (Lockdown 1.0),
c. 16th April to 27th April 2020: 12days (Lockdown 2.0, incomplete),
d. 25th March to 27th April 2020: 33days (Lockdowns 1.0 and 2.0, incomplete),
e. 11th March to 27th April 2020: 47days (Declaration of pandemic and Lockdowns 1.0 and 2.0, incomplete).

Round a has been considered for the time period from 11th March to April 15, because on 11th March, WHO upgraded the status of COVID-19 to Pandemic from Epidemic and on that day the first death in India due to coronavirus was reported. Round b is considered for the period from 25th March to 15th April to see the effect of COVID-19 on stock market and exchange rate of India exclusively for the first phase of lockdown. Round c was considered to see the performance of stock market and exchange rate under the effect of Covid-19 when lockdown is extended in India. Similarly, the round d was considered for 33 days to see the same effect and to examine how the effect of COVID-19 changes on these two variables from first lockdown phase to second lockdown phase. Finally, round e is considered for 48 days to check whether the above results hold for long.

In our analysis we use closing value of the stock market. The closing stock price is significant for many reasons. Investors, traders, financial institutions, regulators and other stakeholders use it as a reference point for determining performance over a specific time such as one year, a week and over a shorter time frame such as one minute or less. In fact, investors and other stakeholders base their decisions on closing stock prices. Supplementary Table 2 reports the calculated indices that were used for fitting the models and drawing inferences.

Results

Round a

During this round (11th March-15th April 2020) daily more than 342 people were being infected by coronavirus on an average, but this average was >38 before the lockdown 1.0 and approximately 536 after. It is observed that the infected cases increased daily at 16.51% but after the announcement of lockdown, the growth rate reduced by 2.12%, the daily recovery rate and death rate increasing by 21.21% and 20.94% respectively. The daily death and recovery rate reduced by 4.16% and 6.64% after the announcement of lockdown. It can apparently be commented that the lockdown made the situation better in general for controlling the infection.

During October 7, 2019 to March 10, 2020, the average foreign exchange rate of India was 71.44 for 155 days but after the declaration of COVID-19 as a Pandemic this daily average changed to 74.74 and again increased to 75.94 after the announcement of lockdown 1.0. However, post lockdown 1.0, the valuation of Indian Rupee improved, implied by the reduction in daily growth rate of exchange rate by 0.2%. The daily growth rate of exchange rate falls to 0.01% from 0.21% post-lockdown.

It is observed that the daily average value of SENSEX falls by 1375.53 point after the announcement of lockdown. But 25th March onwards the growth rate of SENSEX was 0.64 which was -1.9%, i.e. in the opposite direction before lockdown. The Stock market held an
The three variables were checked to be stationary by using unit root test at its level form. We regress GSENSEX on GROWTHC adjusting for GEX and the model is overall significant at 5% level by the P-value of F statistic (Supplementary Materials 1.2), along with GSENSEX significantly affecting GEX at 5% level. One-point increase in GEX reduces GSENSEX by 3.83 point and the same in GROWTHC increases GSENSEX by 0.03 points (Figure 1b). In this period, the correlation matrix shows that there was a positive correlation between GROWTHC and GEX, and a negative correlation between GROWTHC and GSENSEX (Supplementary Materials 6.1). The impact was more pronounced on the exchange rate than on the Sensex.

On applying VAR, we do find a significant negative dependence between GSENSEX and GROWTHC, evident by the computed t-statistic (Supplementary Materials 7.2). This implied that growth rate of Sensex for the current period was negatively affected by the growth rate of the number of infected cases during this period. Looking at the IRF graphs (Figures 2c-d), it can be seen that during Round b, due to the COVID-19 shock, the growth rate of Sensex and the growth rate of exchange rates would have taken about 5.5 periods (days) to return to their long-run growth trend.

Round b

During this round, the nation was experiencing its first phase of complete lockdown due to COVID-19. The daily average growth rate of confirmed cases was held at 15.68%; for recovery and death cases the rates were 18.62% and 19.39% respectively. On April 7, GSENSEX value appears to be maximum at 8.97% and on March 30, this rate was minimum as -4.6%; throughout the round, the daily average was 0.64%. On April 1, GEX was maximum at 1.4% and on March 26 it achieved a minimum (Figure 2a).

The three variables were checked to be stationary by using unit root test at its level form. Regression result of GEX as dependent variable on GROWTHC and GSENSEX as covariates indicates the overall model to be non-significant at 5% level (Supplementary Materials 2.3 and Figure 2b). One-point increase in GSENSEX causes GEX to fall by 0.067 point and the same in GROWTHC causes GEX to rise by 0.02 point. In this period, the correlation matrix exhibits a positive correlation between GROWTHC and GEX, but a negative correlation between GROWTHC and GSENSEX (Supplementary Materials 7.1). This meant that with the rise in the growth rate of the number of confirmed cases, the Indian currency continued depreciating, whereas the stock exchange index started to fall. Also, there is a notably strong negative correlation between the exchange rate and the SENSEX index.

On applying VAR, we do find a significant negative dependence between GSENSEX and GROWTHC, evident by the computed t-statistic (Supplementary Materials 7.2). This implied that growth rate of Sensex for the current period was negatively affected by the growth rate of the number of infected cases during this period. Looking at the IRF graphs (Figures 2c-d), it can be seen that during Round b, due to the COVID-19 shock, the growth rate of Sensex and the growth rate of exchange rates would have taken about 5.5 periods (days) to return to their long-run growth trend.

