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Research Article

Asia-Pacific Resilience: Evaluating Energy Market, Financial Market and Black Swan Event Policy Responses

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ABSTRACT

In response to the onset of any black swan event i.e., COVID-19, the governments of global economies were prompted to implement stringent policies, overwhelming the extent and intensity of past pandemics e.g. Spanish Flu and the 1957-58 influenza outbreak to name the few. This study is an attempt to analyze the impact of the government stringent policies on oil price, exchange rates, stick returns, and commodity prices in order to combat the mortality rate of COVID-19. Our results illustrate that the commodity prices leave more definite impressions as compared to oil prices and exchange rates, while the stock returns are significantly impacted by government stringent measures. This study further accentuates the crucial role of policy actions for combating the economic effects of black swan event while backing the balanced measures which safeguard public health along with the economic stability.

Key words: Government stringent measures, Exchange Rate, stock return, oil price

JEL classification: J68, F38, G12, Q43

INTRODUCTION

Oil is one of the key driving force of the global economy. A sudden drop in oil prices can create uncertainty in the global economy, although it can also reduce production costs and boost economic growth (Narayan et al., 2014). This economic growth can lead to higher stock prices due to increased future earnings and dividends (Filis, 2010; Jones and Kaul, 1996). Fluctuations in oil prices are typically linked to business cycles, economic conditions, and crises.

The black swan events i.e, pandemics impacted financial markets with similar intensity to the energy market. For instance COVID-19 pandamic affected stock markets through various channels. With the onset of the pandemic led to a significant decline in economic activities, posing substantial challenges to business profitability and operations amid strict measures like lockdowns (Adda, 2016). Additionally, the pandemic-induced economic and financial shocks were global, spreading quickly due to the high interconnectivity of markets facilitated by globalization and financial integration (Chen et al., 2018; Liu et al., 2020). Other channels included panic selling, profit-taking, and the search for safer assets during the pandemic (Lucey and Li, 2015).

Stock markets are one of the crucial elements of an economy for predicting real economic activity. As Harvey (1989) asserts that "equity prices reflect expectations of real activity, and changes in equity values partly reflect reassessments of these expectations." Therefore, market expectations, as illustrated by the = stock prices, can provide insights into growth prospects, especially amid the unprecedented uncertainty of the COVID-19 pandemic (Gormsen and Koijen, 2020). Financial investors tend to exit volatile markets in search of more stable investments during unforeseen crises (Arin et al., 2008).

The aggressive, and widespread implementation of government policies in response to black swan events like COVID-19 pandemic are much stricter and more comprehensive as compared to the policies advised and implemented by governments during previous pandemics like the Spanish Flu and influenza pandemic of 1957-58 . This study

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attempts to assess the impact of impact of policy response on world market during the black swan events i.e., global pandemic in 2020 which further probes the impact of income support policy on stock returns, and energy market. This study further attempts to identify the effect of these stringency policies on financial as well as energy market of Asian economies.

OBJECTIVES

To investigate these issues, the main objectives of the study are:

- To estimate the impacts of government stringency policies on the coronavirus pandemic.
- To examine the effects of government policy responses on financial markets and the energy market in Asian economies.
- To explore the impact of the pandemic on government stringency policies and on financial and energy markets.

RESEARCH CONTRIBUTION

Following the declaration of the Coronavirus epidemic, the aggressive and widespread implementation of government policies in response to COVID-19 has been significantly stricter and more comprehensive compared to the policies implemented during previous pandemics such as the Spanish Flu and the influenza pandemic of 1957-58. This study aims to assess the impact of these policy responses on global markets during the pandemic, focusing on their effects on stock returns, commodity prices, oil prices, and exchange rates. Additionally, the study examines the overall impact of the pandemic on the Asian economy.

This research presents a contribution in the existing literature on oil price and black swan events like COVID-19 outbreak with the government policy responses in several ways. We focus on the impact of stringent measures taken by governments on country-specific data for the Asia-Pacific region. Firstly, we analyze the response of country-specific restrictive measures on stock price returns, exchange rates, and COVID-19 mortality rates. Secondly, we examine the COVID-19 impact mortality rates and stringency measures on changes in oil prices, exchange rates, and stock prices. We estimated these impacts over a 10-month period from March to December 2020, employing a panel Vector Auto Regression (VAR) model. This approach allows us to directly investigate the effect of stringent policy measures and COVID-19 death rates on macroeconomic variables.

