COVID-19 pandemic: measuring stock indices correlation between different countries

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Abstract. The study's goal is to assess cross-country stock correlation during the 2019 global corona-virus outbreak. The paper uses vector autoregression model (VAR) for analysis of correlation between 6 countries stock indices. This paper investigates international stock return correlations between 6 countries, China, the U.S., France, Germany, the U.K and Japan. Estimate correlations are modeled in EViews 9 to evaluate that based on Covid-19 whether the stock markets in different countries can affect each other. Results show that changes in one of the endogenous variables cause fluctuations in the other variables. COVID 19 produced some shocks to the representative index returns of the six countries mentioned above. Also after analysis using the impulse function, there is areas of strength for a relationship between's the list return instability of the six nations, i.e. stock market volatility in each country affects other countries to a greater or lesser extent during special events, providing an idea for improving the current situation of financial markets in each country. Therefore, governments need to consider the stock market situation in other countries in order to take effective action to prevent stock markets from being affected by Covid-19.

Keywords: COVID 19; stock; correlation; VAR.

1. Introduction

Stock market correlations have been a hot topic in the financial world. Empirical studies on cross-country stock market correlations are important for financial globalization as they have important implications on how to stabilize financial markets in times of epidemic volatility. Return volatility and correlations are known to fluctuate in turbulent times. Given the unique nature of this health and financial double layer of volatility, COVID provides an attractive research environment in which to study the correlation of stock markets between different countries in particular periods. Besides, because the impact of the new crown epidemic has spread around the world, countries have taken measures such as lockdowns, which have had a great impact on financial markets. Introducing the new crown epidemic as a factor, stock indices of representative financial markets around the world were selected for research. Stock market correlation is the concept that, depending on the magnitude of the effect, when one stock market varies, other stock markets are also affected, sometimes in the same direction and sometimes in the other direction. The prevailing explanation for stock market correlation is the theory of financial market contagion.

The estimates chosen between October 2019 and the present are realistic and can help us achieve an effective result because COVID outbreaks start in 2020. We chose China, the U.S., France, the U.K., Japan, and Germany as our research subjects because they have the world's highest levels of economic development. Return relationships are at first determined for six securities exchange lists, including the SSCE for China, the S&P 500 for the US, the FTSE 100 for the Unified Realm, the CAC 40 for France, the N225 for Japan, and the DAX 30 for Germany for the time after October 2019.The paper uses vector auto-regression model (VAR) for analysis of correlation between 6 countries stock indices.

Main findings are summarizes as follows. First, stock returns in these 6 countries experienced the same trends, significant decline after the outbreak. Secondly, using Eviews we can find that there are correlations between different countries during the COVID.

2. Literature Review

It plans to break down the connection of gold, swapping scale, and CSPI on Coronavirus pandemic periods by testing the impact of gold trade costs and conversion standard on CSPI and stock unpredictability [1]. The connection among oil and the US securities exchange has been explored and found that it has changed after the beginning of Coronavirus emergency [2]. Examine the unique connections among six worldwide financial exchange lists and their relationship to expansion vacillation and market unpredictability [3]. To this end, research the unique contingent connection and the lopsided effects of shocks on the relationship has been explored between the US and Chinese financial exchanges previously and during the Coronavirus emergency [4]. The methodology includes a one of a kind group (holographic) assessment of stock-Record relationships, layered stock connections (with the File going about as an additional phantom stock), and uncovered stock connections (after deduction of the Record get back from the stocks returns) [5]. The object is to quantify crosscountry securities exchange relationship and instability transmission during the worldwide coronaviruscorona infection illness 2019 (Coronavirus) pandemic [6]. The results of the normal correlation analysis of the equity indices had shown that the market moves together [7]. Except for the US financial exchange (DJI) and the gold market, most of return series show solid unpredictability industriousness with a worth more prominent than 0.80. The restrictive relationship emphatically increments following the Coronavirus declaration in a few pairings of monetary business sectors, showing the disease impacts among these business sectors all through the new Coronavirus months. Analyze the level of disease impacts when Coronavirus.[8]. The relationship has been attempted between the volatilities of the energy list, especially during the Coronavirus crisis [9]. The global mortality rate of the COVID'19 has been reported, its geospatial and temporal analysis, and an empirical assessment of the impact of social distance policies on economic activity has been evaluated. Report the worldwide death pace of the COVID'19, its geospatial and fleeting investigation, and an experimental appraisal of the effect of social distance strategies on financial movement.[10]. The connection between the securities exchanges of arising has been investigated and economies and the trepidation set off by the Coronavirus pandemic emergency has created in a period that ranges from mid-January 2020 to mid-February 2022[11]. Other influential work includes (Guo et. al., 2020) [12].