Round c

In this round of analyses, data show that the average growth rate of confirmed cases and the growth rate of deaths were 7.55% and 7.27% respectively, significantly lower compared the average of -0.35% growth rate throughout this period. Figure 1a summarizes the patterns in the growth rates across the indices of interest.
previous Rounds. The daily average of exchange rate and Sensex value were on 76.45 and 31385.07 point at growth rates of -0.04% and 0.38% respectively. The domestic currency performed well in this round as can be seen in Figure 3a.

The three variables were checked to be stationary by using unit root test at its level form. One-point change in GROWTHC and GSENSEX were seen to change GEX by 0.01 and 0.12 point respectively. The value of R² is 0.65, which means that GSENSEX and GROWTHC together explain 65% of total variation in GEX (Supplementary Materials 3.1 and Figure 3b). In this period, the correlation matrix shows that there is a high degree of negative correlation between GROWTHC and GEX, but the negative correlation between GROWTHC and GSENSEX was small (Supplementary Materials 8.1). This meant that with the rising growth rate of the number of confirmed cases, the Indian currency started appreciating, whereas the stock exchange index started to fall.

On applying VAR, we find no significant relationship between the variables during this period (Supplementary Materials 8.2). This implies that during this period, the increase in the confirmed COVID-19 cases caused no changes in the values of the other variables. Looking at the IRF graphs (Figures 3c-d), it can be seen that during round c, due to the COVID-19 shock, the growth rate of Sensex and the growth rate of exchange rates would have taken about 8.5 and 9.5 days, respectively, to return to their long-run growth trends.

**Round d**

This round includes the whole lockdown session, i.e., from March 25 to April 27. It has been observed that the extension of lockdown effectively reduces the growth rate of confirmed cases by more than 8.13%. During lockdown 1.0, death cases were increasing at more than 19.39% daily and it declines to 7.27 during lockdown 2.0. But the growth rate of recovered cases falls from 18.62% to 14.43%. If we look at the stock market performance, then we will see that daily growth rate falls by 0.3% from lockdown 1.0 to 2.0. The average GSENSEX value is held at 0.54% for the entire lockdown session, while the same was 0.64% for lockdown 1.0 and 0.38% for lockdown 2.0. After March 25, the average growth rate of exchange rate is negative, but it was positive before April 15 and becomes negative after the extension. The average decreasing rate of exchange rate after extension is almost 2.8 times of the average increasing rate of exchange rate till 15th of April (Figure 4a).

We apply unit root test which shows that the growth rate for confirmed cases is non-stationary and becomes stationary at first difference form. So, we apply simple linear regression model between GEX and GSENSEX considering GEX as dependent variable. The result shows that GSENSEX affects GEX significantly at 1% level. One-point change in GSENSEX leads to an estimated 0.09-point change in GEX. (Supplementary Materials 4.1 and Figure 4b). In this period, the correlation matrix shows that there is a negative correlation between GROWTHC and GEX, as well as GROWTHC and GSENSEX (Supplementary Materials 9.1). This means that with the rising growth rate of the number of confirmed cases, the Indian currency appreciated, whereas the stock exchange index experienced a fall. However, the impact was more pronounced on the exchange rate than on the Sensex.

On applying VAR, we find no significant relationship between the variables during this period (Supplementary Materials 9.2). Looking at the IRF graphs (Figures 4c-d), it can be seen that during round d, due to the COVID-19 shock, the growth rate of Sensex and the growth rate of exchange rates would have taken about 4.5 days, respectively to return to their long-run growth trend.

**Round e**
Finally, we look at the effect of COVID-19 for the whole pre and during-lockdown period on Sensex and exchange rate. Over this period, post the declaration of the pandemic, the exchange rate and Sensex held their values on an average at 75.72 and 30375.6028 respectively.

The three variables were checked to be stationary by using unit root test at its level form. When we regress GSENSEX on GEX and GrowthC, it is found that the model is overall significant at 5% level and GSENSEX is significantly affected by GEX at the same level. One-point change in GEX and the growth rate of confirmed cases would change the growth rate of Sensex by 3.75 points and 0.02 point respectively (Supplementary Materials 5.3 and Figure 5b). In this period, the correlation matrix shows that there was a positive correlation between GROWTHC and GEX, and a negative correlation between GROWTHC and GSENSEX (Supplementary Materials 10.1). This meant that with the rising growth rate of the number of confirmed cases, the Indian currency depreciated, whereas the stock exchange index fell. However, the impact was more pronounced on the exchange rate than on the Sensex.

On applying VAR, we find no significant relationship between the variables during this period (Supplementary Materials 10.2). Looking at the IRF graphs (Figures 5c-d), it can be seen that during round e, due to the COVID-19 shock, the growth rate of Sensex and the growth rate of exchange rates would have taken about 4.5 days, respectively to return to their long-run growth trend.

**Discussions**

The main objective of this study is to explore the relationship among the number of infected cases, exchange rate and stock market in India and to analyse the correlation among the growth rate series of these three variables. Since October 07, 2019 to March 10, 2020, average exchange rate of USD to INR was at 71.44 but after march 11, when the COVID-19 has been declared to be Pandemic by WHO, the average exchange rate over the period considered became 75.72. We observed a generally positive correlation between the growth rate of infected cases and the growth rate of exchange rate. This correlation was found to be negative between the growth rate of infected cases and the growth rate of Sensex. The VAR results implied that the increase in the confirmed COVID-19 cases caused suggestive but not statistically significant changes in the values of the exchange rate and Sensex, and that due to the COVID-19 shock, the growth rate of Sensex and the growth rate of exchange rates would have taken a substantial number of days, in general, to return to their long-run growth trends. The decision of lockdown appears to be effective in controlling the spread of COVID-19 reflected by the average daily growth rate of confirmed cases and death cases. The daily average growth rate of confirmed cases was 17.804% before the lockdown which changes first to 15.684% in first phase of lockdown and then to 7.55% when the lockdown is extended. Similarly, the growth rate of deaths was 23.55% before the lockdown which first falls to 19.39% in first phase of lockdown and again to 7.27% when it is extended after April 15. These are indications that the lockdown improved the situation to some extent.