Thirdly, this study is a dynamic approach on the effects of COVID-19 and macroeconomic variables, focusing specifically on Asian economies. Fourthly, we generate generalized impulse response functions to analyze the impact of minor changes in policy variables on the variables of concern. Our analysis is based on the Dumitrescu Hurlin panel causality test to check the causal relationships between policy variables and financial variables. Variance decomposition analysis is conducted to explore the impact of policy responses and COVID-19 death rates on oil prices, stock rates, exchange rates, and commodity prices.

This analysis aims to produce policy recommendations for governments, policy-making institutions, and researchers by evaluating the effectiveness of stringent measures in mitigating the pandemic's impact in Asia. Additionally, it provides empirical support for identifying regions where strict measures have been successful and should be considered for future adoption.

ORGANIZATION

This study is organized into five sections. The first section includes the introduction, objectives and contribution of the study. Next chapter reviews the empirical literature and theoretical framework concerning the impacts of black swan events and policy responses on macroeconomic variables. The third section outlines the methodology and data. The fourth section presents the empirical findings and discussion. The last chapter is dedicated to conclusion and policy recommendations.

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LITERATURE REVIEW

There are number of studies which have tried to predict the pandemic dynamics globally i.e. the black swan events in Italy (Remuzzi and Remuzzi 2020; Grasselli et al. 2020; Fanelli and Piazza 2020), and other countries (Zhang et al 2020). Likewise, there has been empirical research on the effects of lockdown which estimated the effect in terms of survival of patients and contamination drop (Lavezzo et al. 2020, Hsiang et al. 2020).

Paul Krugman (2020) remarked, "Let's be clear: we knew or should have known that something like COVID-19 was going to happen," and indeed, it did. The COVID-19 pandemic struck the global economy with unprecedented force. No previous pandemic in the past 120 years caused the kind of daily stock market volatility witnessed in 2020 due to the coronavirus. Unlike earlier infectious disease periods, which saw significant market changes over weeks or months, the COVID-19 pandemic period is notable for its exceptionally high frequency of large daily stock market movements.

Oil prices hit historic lows due to an oversupply during the pandemic. The last significant drop in crude oil prices was during the Gulf War in 1991 (OPEC, 2020a). However, since March 12, 2020, oil prices dramatically fell in response to the pandemic, which caused a significant drop in demand (OPEC, 2020a). Notably, on April 20th, reaching -$37.63 per barrel (Sönnichsen, 2020). The drop in oil demand was primarily due to widespread quarantine measures and restrictions. Additionally, a conflict between OPEC and Russia over crude oil production led to further price instability. Russia refused to cooperate with OPEC's plan to cut production to match declining demand, aiming instead to undercut US shale oil production. Rosneft indicated that reducing production would have allowed US shale oil to capture a larger market share, disadvantaging Russian oil. The lack of agreement between Russia and Saudi Arabia on production cuts exacerbated the crisis (OPEC, 2020b). Consequently, oil prices varied from $150 per barrel in 2014 to $30 per barrel in 2020 (Alkhathlan et al., 2014).

Qing et al. (2020) investogated a spillover effects of COVID-19 on stock markets by employing the daily data from June 1, 2019, to March 16, 2020, focusing on markets in Germany, France, China, Japan, South Korea, Italy, the USA, and Spain. Baker et al. (2020) analyzed the unprecedented effects of COVID-19 on the US stock market, finding that government restrictions on commercial activities and social distancing measures had a severe adverse impact. The study noted that the US stock market was more affected by COVID-19 than by previous health pandemics like the Spanish Flu (1918-1919), Asian Flu (1957-1958), and Hong Kong Flu (1968). Osagie et al. (2020) explored the impact of the pandemic on the stock exchange performance in African countries using the EGARCH estimation technique.

The study also examined the issues of exchange rate depreciation and increased public expenditure to protect public health and support economic activities. Olaniyi (2020) analyzed the socio-economic impact of COVID-19, finding that the pandemic's economic implications were detrimental to both the health and economic sectors, affecting travel, trade, food and agriculture, various markets, and retail chains.

Several studies focused on the effects of lockdowns, estimating their impact on lives saved and reduced contamination (Lavezzo et al., 2020). Casella (2020) compared the strict lockdown measures in China with the more lenient measures in Italy's Lazio region, finding that stringent measures can be useful if implemented early, while mitigation measures are likely to fail. Pedersen et al. (2020) developed an SIQR (Susceptible, Infectious, Quarantined, Recovered) model to estimate the impact of lockdown policies in northern Italy using data up to March 2019. Hence, by the end of March 2020, nearly 100% of the US population lived in areas where state or local authorities had closed educational institutions and dine-in restaurants. Approximately 70% lived in regions with mandatory non-essential business closures, and about 90% were under stay-at-home orders and public gathering bans. Most regions began easing some social distancing requirements by early May (Nguyen et al., 2020), but major restrictions remained in place until early June across the country. Other countries also imposed state-authorized bans and restrictions on social gatherings and dine-in restaurants, though travel bans and restrictions were relaxed by the end of August 2020.