3. Data and methodology

3.1. Data

The selection period is from October 28, 2019 to October 28, 2022. Stock index data were selected from six main stock indices in the following places: SSCE for China (R1), S&P 500 for U.S (R2)., FTSE 100 for U.K., CAC 40 for France, N225 for Japan and DAX 30 for Germany could be chosen. The following formula was used to transform the daily index data into daily returns for the VAR analysis.:

$$y_t = 100\log\left(\frac{r_t}{r_{t-1}}\right) \quad (1)$$

And then we gain six time series graphs of daily returns (shown in Figure 1): SSCE(R1) S&P500(R2) CAD40(R3) N225(R4) DAX(R5) FTSE100(R6).

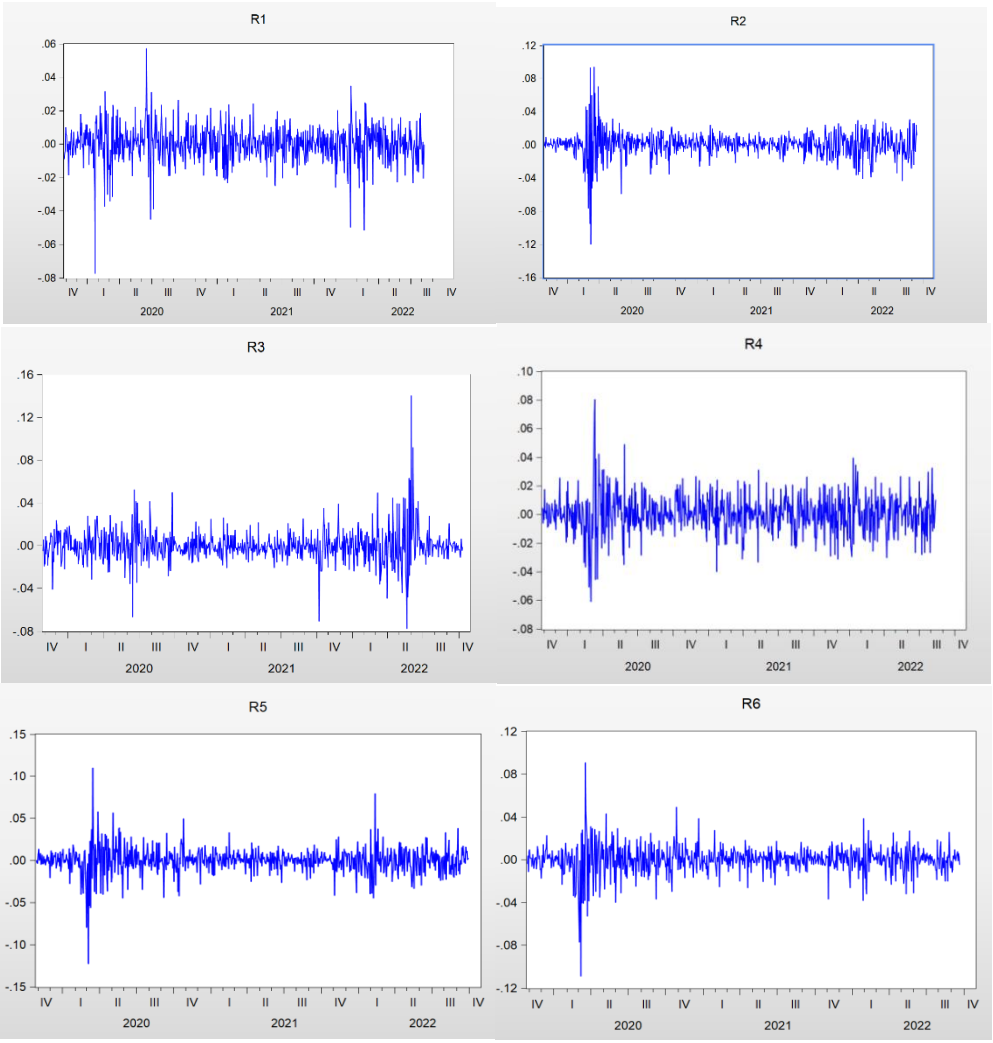

Fig 1. Daily returns

Source: 51iFind [14]

3.2. Formal test

3.2.1 Stationary test of sequences

To avoid bias caused by random disturbance terms, we use ADF (augment Dickey-Fuller test) to assess the stability of the time series. From the test results, the values of the t-test statistics for the index returns of the six countries are smaller than the corresponding critical values at the 1%, 5% and 10% significance levels, indicating that the time series has a unit root.