The average growth rate of exchange rate and Sensex were 0.06% and -0.17% respectively over the entire period considered in this study. During the first phase of lockdown growth rate of exchange rate is 0.013% which is lower than the daily average growth rate of exchange rate observed before lockdown. With the extension of lockdown, the daily growth rate of exchange rate becomes -0.04% (INR being appreciated) after April 15. During lockdown 1.0, there is a positive correlation between GROWTHC and GEX, but a negative correlation between GROWTHC and GSENSEX. This meant that with the rise in the growth rate of the number of
confirmed cases, the Indian currency continued depreciating, whereas the stock exchange index started to fall. Also, there is a strong negative correlation between the exchange rate and the Sensex index, implying that with the Indian currency depreciating the stock exchange also dropped. With extension of the lockdown, clear variabilities were observed in the relationships across the variables of interest. We found a high degree of negative correlation between GROWTHC and GEX, but the negative correlation between GROWTHC and GSENSEX was almost washed out. Under the combined lockdown period, from March 25 to April 27, a positive correlation between GrowthC and Gex and a negative correlation between GrowthC and Gsensex were observed which means that INR is being depreciated with rising growth rate of confirmed cases.

Our investigations into the relations and interdependence between economic and health variables in context of the pandemic and the lockdown identify strong evidences of variability in these relationships over time. It is quite evident that these changes are extremely dynamic, and nuanced observation at the rapidly-changing scenario is required for effective policy decisions. Our framework is quite flexible and quick updating of the results is possible based on new incoming data, which is why it can potentially be useful in identifying the current needs from a decision-making perspective.
References

Abu Bakar, N. & Rosbi, S. (2020). Impact of Coronavirus Disease 2019 (COVID-19) to Equity Market and Currency Exchange Rate. 11. 22-31. 10.9790/5933-1102062231.

Acharjee, S. (2020). Pandemics of the Past. Retrieved 19 June 2020, from https://www.indiatoday.in/india-today-insight/story/coronavirus-pandemics-of-the-past-1656730-2020-03-18

Albulescu, C. (2020). Coronavirus and financial volatility: 40 days of fasting and fear. arXiv preprint arXiv:2003.04005.

Bahmani-Oskooee, M., & Saha, S. (2018). On the relation between exchange rates and stock prices: a non-linear ARDL approach and asymmetry analysis. Journal of Economics and Finance, 42(1), 112-137.

Bloom, D. E., Canning, D. Et al. (2004). Epidemics and economics. Interactions Between Global Change and Human Health (Scripta Varia), 106, 304–331.

Bryner, Jeanna. “1st Known Case of Coronavirus Traced Back to November in China.” Live Science, 14 Mar. 2020, https://www.livescience.com/first-case-coronavirus-found.html

Challa, M. L., Malepati, V., & Kolusu, S. N. R. (2018). Forecasting risk using auto regressive integrated moving average approach: an evidence from S&P BSE Sensex. Financial Innovation, 4(1), 24.

Choudhury, S. (2020). IMF says India's growth rate could top 7% in 2021 if the coronavirus outbreak is brought under control. Retrieved 19 June 2020, from https://www.cnbc.com/2020/04/20/coronavirus-imf-forecasts-india-growth-rate-at-7point4-percent-in-2021.html

COVID-19 India. COVID-19 Tracker Updates for India for State-wise and District-wise data. 2020. Retrieved May 2020, from COVID19 India: https://www.covid19india.org

Eichenbaum, M. S., Rebelo, S., & Trabandt, M. (2020). The macroeconomics of epidemics (No. w26882). National Bureau of Economic Research.

Gopinathan, R., & Durai, S. R. S. (2019). Stock market and macroeconomic variables: New evidence from India. Financial Innovation, 5 (1), 1–17.

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., ... & Cheng, Z. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The Lancet, 395(10223), 497-506.

Kaufman, G. (1995). Research in Financial Services: Banking, Financial Markets, and Systemic Risk. Greenwich, CT: JAI.

Keogh-Brown, M. R., Smith, R. D., Edmunds, J. W., & Beutels, P. (2010). The macroeconomic impact of pandemic influenza: estimates from models of the United Kingdom, France, Belgium and The Netherlands. The European Journal of Health Economics, 11(6), 543-554.

Liu, H., Manzoor, A., Wang, C., Zhang, L., & Manzoor, Z. (2020). The COVID-19 outbreak and affected countries stock markets response. International Journal of Environmental Research and Public Health, 17(8), 2800.

McKenzie, M. D. (1999). The impact of exchange rate volatility on international trade flows. Journal of economic Surveys, 13 (1), 71–106.
Nazir, M. S., Nawaz, M. M., & Gilani, U. J. (2010). Relationship between economic growth and stock market development. African Journal of Business Management, 4 (16), 3473.

Pfaff, B. (2008). VAR, SVAR and SVEC models: Implementation within R package vars. Journal of Statistical Software, 27(4), 1-32.

Prabu, A. E., Bhattacharyya, I., & Ray, P. (2020). Impact of monetary policy on the Indian stock market: Does the devil lie in the detail? Indian Economic Review, 1-24.