Furthermore, social distancing became a new research focus following the issuance of lockdown and stay-at-home orders. Chiou et al. (2020) and Wright et al. (2020) examined the relationship between income and compliance with social distancing orders. Chiou et al. (2020) found a positive and significant correlation, while Wright et al. (2020) noted that lower-income communities were less likely to comply. Allcott et al. (2020), Barrios (2020), and Painter et al. (2020) found that Republicans in the USA were less likely to observe social distancing. Eventually, Beland et al.

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(2020) used a difference-in-differences technique by utilising the data of US economy, finding that home based orders disproportionately risen up the level of unemployment among younger, less-skilled, less-literate, and immigrant labor.

The black swan events have far reaching effect on oveerall economy and the behaviour of policy makers. For instance during the pandemic of 2020, the governments imposed stringent measures, including partial or full business closures, restrictions on public events, bans on public gatherings, airport restrictions, workplace closures, school closures, public transport closures, stay-at-home requirements, and public awareness activities.

It is interestung to note that following pandemic of 2020, two new variants of COVID-19, SARS-CoV-2, were identified. One was observed in the UK and the other was discovered in South Africa (WHO, 2020). Both variants shared the N501Y mutation but are otherwise different. The most concerning aspect of these variants is their rapid spread and high mortality rate, leading to new lockdowns and stricter movement and travel bans (Kirby, 2021).

Finally, the literature has underestimated the policies and measures which have both direct and indirect effects. The direct effects are due to the particular measures and restrictions implemented and the specific time period during which they are imposed, and indirect effects for which things can be altered and the difference between lockdowns vague, for instance, the announcement effect. Certainly, the spread count of coronavirus depends on the behavior of individuals i.e. keep safe distance from the fellow human beings, avoiding the skin contact, sanitizing hands, which can be amended by the observation and awareness of the pandemic. The announcement and application of restrictive measures both can have a significant effect on these. Since, the restrictions imposed by the government on commercial activities during the coronavirus pandemic are more rigorous, broader in scope, more extensive, and longer in duration as compared to previous measures taken during the prior infectious diseases like Spanish Flu, influenza pandemics etc. However, there is a limited literature on the policies of government in response to COVID-19 and their effects on macro-economic variables. This study attempted to fill this gap and contribute in literature by performing Structural VAR model to analyze the impact of COVID-19 shocks on the number of economic variables and the impact the policy response of government.

MODEL AND METHODOLOGY

Theoretical Framework

COVID-19 pandemic hit the economy like a hurricane and the economy is paralyzed to the level that economists started comparing it with the Great Depression of 1930s and Great Financial Crisis (GFC) of 2008. IMF has anticipated the drop in global economic growth to an abnormal -3% in 2020, while unemployment rate was already topping the history, pointing to the dreadful recession on the way (Gopinath, 2020). Besides, it was believed that this recession might pass over the great recession and great financial crisis and, in fact, it could remind us of the 1930s Great Depression (Canfranc, 2020). With the striking similarity of the intensity of current crises with the last two crises, the impact of the coronavirus is different and intimidating in number of ways, for instance, the recent havoc is not entrenched in any economic origins as compared to the previous crisis, both crisis, GD and the GFC, were the endogenous shocks and the outcome of the issues which were being gathered since long time. Besides, the sudden break out of this crisis with least anticipation made it the big deal by directly impacting the quality of life, health crisis, and its and its simultaneous deep economic scabs to financial as well as real sectors of economy.

Impact on the real economy

Due to the pace and intensity of coronavirus its impact on real economy side have been far more damaging with the potential to turn out even more horrific than the Great Depression of 1930s. The world is going through an exogenous obstruction on the demand as well as the supply sides of economy. Because of the subprime mortgage crisis which leads to the financial crisis of 2007-08, it ended up in the decline in consumer expenditures, which “affected the demand side first” (Strauss, 2020). Besides, even during Great Depression of 1930s the financial bubble was burst by the stock market crash which cause the drain in consumption and investment spending and ultimately caused a reduction in the aggregate demand.