3.2.2 Granger causality test

A common econometrics issue in economic analysis is figuring out is whether one variable is the reason for changes in another variable. The renowned causal relationship test was developed by Granger, who was awarded the 2003 Nobel Prize in Economics, and is used to examine the causative linkages between economic variables across time.

Utilizing this system, we find that there is a causal connection between's the securities exchange yields in the six nations.

3.3. VAR model

3.3.1 Determine the optimal lag order

The ideal slack request of the VAR not set in stone as per the request with the most "*", so the slack request of the VAR model is at last chosen as 7, that is, VAR (7):

$$R_t = \Gamma_0 + \Gamma_1 R_{t-1} + \Gamma_2 R_{t-2} + \cdots + \Gamma_7 R_{t-7} + \varepsilon_t \quad (2)$$

Table 1. lag order

Lag	LogL	LR	FPE	AIC	SC	HQ
0	12310.34	NA	4.77E-23	-34.36967	-34.33134	-34.35487
1	12369.5	117.1572	4.47E-23	-34.43435	-34.16606	-34.33075
2	12571.71	397.0831	2.81E-23	-34.89864	-34.40039*	-34.70623*
3	12609.64	73.84053	2.8E-23	-34.90402	-34.17581	-34.62282
4	12656.71	90.85201	2.71E-23	-34.93494	-33.97676	-34.56493
5	12694.12	71.57877	2.7E-23	-34.93887	-33.75074	-34.48007
6	12748.71	103.5453	2.56E-23	-34.99081	-33.57272	-34.44321
7	12795.77	88.46249	2.49e-23*	-35.02170*	-33.37364	-34.38529
8	12831.7	66.95486	2.49E-23	-35.02152	-33.1435	-34.29632
9	12849.36	32.60006	2.62E-23	-34.97028	-32.8623	-34.15628
10	12881.23	58.31488*	2.65E-23	-34.95875	-32.62081	-34.05595

3.3.2 VAR model stationarity test

The VAR model must be made stable before the impulse response analysis can be carried out, and only if the model is stable can the subsequent analysis be carried out. We determine the stability of this model by analyzing the AR plot.

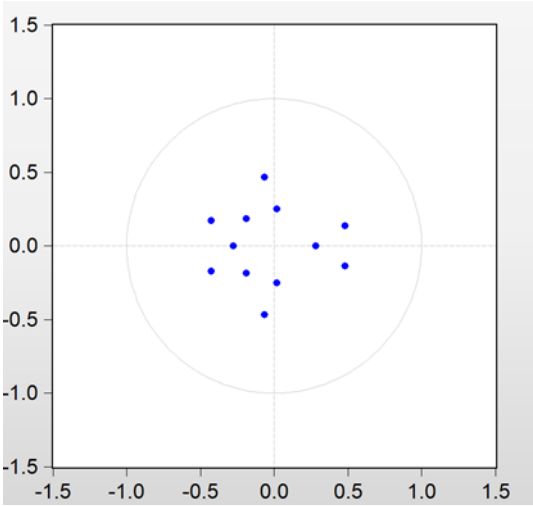

Fig 2. Inverse Roots of AR Characteristic Polynomial

The VAR model must be stationary before the impulse effect analysis can be performed, as shown in the figure 2, the root of the characteristic polynomials of the VAR model is less than 1 and all are in the unit circle, indicating that the estimated VAR model satisfies the stationarity condition.

3.3.3 Impulse response analysis

As VAR models reflect dynamic change connections between factors, when a shock is applied to an irregular aggravation term (otherwise called another interest) of an endogenous variable in a VAR model, there will undoubtedly be an effect on the flow and future upsides of all endogenous factors in the whole VAR framework. Using the impulse response function it is possible to analyse the dynamic impact on the system when the VAR model receives a shock of some kind. When the vector autoregressive process is smooth, the magnitude of the impulse response function decays over time until it disappears:

$$\lim_{s\to\infty}\left(\frac{\partial R_{i,t+s}}{\partial \varepsilon_{jt}}\right) = 0 \;\; i,j = 1,2,\cdots,k \quad (3)$$