Ramelli, S., & Wagner, A. F. (2020). Feverish stock price reactions to covid-19.

Sreevatsan, A. (2020). Why 1918 matters in India’s corona war. Retrieved 19 June 2020, from https://www.livemint.com/news/world/why-1918-matters-in-india-s-corona-war-11584033795146.html
Figures

Figure 1: Summary of results for round a.

Panel a: The pattern of growth of infected cases (GROWTHC), growth of exchange rate (GEX) and growth of SENSEX (GSENSEX) are shown for the time period March 11 to April 15 in India. In vertical axis, growth rates are plotted; time (date) is in the horizontal axis.

Panel b: Summaries corresponding to regression of GSENSEX on GROWTHC and GEX from March 11 to April 15 where the blue line, the red line and the green line represent residual, actual and fitted values respectively.

Panel c: Impulse Response Function graph of GEX to GROWTHC during the period of March 11 to April 15.

Panel d: Impulse Response Function graph of GSENSEX to GROWTHC during the period of March 11 to April 15.
Figure 2: Summary of results for round b.

Panel a: The pattern of growth of infected cases (GROWTHC), growth of exchange rate (GEX) and growth of SENSEX (GSENSEX) are shown for the time period March 25 to April 15 in India. In vertical axis, growth rates are plotted; time (date) is in the horizontal axis.

Panel b: Summaries corresponding to regression of GEX on GROWTHC and GSENSEX from March 25 to April 15 where the blue line, the red line and the green line represent residual, actual and fitted values respectively.

Panel c: Impulse Response Function graph of GEX to GROWTHC during the period of March 25 to April 15.

Panel d: Impulse Response Function graph of GSENSEX to GROWTHC during the period of March 25 to April 15.
Figure 3: Summary of results for round c.

Panel a: The pattern of growth of infected cases (GROWTHC), growth of exchange rate (GEX) and growth of SENSEX (GSENSEX) are shown for the time period April 16 to April 27 in India. In vertical axis, growth rates are plotted; time (date) is in the horizontal axis.

Panel b: Summaries corresponding to regression of GEX on GROWTHC and GSENSEX from April 16 to April 27 where the blue line, the red line and the green line represent residual, actual and fitted values respectively.

Panel c: Impulse Response Function graph of GEX to GROWTHC during the period of April 16 to April 27.

Panel d: Impulse Response Function graph of GSENSEX to GROWTHC during the period of April 16 to April 27.
Figure 4: Summary of results for round 4.

Panel a: The pattern of growth of infected cases (GROWTHC), growth of exchange rate (GEX) and growth of SENSEX (GSENSEX) are shown for the time period March 25 to April 27 in India. In vertical axis, growth rates are plotted; time (date) is in the horizontal axis.

Panel b: Summaries corresponding to regression of GEX on GSENSEX from March 25 to April 27 where the blue line, the red line and the green line represent residual, actual and fitted values respectively.

Panel c: Impulse Response Function graph of GEX to GROWTHC during the period of March 25 to April 27.

Panel d: Impulse Response Function graph of GSENSEX to GROWTHC during the period of March 25 to April 27.
Figure 5: Summary of results for round e.

Panel a: The pattern of growth of infected cases (GROWTHC), growth of exchange rate (GEX) and growth of SENSEX (GSENSEX) are shown for the time period March 11 to April 27 in India. In vertical axis, growth rates are plotted; time (date) is in the horizontal axis.

Panel b: Summaries corresponding to regression of GSENSEX on GROWTHC and GEX from March 11 to April 27 where the blue line, the red line and the green line represent residual, actual and fitted values respectively.

Panel c: Impulse Response Function graph of GEX to GROWTHC during the period of March 11 to April 27.

Panel d: Impulse Response Function graph of GSENSEX to GROWTHC during the period of March 11 to April 27.
Supplementary Document for
Examining the Effect of COVID-19 on Foreign Exchange Rate and Stock Market
– An Applied Insight into the Variable Effects of Lockdown on Indian Economy

Indrajit Banerjee¹, Atul Kumar¹, Rupam Bhattacharyya².*

¹Department of Economic Studies and Policies, Central University of South Bihar
²Department of Biostatistics, University of Michigan

*Corresponding author. Address: 1415 Washington Heights, Ann Arbor, MI 48109, USA. Email ID: rupamb@umich.edu, Phone: +17348006834.
Supplementary Materials

1) Results of Multiple Linear Regression Models for round a

1.1) Summary of OLS regression results

Dependent Variable: GROWTHC

| Variable  | Coefficient | Std. Error | t-Statistic | Prob. |
|-----------|-------------|------------|-------------|-------|
| C         | 0.16        | 0.02       | 10.68       | 0.001 |
| GEX       | 6.18**      | 2.93       | 2.11        | 0.04  |
| GSENSEX   | 0.18        | 0.41       | 0.44        | 0.66  |

R-squared 0.13***

F-statistic 2.51

Adjusted R-squared 0.08

Prob(F-statistic) 0.097

Note. * p < .01. ** p < .05. *** p<.1

1.2) Summary of OLS regression results

Dependent Variable: GSENSEX

| Variable  | Coefficient | Std. Error | t-Statistic | Prob. |
|-----------|-------------|------------|-------------|-------|
| C         | -0.005      | 0.01       | -0.41       | 0.69  |
| GROWTHC   | 0.03        | 0.07       | 0.44        | 0.66  |
| GEX       | -3.83*      | 1.13       | -3.4        | 0.001 |