Globalization as a culprit

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In order to fight the coronavirus pandemic, the governments had to commence the measures by reducing the industrial production and output which had the severe consequences. Certainly, it is a crisis of globalization even not having any economic origins. More specifically, "Pandemic is the most seamless example of the type of crises to which global capitalism is predominantly at stake" (Baker, 2020). The new era of globalization era started in the 70s, compelled by technological development, deregulation, and capital liberalization etc as nations began to direct more towards neo-liberalism (Monbiot, 2016). During 1990s, this successively resulted in a spurt in investments and the advent of manufacturing centers in other emerging countries nations (Tooze, 2018). Consequently, the world viewed the beginning of an utterly different period of value supply chain management where the different parts of a product began to manufacture in different countries (Sanyal et al., 2012). Despite the fact there was in fact a great financial movement particularly from Europe to the US in 1920s, which was an additional reason to cause the depression. During the Great financial crisis, it was actually a squirt in the financial globalization that caused 2008 mortgage crisis. Even then the supply chains disruption was not as explicit as present. Besides, we cannot ignore the China's contribution in global economy. Even during the SARs outbreak in 2003 the contribution of Choina to global GDP was approximately 4% (Sengupta, 2020). This figure exceeds 20% now, which makes COVID outbreak originated from China, even more damaging to world economy. (Sengupta, 2020)

Global supply chains disruption

The three nubs of production, exchange and corporate movement are the US, China and the Euroarea and they are interrelated by the flows of trade, organized by complex supply chains globally (Tooze, 2020). Therefore, the hubs and the whole world meticulously fighting the coronavirus and impose the stringent measure, we witnessed the major disruption of supply chains which has global ripple effects. Due to COVID related transportation activities, approximately 75% of global industries companies stated the disruption of supply chain disruptions (in the production, procurement and distribution areas) (Sengupta, 2020). The assembling of different parts, manufactured in abroad, is required for the production of final product (Sengupta, 2020). Hence, any block in the process spontaneously affects all the manufacture and stakeholders involved in making that good around the globe. Furthermore, the bans on travel and transportation, the prices of goods have also shrunken which hit the manufacturers even more severely (World Economic Outlook, 2020).

Demand-side shocks

The real economy is witnessing the demand-side shocks parallel with the supply side shocks, which is eventually a product of damaged globalization. Besides affecting the financial sector, the supply shock affects the demand side as well. As the constraints of producer detain the consumer, a demand shock occurs universally (Strauss, 2020). With the decline in manufacturing process, the industries tend to fire workers to cut down on the cost of production which leads to unemployment. Concurrently the stringency measures imposed by the governments to restrict the movement of people leads to the drastic reduction of aggregate demand for goods and service, lowered purchasing power, and hence unemployment around the world. Moreover, the reduction in investment and bankruptcies happen across the world due to loss of global business confidence. Thus, the concurrent shocks of demand and supply, intensified by the degree of globalization, could lead the real economy to observe a much hazardous global economic fall (around -3%) worse than the 0.1% drop in 2009 Great Financial Crisis and Great Depression if the coronavirus sustain for longer time (Canfranc, 2020; World Economic Outlook, 2020).

Financial economy

Fama (1970) formulated the variant of the Efficient market hypothesis (EMH) which stated that an effective stock market represents all the available economic, industrial and business facts and figures in its stock prices. According to the Efficient market hypothesis, in is weak form, the stock market indicates all trading information i.e. previous prices and volumes. However, the stock market indicates all publicly available information in the semi strong form of efficient market hypothesis. And efficient market hypothesis in its strong form, indicates that stock prices represent all the relevant and significant information including public and private information. Therefore, Efficient market hypothesis in its all variants emphasize that stock prices would represent the available information. Henceforth, likewise the global market has been subject to great instability from the emergence of COVID-19, shown in plunged

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sock price and dropped confidence of investors. Therefore, one of the motivations of this study is to analyze the impacts of COVID-19 quantitatively on the stock market performance country wise as well as globally.

Hence, along with the fall of the real economy, there has been a sharp contraction of the global financial market conditions as well.

Empirical Model

During periods of crisis, such as financial market volatility, instability typically rises sharply and can spread across various markets (Diebold et al., 2012). Therefore, analyzing potential shock spillovers from the onset of COVID-19 can serve as early warning signs about the severity and economic costs of the pandemic.