R-squared 0.27**

F-statistic 6.11

Adjusted R-squared 0.23

Prob(F-statistic) 0.006

Note. * p < .01. ** p < .05. *** p<.1

1.3) Summary of OLS regression results

Dependent Variable: GEX

| Variable  | Coefficient | Std. Error | t-Statistic | Prob. |
|-----------|-------------|------------|-------------|-------|
| C         | -0.003      | 0.002      | -1.46       | 0.15  |
2.2) Summary of OLS regression results
Dependent Variable: GSENSEX

| Variable     | Coefficient | Std. Error | t-Statistic | Prob.   |
|--------------|-------------|------------|-------------|---------|
| C            | 0.01        | 0.01       | 0.72        | 0.48    |
| GROWTHC      | -0.02       | 0.08       | -0.25       | 0.8     |
| GEX          | -2.1***     | 1.19       | -1.77       | 0.09    |
| R-squared    | 0.18        | F-statistic| 2.05        |
| Adjusted R-squared | 0.1       | Prob(F-statistic) | 0.16 |

Note. * p < .01. ** p < .05. *** p<.1
2.3) Summary of OLS regression results

Dependent Variable: GEX

| Variable   | Coefficient | Std. Error | t-Statistic | Prob. |
|------------|-------------|------------|-------------|-------|
| C          | -0.002      | 0.002      | -1.007      | 0.33  |
| GROWTHC    | 0.02        | 0.01       | 1.48        | 0.16  |
| GSENSEX    | -0.07***    | 0.04       | -1.77       | 0.09  |

R-squared 0.26***  F-statistic 3.33
Adjusted R-squared 0.18  Prob(F-statistic) 0.06

Note. * p < .01. ** p < .05. *** p<.1

3) Results of Multiple Linear Regression Models for round c

3.1) Summary of OLS regression results

Dependent Variable: GEX

| Variable   | Coefficient | Std. Error | t-Statistic | Prob. |
|------------|-------------|------------|-------------|-------|
| C          | 0.001       | 0.003      | 0.34        | 0.74  |
| GSENSEX    | -0.12*      | 0.05       | -4.03       | 0.003 |
| GROWTHC    | -0.01       | 0.04       | -0.24       | 0.82  |

R-squared 0.65*  F-statistic 8.23
Adjusted R-squared 0.57  Prob(F-statistic) 0.01

Note. * p < .01. ** p < .05. *** p<.1

3.2) Summary of OLS regression results

Dependent Variable: GSENSEX

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| C        | 0.01        | 0.01       | 0.69        | 0.51  |
| GEX      | -3.39*      | 0.84       | -4.03       | 0.003 |
4) Results of Multiple Linear Regression Models for round d

4.1) Summary of OLS regression results

Dependent Variable: GEX

| Variable    | Coefficient | Std. Error | t-Statistic | Prob. |
|-------------|-------------|------------|-------------|-------|
| C           | 0.0005      | 0.001      | 0.54        | 0.59  |
| GSENSEX     | -0.1*       | 0.03       | -3.03       | 0.005 |

R-squared 0.22* F-statistic 9.17
Adjusted R-squared 0.2 Prob(F-statistic) 0.005

Note. * p < .01. ** p < .05. *** p<.1

5) Results of Multiple Linear Regression Models for round e

5.1) Summary of OLS regression results

Dependent Variable: GROWTHC

| Variable    | Coefficient | Std. Error | t-Statistic | Prob. |
|-------------|-------------|------------|-------------|-------|
| C           | 0.14        | 0.013      | 11.18       | 0.0001|
| GEX         | 6.004**     | 2.68       | 2.24        | 0.03  |
| GSENSEX     | 0.12        | 0.39       | 0.32        | 0.75  |

R-squared 0.12*** F-statistic 3.067
Adjusted R-squared 0.08 Prob(F-statistic) 0.06

Note. * p < .01. ** p < .05. *** p<.1
5.2) Summary of OLS regression results

Dependent Variable: GEX

| Variable   | Coefficient | Std. Error | t-Statistic | Prob. |
|------------|-------------|------------|-------------|-------|
| C          | -0.002      | 0.001      | -1.54       | 0.13  |
| GSENSEX    | -0.07*      | 0.018      | -4.12       | 0.0002|
| GROWTHC    | 0.02**      | 0.007      | 2.24        | 0.03  |

R-squared  | 0.36*      | F-statistic | 12.65       |
Adjusted R-squared | 0.33      | Prob(F-statistic) | 0.000044    |

Note. * p < .01. ** p < .05. *** p<.1

5.3) Summary of OLS regression results

Dependent Variable: GSENSEX

| Variable   | Coefficient | Std. Error | t-Statistic | Prob. |
|------------|-------------|------------|-------------|-------|
| C          | -0.002      | 0.009      | -0.22       | 0.83  |
| GROWTHC    | 0.02        | 0.06       | 0.32        | 0.75  |
| GEX        | -3.75*      | 0.91       | -4.12       | 0.0002|

R-squared  | 0.29*      | F-statistic | 9.19       |
Adjusted R-squared | 0.26      | Prob(F-statistic) | 0.0005    |

Note. * p < .01. ** p < .05. *** p<.1

6) Correlation and VAR model summaries for round a

6.1) Correlation Matrix

|       | GROWTHC | GSENSEX  | GEX   |
|-------|---------|----------|-------|
| GROWTHC | 1       |          |       |
| GSENSEX | -0.122  | 1        |       |
| GEX    | 0.356   | -0.516   | 1     |
6.2) Summary of Vector Autocorrelation Estimates

|                  | GROWTHC | GSENSEX | GEX  |
|------------------|---------|---------|------|
| GROWTHC(-1)      | -0.029  | 0.109   | -0.009 |
|                  | (0.194) | (0.885) | (0.012) |
|                  | [-0.147]| [1.23]  | [-0.74] |
| GSENSEX(-1)      | 0.562   | 0.145   | -0.156 |
|                  | (0.448) | (0.204) | (0.028) |
|                  | [1.254] | [0.071] | [-0.556] |
| GEX(-1)          | 2.417   | 0.385   | -0.208 |
|                  | (3.5)   | (1.597) | (0.222) |
|                  | [0.69]  | [0.242] | [-0.936] |

Note. figs. in () and [] represent std. error and t-statistic, respectively.