To investigate this, we employed the pairwise Dumitrescu and Hurlin Panel Causality test (2012) for panel data. Dumitrescu and Hurlin proposed a straightforward Granger (1969) non-causality test designed for heterogeneous panel data models with fixed coefficients. This test examines the null hypothesis, which asserts the absence of homogeneous Granger causality, against the alternative hypothesis, which suggests the presence of causality in at least one cross-sectional unit of the panel. The Dumitrescu and Hurlin causality test can be generally formulated as follows:

$$y_{it} = \alpha_I + \sum^{k}_{k=1} \gamma^{k}_{i} y_{i,t-k} + \sum^{k}_{k=1} \beta^{k}_{i} x_{i,t-k} + \varepsilon_{i,t} \quad \text{..... (1)}$$

where $k \in N^{*}$ and $\beta_i = (\beta^{1}_{i,} \text{.....}, \beta^{2}_{i})$

The Vector Autoregression (VAR) is a statistical model used for estimating the behavior of time series and forecasting (Sim, 1980). The economy's natural response to the economic shocks and the impact of these shocks development of macroeconomic framework is supplemented in the VAR models. This study adapts the VAR model to examine the effects of the current COVID-19 pandemic and the policy measures on the economic variables. The modified form of VAR model of order p is considered as:

$$y_t = B_0 + B_{1yt-1} + \cdots + B_{pyt-p} + \delta_t u_t \text{..... (2)}$$

$$u_t \approx N(0, \sum)$$

Where $y_t$is a $(n \times 1)$ vector of endogenous variables, modeled as a function of a constant term, their lagged values, and $(n \times 1)$ is the vector of forecast errors u_t. In equation (1) y_t, B_0 *and* u_t are $k\ x\ 1$ column vector and B_0, B_1, B_2 ... ... B_p are $k\ x\ k$ matrices of coefficients. Endogenous variables includes change in oil prices (OP), death rate due to COVID, ER is change in exchange rate, CP is change in commodity price (edible and nonedible), SP is stock price return and Stringency action is stringency measures and β_1 to β_5 are the measure of sensitivity of variables.

This study uses a panel VAR model of the form given below in order to analyze the impact of COVID-19 on macroeconomic factors. The pVAR model helps in the short time dimension, therefore helps to render some primary analysis on the announcement effects of coronavirus pandemic. The traditional pVAR model is written as follows, for the analysis of impact of COVID-19 on macroeconomic factors e.g. oil price, commodity price, stringency measures, exchange rate and stock market performance.

$$Y_{it} = [OP_{it}\ ER_{it} SP_{it} Death_{it} Stringency_{it}\ CP_{it}] \quad (3)$$

$$OP_{it} = \sum_{i=1}^{m} \alpha_{11} OPi_t + \sum_{i=1}^{n} \alpha_{12} ER_{it} + \sum_{i=1}^{r} \alpha_{13} Stringency_{it} + \sum_{i=1}^{v} \alpha_{14} SP_{it} + \sum_{i=1}^{w} \alpha_{15} CP_{it} + u_{1it} \quad (2)$$

$$ER_{it} = \sum_{i=1}^{m} \alpha_{21} ER_{it} + \sum_{i=1}^{n} \alpha_{22} OP_{it} + \sum_{i=1}^{r} \alpha_{23} St_{it} + \sum_{i=1}^{v} \alpha_{24} S_{it} + \sum_{i=1}^{w} \alpha_{25} CP_{it} + u_{2it} \quad (4)$$

$$SP_{it} = \sum_{i=1}^{m} \alpha_{31} SP_{it} + \sum_{i=1}^{n} \alpha_{32} OP_{it} + \sum_{i=1}^{r} \alpha_{33} ER_{it} + \sum_{i=1}^{v} \alpha_{34} Stringency_{it} + \sum_{i=1}^{w} \alpha_{35} CP_{it} + u_{3it} \quad (5)$$

$$Stringency_{it} = \sum_{i=1}^{m} \alpha_{41} SP_{it} + \sum_{i=1}^{n} \alpha_{42} OP_{it} + \sum_{i=1}^{r} \alpha_{43} ER_{it} + \sum_{i=1}^{v} \alpha_{44} Stringency_{it} + \sum_{i=1}^{w} \alpha_{45} CP_{it} + u_{4it} \quad (6)$$

$$CP_t = \sum_{i=1}^{m} \alpha_{51} CP_{it} + \sum_{i=1}^{n} \alpha_{52} OP_{it} + \sum_{i=1}^{r} \alpha_{53} ER_{it} + \sum_{i=1}^{v} \alpha_{54} Stringency_{it} + \sum_{i=1}^{w} \alpha_{55} SP_{it} + u_{5it} \quad (7)$$

Where OP is oil price, ER is exchange rate, CP is commodity price, St is stringency, and S is stock market returns and $u_{1t}, u_{2t} u_{3t} u_{4t} u_{5t}$ are the error terms supposed to be uncorrelated with white noise properties N (0, δ).