7) Correlation and VAR model summaries for round b

7.1) Correlation Matrix

|         | GROWTHC | GSENSEX | GEX |
|---------|---------|---------|-----|
| GROWTHC | 1       |         |     |
| GSENSEX | -0.204  | 1       | 1   |
| GEX     | 0.371   | -0.418  | 1   |

7.2) Summary of Vector Autocorrelation Estimates

|                  | GROWTHC | GSENSEX | GEX  |
|------------------|---------|---------|------|
| GROWTHC(-1)      | -0.054  | 0.167   | -0.02 |
|                  | (0.273) | (0.073) | (0.016) |
|                  | [-0.197]| [0.282] | [-1.23] |
### 8) Correlation and VAR model summaries for round e

#### 8.1) Correlation Matrix

|          | GROWTHC | GSENSEX | GEX  |
|----------|---------|---------|------|
| GROWTHC  | 1       |         |      |
| GSENSEX  | -0.178  | 1       |      |
| GEX      | 0.973   | -0.803  | 1    |

#### 8.2) Summary of Vector Autocorrelation Estimates

|          | GROWTHC | GSENSEX | GEX  |
|----------|---------|---------|------|
| GROWTHC(-1) | -0.045  | 0.243   | -0.003 |
|           | (0.37)  | (0.328) | (0.077) |
|           | [-0.122] | [0.742] | [-0.041] |
| GSENSEX(-1) | 0.53    | 0.109   | 0.059 |
|           | (0.688) | (0.61)  | (0.143) |
|           | [0.77]  | [0.179] | [0.412] |
| GEX(-1)   | 1.144   | 1.376   | 0.051 |
|           | 2.888   | 2.559   | (0.599) |

Note. Figs. in () and [] represent std. error and t-statistic, respectively.

---

GSENSEX(-1)  0.119  -0.031  -0.03  
(0.786)  (0.21)  (0.047)  
[0.151]  [-0.146]  [0.642]  

GEX(-1)  0.72  -1.223  -0.118  
(4.675)  (1.252)  (0.28)  
[0.154]  [-0.977]  [-0.42]  

---

29
9) **Correlation and VAR model summaries for round d**

### 9.1) Correlation Matrix

|        | GROWTHC | GSENSEX | GEX  |
|--------|---------|---------|------|
| GROWTHC| 1       |         |      |
| GSENSEX| -0.156  | 1       |      |
| GEX    | 0.322   | -0.472  | 1    |

### 9.2) Summary of Vector Autocorrelation Estimates

|        | GROWTHC | GSENSEX | GEX  |
|--------|---------|---------|------|
| GROWTHC(-1) | 0.193   | 0.113   | -0.013 |
|          | (0.19)  | (0.053) | (0.012) |
|          | [1.012] | [2.12]  | [-1.137] |
| GSENSEX(-1) | 0.279   | -0.062  | -0.02  |
|          | (0.638) | (0.178) | (0.04) |
|          | [0.438] | [-0.347] | [-0.495] |
| GEX(-1)  | -0.611  | -0.464  | -0.125 |
|          | 3.413   | 0.956   | (0.212) |
|          | [-0.179] | [-0.485] | [-0.59] |

*Note. figs. in () and [] represent std. error and t-statistic, respectively.*

10) **Correlation and VAR model summaries for round e**

### 10.1) Correlation Matrix

|        | GROWTHC | GSENSEX | GEX  |
|--------|---------|---------|------|
| GROWTHC| 1       |         |      |
| GSENSEX| -0.147  | 1       |      |
| GEX    | 0.344   | -0.537  | 1    |
### 10.2) Summary of Vector Autocorrelation Estimates

|                  | GROWTHC | GSENSEX | GEX    |
|------------------|---------|---------|--------|
| GROWTHC(-1)      | 0.209   | 0.065   | -0.004 |
|                  | (0.158) | (0.068) | (0.01) |
|                  | [1.322] | [0.966] | [-0.445] |
| GSENSEX(-1)      | 0.46    | 0.036   | -0.015 |
|                  | (0.415) | (0.177) | (0.026) |
|                  | [1.107] | [0.202] | [-0.568] |
| GEX(-1)          | 0.85    | 0.755   | -0.196 |
|                  | (2.97)  | (1.268) | (0.185) |
|                  | [0.286] | [0.596] | [-1.057] |

*Note.* figs. in () and [] represent std. error and t-statistic, respectively.
**Supplementary Tables**

*Supplementary Table 1:* Raw data as collected and used for the work.

| Date       | Confirmed | Recovered | Deaths | Exchange Rate | Stock Exchange Value (Close) |
|------------|-----------|-----------|--------|---------------|------------------------------|
| 11-03-2020 | 62        | 4         | 1      | 73.8128       | 35697.39844                  |
| 12-03-2020 | 73        | 4         | 1      | 74.55003      | 32778.14063                  |
| 13-03-2020 | 82        | 4         | 2      | 73.83332      | 34103.48047                  |
| 14-03-2020 | 102       | 4         | 2      | 73.83332      | 34103.48047                  |
| 15-03-2020 | 113       | 13        | 2      | 73.83332      | 34103.48047                  |
| 16-03-2020 | 119       | 13        | 2      | 74.0037       | 31390.07031                  |
| 17-03-2020 | 142       | 14        | 3      | 74.06519      | 30579.08984                  |
| 18-03-2020 | 156       | 14        | 3      | 74.54414      | 28869.50977                  |
| 19-03-2020 | 194       | 15        | 4      | 74.80931      | 28288.23047                  |
| 20-03-2020 | 244       | 20        | 5      | 75.42809      | 29915.96094                  |
| 21-03-2020 | 330       | 23        | 4      | 75.42809      | 29915.96094                  |
| 22-03-2020 | 396       | 27        | 7      | 75.42809      | 29915.96094                  |
| 23-03-2020 | 499       | 27        | 10     | 76.34194      | 25981.24023                  |
| 24-03-2020 | 536       | 40        | 10     | 76.3796       | 26674.0293                   |
| 25-03-2020 | 657       | 43        | 12     | 76.35796      | 28535.78                     |
| 26-03-2020 | 727       | 45        | 20     | 74.86767      | 29946.77                     |
| 27-03-2020 | 887       | 73        | 20     | 75.42804      | 29815.59                     |
| 28-03-2020 | 987       | 84        | 24     | 75.42804      | 29815.59                     |
| 29-03-2020 | 1024      | 95        | 27     | 75.47063      | 29815.59                     |
| 30-03-2020 | 1251      | 102       | 32     | 75.40123      | 28440.32                     |
| 31-03-2020 | 1397      | 123       | 35     | 75.32452      | 29468.49                     |
| 01-04-2020 | 1998      | 148       | 58     | 76.40519      | 28265.31                     |
| 02-04-2020 | 2543      | 191       | 72     | 76.39841      | 28265.31                     |
| 03-04-2020 | 2567      | 192       | 72     | 76.15346      | 27590.95                     |
| 04-04-2020 | 3082      | 229       | 86     | 76.15346      | 27590.95                     |
| 05-04-2020 | 3588      | 229       | 99     | 76.15346      | 27590.95                     |
| 06-04-2020 | 4778      | 375       | 136    | 75.9655       | 27590.95                     |
| 07-04-2020 | 5311      | 421       | 150    | 75.6419       | 30067.21                     |
| 08-04-2020 | 5916      | 506       | 178    | 75.94512      | 29893.96                     |
| 09-04-2020 | 6725      | 620       | 226    | 76.3109       | 31159.62                     |
| 10-04-2020 | 7598      | 774       | 246    | 76.23127      | 31159.62                     |
| 11-04-2020 | 8446      | 969       | 288    | 76.23127      | 31159.62                     |
| 12-04-2020 | 9205      | 1080      | 331    | 76.23127      | 31159.62                     |
| 13-04-2020 | 10453     | 1181      | 358    | 75.92622      | 30690.02                     |
| 14-04-2020 | 11487     | 1359      | 393    | 75.99731      | 30690.02                     |
| 15-04-2020 | 12322     | 1432      | 405    | 76.56986      | 30379.81                     |
| 16-04-2020 | 13430     | 1768      | 448    | 76.83679      | 30602.61                     |
| 17-04-2020 | 14352     | 2041      | 486    | 76.54123      | 31588.72                     |
| 18-04-2020 | 15722     | 2463      | 521    | 76.54123      | 31588.72                     |
| 19-04-2020 | 17615     | 2854      | 559    | 76.54123      | 31588.72                     |
| Date       | Code  | Quantity | Quantity | Price    | Total     |
|------------|-------|----------|----------|----------|-----------|
| 20-04-2020 | 18539 | 3273     | 592      | 76.64382 | 31648     |
| 21-04-2020 | 20080 | 3975     | 645      | 76.99003 | 30636.71  |
| 22-04-2020 | 21370 | 4370     | 681      | 76.41007 | 31379.55  |
| 23-04-2020 | 23077 | 5012     | 721      | 75.88865 | 31863.08  |
| 24-04-2020 | 24530 | 5498     | 780      | 76.26434 | 31327.22  |
| 25-04-2020 | 26283 | 5939     | 825      | 76.26434 | 31327.22  |
| 26-04-2020 | 27890 | 6523     | 881      | 76.29127 | 31327.22  |
| 27-04-2020 | 29451 | 7137     | 939      | 76.23058 | 31743.08  |
**Supplementary Table 2:** Calculated Growth Rate indices used for the work.