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Besides, this study attempts to analyze if there is asymmetric impact of COVID and the policies in the response of pandemic on the stock market, exchange rate, oil price and commodity prices. Along with these asymmetric impacts, an emphasis is on the short and long-run impact of these policies.

Data and Sample

This study used the data for Asian pacific countries comprisis of COVID-19 death rates, changes in oil prices, changes in exchange rates, stringency measures taken by each country, changes in commodity prices (both edible and non-edible), and stock price returns. The study covers a ten-month period from the first week of March to the 4th week of December 2020, utilizing daily data (five days a week). The goal is to analyze the COVID-19 effects and stringency measures on the financial markets of Asian economies.

Data for these variables is gathered from Bloomberg, the IMF, the OECD, and the Oxford Coronavirus Government Response Tracker. Depending on data availability, the study focuses on countries in the Asia-Pacific region, including Australia, Bangladesh, China, India, Indonesia, Japan, Kazakhstan, Malaysia, New Zealand, Pakistan, the Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, and Vietnam.

RESULTS AND DISCUSSION

This precise review demonstrates that the extensive, and widespread implementing of government policies against the COVID-19 pandemic in 2020 has been significantly more severe and comprehensive than measures used in previous pandemics and crises. It is unprecedented to impose such stringent measures globally during any past pandemic. These government interventions, combined with deliberate social distancing, have drastically reduced economic activity worldwide. As Baldwin (2020) stated, the coronavirus and stringent control measures have significantly reduced the labor flow to businesses and industries, leading to a sudden and sharp drop in the output of goods and services. Additionally, these control measures have decreased customer flow to businesses, causing a substantial decline in business activity, except for online businesses and delivery services.

To analyze the relationship between these variables in depth, several tests were performed. It is imperative to determine the stationarity of variables in consideration, which is usually performed by analyzing the significant intercept or trend over the course of time. Usually, a unit root test is run on all the variables in order to identify the significance. For this purpose, we performed Levin, Lin & Chu unit root test and check the stationarity of variables. This is considered as most appropriate for panel data as per literature. The outcome of the test, stationarity, and the significance of intercepts and trends are given in the Appendix 1.

Beside verification of presence of unit roots in the variables, literature further encourages to examine the optimal lag length, which is performed by using Akaike Information Criterion (AIC) which choose the maximum lag length. According to the AIC, the optimal lag length is 24 lags, and the corresponding probability values are shown in Appendix 2. After determining the optimal lag length, diagnostic tests were conducted, including tests for normality, heteroscedasticity, and autocorrelation. The p-values indicated that none of these issues were present, as shown in Appendix 3.

Next, a causality test was taken to investigate whether there was a statistically significant relationships amid variables and to determine a direction of these causal relationships. For this purpose, the Dumitrescu-Hurlin test for panel data was used. Null hypothesis of this test states that there is no causal relationship from one variable to another. The relationships between all variables were tested, and results are presented in Table 1.

Table 1: Dumitrescu Hurlin Granger Causality test

No.	Null hypothesis	Decision
1	Death rate does not homogeneously cause stringency action	Reject
2	Stringency action does not homogeneously cause death rate	Reject
3	Stringency action does not homogeneously cause stock price return	Reject

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4	Stringency action does not homogeneously cause exchange rate	Reject
5	Death rate does not homogeneously cause oil price	Reject
6	Death rate does not homogeneously cause edible commodity price	Reject
7	Stringency action does not homogeneously cause oil price	Reject

Only statistically significant relationships are presented here, defined by probability values less than 0.05, indicating rejection of the null hypothesis of no relationship among variables. All tested relationships for the full sample are detailed in Appendix 4.

The first hypothesis in the table above suggests that the death rate from the pandemic significantly influences government responses aimed at restricting social activities. In other words, governments are motivated to take action when faced with high mortality rates due to the pandemic. The rejection of the null hypothesis indicates that mortality rates have a significant impact on government actions.

Similarly, the second hypothesis states that the stringency of government policy measures has a significant impact on reducing death rates in Asia. The table above also highlights significant relationships such as the impact of policy stringency on stock price returns, oil prices, and exchange rates. Changes in the death rate also show significant impacts on oil prices and prices of edible commodities.

Asia & Pacific Region:

The analysis includes 17 Asian economies as mentioned in previous sections. The Dumitrescu-Hurlin panel causality test is applied to these countries to evaluate causal relationships between key variables of interest: changes in stringency measures, death rates, exchange rates, and stock returns. Detailed results of this test can be found in Appendix 4.

Table 2: Dumitrescu Hurlin panel causality test

No.	**Null hypothesis**	**Asia & pacific**
1	Stringency action does not homogeneously cause mortality/ death rate	Reject
3	Exchange rate does not homogeneously cause stock price return	Reject
4	Stringency action does not homogeneously cause stock price return	-

There are two significant relationships for Asia-Pacific illustrated by causality test. First, the variation in the government stringency actions effect the mortality rate in Asia & Pacific. Second, the casula nexus between government stringency actions and stock returns. Wheres, there is no significant causal relation is found from changes in stringency measures to death rates in Asia-Pacific. Moreover, the changes in exchange rate significantly influemce the stock returns. These outcomes are in line with the previous studies which illustrate that any fluctuations in exchange rates may affect stock prices (Narayan et al., 2020; Liu, 2020; Wong, 2017).

In order to analyze the casual effect of these variables further, the impulse response functions (IRFs) are shown. The IRFs indicate the pattern of change of variables of interest in response to minor external changes, for instance the government stringency measures or pandemic-induced death rates. The IRFs for these significant relationships in Asia-Pacific are presented below.

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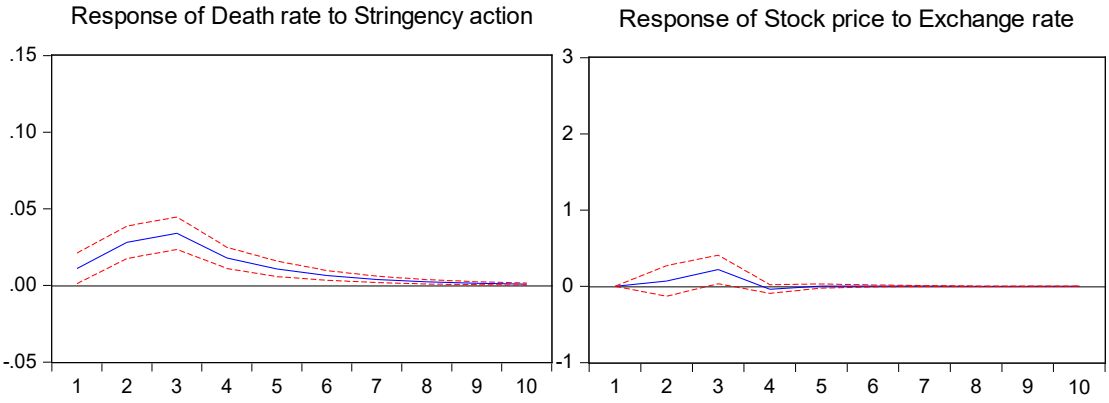
Figure 1: Impulse response function (Asia & pacific)



The nexus between stringency actions and death rates is illustrated by the above graphs. The impulse response functions (IRFs) validate that a one standard deviation shock to stringency actions initially causes an increase in death rates. In the Asia-Pacific region, the results indicate that death rates rise initially but begin to decrease after approximately five days. This delayed response could be attributed to factors such as implementation delays announced by governments or initial deaths among already infected populations.

In order to analyze the overall intensity of impact of this variable, the coefficients of the Vector Autoregression (VAR) model are shown below.

Table 3: Results of VAR (Asia & pacific)

Asia & pacific	**Death rate**	**Stock return**
Stringency action	0.2	-
	[5.16]	
Exchange rate	-	0.08
		[3.68]
	[5.07]	[-2.57]

The above table illustrates the impact of changes in stringency measures on death rates and it indicates a positive effect. Moreover, the change in exchange rate positively effects the stock prices of Asia and Pacific, however stringency measures show a negative yet significant impact on stock returns for Asian economies. The results are in line with previous findings (Zaremba et al., 2020).

The below table number 4 illustrates the variance decomposition of the given variables which investigates the percentage of the change in death rates and stock returns is carried out by the variation in stringency measures and exchange rates.