| Date      | GROWTHC | GROWTHR | GROWTHD | GEX      | GSENSEX |
|-----------|---------|---------|---------|----------|---------|
| 11-03-2020 | 0.107143 | 0       | -0.00463 | 0.001752 |
| 12-03-2020 | 0.177419 | 0       | 0       | 0.009988 | -0.08178 |
| 13-03-2020 | 0.123288 | 0       | 1       | -0.00961 | 0.040434 |
| 14-03-2020 | 0.243902 | 0       | 0       | 0         | 0       |
| 15-03-2020 | 0.107843 | 2.25    | 0       | 0         | 0       |
| 16-03-2020 | 0.053097 | 0       | 0       | 0.002308 | -0.07956 |
| 17-03-2020 | 0.193277 | 0.076923077 | 0.5 | 0.000831 | -0.02584 |
| 18-03-2020 | 0.098592 | 0       | 0       | 0.006467 | -0.05591 |
| 19-03-2020 | 0.24359 | 0.071428571 | 0.333333 | 0.003557 | -0.02013 |
| 20-03-2020 | 0.352459 | 0       | 0       | 0.040434 | 0.057541 |
| 21-03-2020 | 0.260101 | 0       | 0       | 0         | 0       |
| 22-03-2020 | 0.053097 | 0       | 0       | 0.002308 | -0.07956 |
| 23-03-2020 | 0.193277 | 0.076923077 | 0.5 | 0.000831 | -0.02584 |
| 24-03-2020 | 0.098592 | 0       | 0       | 0.006467 | -0.05591 |
| 25-03-2020 | 0.24359 | 0.071428571 | 0.333333 | 0.003557 | -0.02013 |
| 26-03-2020 | 0.352459 | 0       | 0       | 0.040434 | 0.057541 |
| 27-03-2020 | 0.260101 | 0       | 0       | 0.002308 | -0.07956 |
| 28-03-2020 | 0.193277 | 0.076923077 | 0.5 | 0.000831 | -0.02584 |
| 29-03-2020 | 0.098592 | 0       | 0       | 0.006467 | -0.05591 |
| 30-03-2020 | 0.24359 | 0.071428571 | 0.333333 | 0.003557 | -0.02013 |
| 31-03-2020 | 0.352459 | 0       | 0       | 0.040434 | 0.057541 |
| 01-04-2020 | 0.260101 | 0       | 0       | 0.002308 | -0.07956 |
| 02-04-2020 | 0.193277 | 0.076923077 | 0.5 | 0.000831 | -0.02584 |
| 03-04-2020 | 0.098592 | 0       | 0       | 0.006467 | -0.05591 |
| 04-04-2020 | 0.24359 | 0.071428571 | 0.333333 | 0.003557 | -0.02013 |
| 05-04-2020 | 0.352459 | 0       | 0       | 0.040434 | 0.057541 |
| 06-04-2020 | 0.260101 | 0       | 0       | 0.002308 | -0.07956 |
| 07-04-2020 | 0.193277 | 0.076923077 | 0.5 | 0.000831 | -0.02584 |
| 08-04-2020 | 0.098592 | 0       | 0       | 0.006467 | -0.05591 |
| Date       | Value1  | Value2          | Value3  | Value4  | Value5  |
|------------|---------|-----------------|---------|---------|---------|
| 09-04-2020 | 0.136748| 0.225296443     | 0.269663| 0.004816| 0.042338|
| 10-04-2020 | 0.129814| 0.248387097     | 0.088496| -0.00104| 0       |
| 11-04-2020 | 0.111608| 0.251937984     | 0.170732| 0       | 0       |
| 12-04-2020 | 0.089865| 0.114551084     | 0.149306| 0       | 0       |
| 13-04-2020 | 0.135578| 0.093518519     | 0.081571| -0.004  | -0.01507|
| 14-04-2020 | 0.098919| 0.150719729     | 0.097765| 0.000936| 0       |
| 15-04-2020 | 0.072691| 0.053715968     | 0.030534| 0.007534| -0.01011|
| 16-04-2020 | 0.08992 | 0.234636872     | 0.106173| 0.003486| 0.007334|
| 17-04-2020 | 0.068652| 0.154411765     | 0.084821| -0.00385| 0.032223|
| 18-04-2020 | 0.095457| 0.206761391     | 0.072016| 0       | 0       |
| 19-04-2020 | 0.120405| 0.158749492     | 0.072937| 0       | 0       |
| 20-04-2020 | 0.052455| 0.146811493     | 0.059034| 0.00134 | 0.001877|
| 21-04-2020 | 0.083122| 0.214482126     | 0.089527| 0.004517| -0.03195|
| 22-04-2020 | 0.064243| 0.099371069     | 0.055814| -0.00753| 0.024247|
| 23-04-2020 | 0.079878| 0.146910755     | 0.058737| -0.00682| 0.015409|
| 24-04-2020 | 0.062963| 0.096967279     | 0.081831| 0.004951| -0.01682|
| 25-04-2020 | 0.071464| 0.080210986     | 0.057692| 0       | 0       |
| 26-04-2020 | 0.061142| 0.098333053     | 0.067879| 0.000353| 0       |
| 27-04-2020 | 0.05597 | 0.094128468     | 0.065834| -0.0008 | 0.013275|
Supplementary Figures

Supplementary Figure 1: Summaries corresponding to regression of GROWTHC on GSENSEX and GEX from March 11 to April 15 where the blue line, the red line and the green line represent residual, actual and fitted values respectively.

Supplementary Figure 2: Summaries corresponding to regression of GEX on GSENSEX and GROWTHC from March 11 to April 15 where the blue line, the red line and the green line represent residual, actual and fitted values respectively.
**Supplementary Figure 3:** Summaries corresponding to regression of GROWTHC on GSENSEX and GEX from March 25 to April 15 where the blue line, the red line and the green line represent residual, actual and fitted values respectively.

**Supplementary Figure 4:** Summaries corresponding to regression of GSENSEX on GROWTHC and GEX from March 25 to April 15 where the blue line, the red line and the green line represent residual, actual and fitted values respectively.
Supplementary Figure 5: Summaries corresponding to regression of GSENSEX on GROWTHC and GEX from April 16 to April 27 where the blue line, the red line and the green line represent residual, actual and fitted values respectively.

Supplementary Figure 6: Summaries corresponding to regression of GROWTHC on GSENSEX and GEX from March 11 to April 27 where the blue line, the red line and the green line represent residual, actual and fitted values respectively.
Supplementary Figure 7: Summaries corresponding to regression of GEX on GROWTHC and GSENSEX from March 11 to April 27 where the blue line, the red line and the green line represent residual, actual and fitted values respectively.