Table 4: Variance decomposition matrix (Asia & pacific)

Asia & pacific	**Variance Decomposition of Death rate**			
Period	**Stringency action**	**Death rate**	**Stock price**	**Exchange rate**
1	0.83	99.17	0.01	0.03
5	10.18	83.30	3.04	3.48
10	10.35	82.94	3.12	3.58
Variance Decomposition of Stock return				

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Period	Stringency action	Death rate	Stock price	Exchange rate
1	0.11	0.06	99.83	1.02
5	0.20	0.29	98.72	0.79
10	0.21	0.29	98.71	0.79
South Asia	Variance Decomposition of Death rate			
Period	Stringency action	Death rate	Stock price	Exchange rate
1	0.72	99.28	0.00	0.00
5	13.12	84.05	1.48	1.35
10	17.35	79.00	2.38	1.28
Variance Decomposition of Stock return				
Period	Stringency action	Death rate	Stock price	Exchange rate
1	0.99	1.65	97.35	0.00
5	1.46	2.57	95.69	0.28
10	1.48	2.61	95.63	0.28

The above table characterized the stringency measures taken by the corresponding governments as a key factor of variation of death rates in Asian countries. Contrary to thus the fluctuations in stock returns in these countries are primarily expounded by its own dynamics instead of any other factor or variable.

CONCLUSION AND POLICY RECOMMENDATIONS

This study has highlighted the unparalleled effect of the black swan events by taking COVID-19 pandemic as a proxy and illustrated the unprecedented responses implemented by economies worldwide. Unlike historical pandemics, the COVID-19 struck the global economy with unparalleled intensity. Comparing COVID-19 with past pandemics suggests that the extraordinary economic responses to COVID-19 cannot be solely attributed to the virulence of the virus itself.

The death toll from COVID-19 could have been significantly higher if governments had adopted a more hands-off approach similar to past pandemics. This study underscores the effect of government restrictions for COVID-19 response, such as bans on social gatherings, public events, and voluntary social distancing, which have significantly affected service-oriented economies. Stringency measures imposed by governments during the pandemic have taken various forms, including international travel restrictions, closure of educational institutions, shutdowns of non-essential businesses, restrictions on public gatherings, and mandates for mask-wearing and social distancing.

Our findings indicate that the pandemic has varied in its impact across different markets. Edible and non-edible commodity prices have been more affected compared to changes in oil prices and exchange rates. In contrast, stock price returns are relatively explained by government policy responses. Thus, policy actions have played a key role in combating the spread of the pandemic's impact on stock prices, exchange rates, and oil prices. However, these measures have been less effective in limiting the effects on commodity prices.

This study provides a rationale for the stringent measures imposed to combat the COVID-19 pandemic, focusing on health justifications for measures like social distancing mandates, travel restrictions, and business closures. While these restrictive measures have been essential for public health, they have also inflicted significant economic damage. There is a critical need to address the health challenges posed by the pandemic while exploring less economically suppressive control measures and policies (Ichino, 2020; Fujita, 2020; Cochrane, 2020; Monras, 2020; Dewatripont et al., 2020).

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APPENDICES

Appendix 1: Levin, Lin & Chu unit root test

Variable	Asia & pacific
Stringency index	I(0) Intercept Trend
Death rate	I(0) Intercept Trend
Stock price	I(0) No intercept No trend
Exchange rate	I(0) No intercept No trend
Commodity price (edible)	I(0) No intercept

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	No trend
Commodity price (non-edible)	I(0) Intercept No trend

Appendix 2: the Lag length criteria

No. of lags	FPE	AIC	SC	HQ
24	0.00022	2.931	3.970	3.239

Appendix 3: Diagnostic test

White test (cross terms)	Normality test (Jarque Berra)	Autocorrelation (LM test)
0.0826	0.2180	0.0941

Appendix 4: causality test name: Dumitrescu Hurlin Panel

No.	Null hypothesis	Decision
1	Death rate does not homogeneously cause stringency action	Reject
2	Stringency action does not homogeneously cause death rate	Reject
3	Stock price return does not homogeneously cause stringency action	Accept
4	Stringency action does not homogeneously cause stock price return	Reject
5	Stringency action does not homogeneously cause exchange rate	Accept
6	Exchange rate does not homogeneously cause stringency action	Accept
7	Stringency action does not homogeneously cause exchange rate	Reject
8	Exchange rate does not homogeneously cause stock price return	Accept
9	Stock price return does not homogeneously cause exchange rate	Accept
10	Death rate does not homogeneously cause oil price change	Reject
11	Death rate does not homogeneously cause edible commodity price change	Reject
12	Death rate does not homogeneously cause non-edible commodity price change	Accept
13	Stringency action does not homogeneously cause oil price change	Reject
14	Stringency action does not homogeneously cause edible commodity price change	Accept
15	Stringency action does not homogeneously cause non-edible commodity price change	Accept