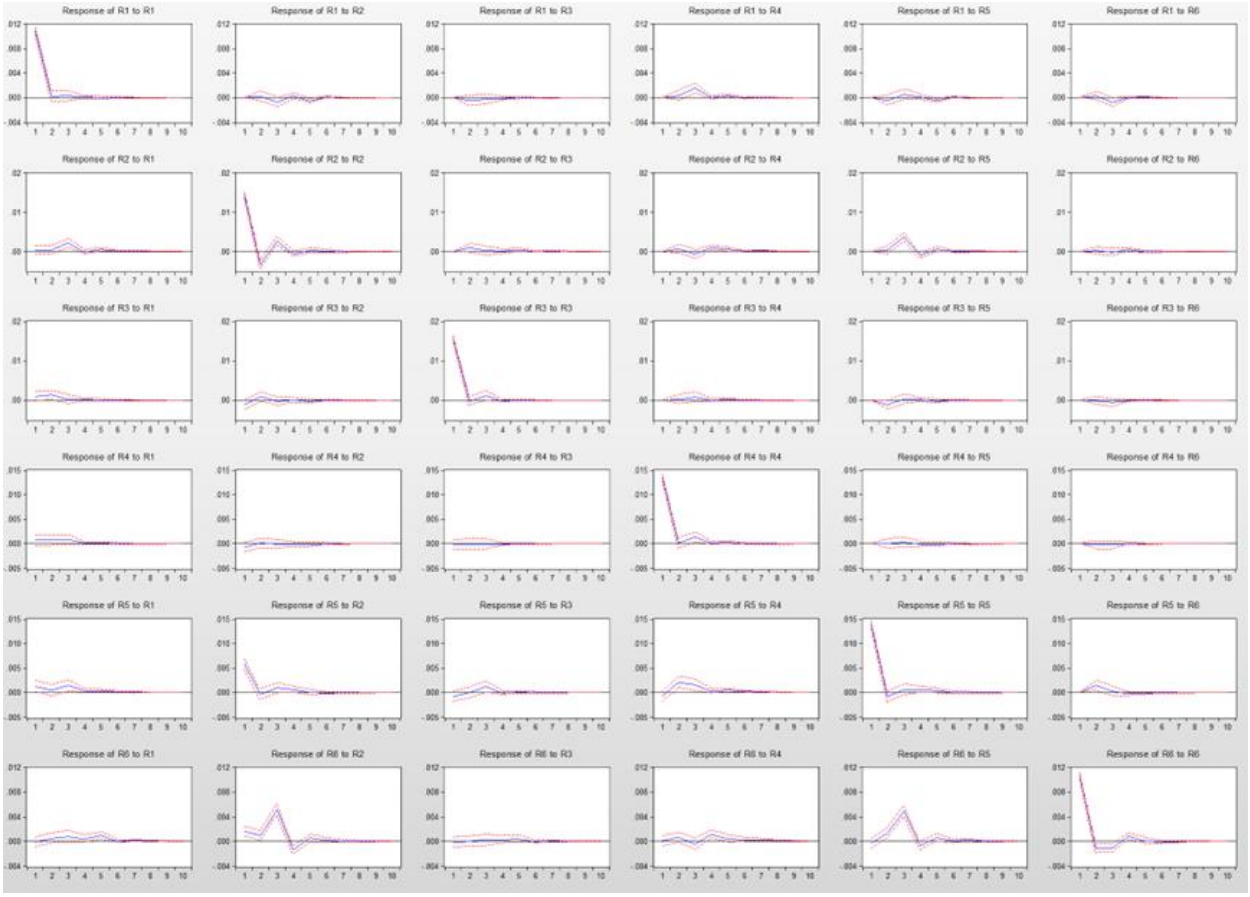

Fig 3. Impulse Response Group Diagram

We choose “Multiple Graphs”and “Choleskey-dof adjusted” to do orthogonal analysis.

Analysis with R1 as an example: The response of R1 to a standard deviation shock of its own gradually decreases in periods 1-3 and then oscillates substantially, reaching a high point (8.79) in period 8; the response of R1 to a standard deviation shock of R2 decreases in a broad trend in periods 1-4 and then oscillates around 0; the response of R1 to a standard deviation shock of R3 is negative in periods 2-10, implying that the decrease in China stock index returns has a dampening effect on The response of R1 to a standard deviation shock of R4 increases slightly and gradually in periods 1-3 and is almost negative in periods 2-10, implying that the decrease in Chinese stock index returns has a dampening effect on the volatility of German stock index returns; the response of R1 to a standard deviation shock of R5 fluctuates slightly around 0 in periods 1-6, is negative in periods 7-8 and oscillates around 0 in periods 9-10. periods, negative in periods 7-8 and gradually recovering in periods 9-10; the response of R1 to a one standard deviation shock to R6 fluctuates slightly in periods 1-5, but there is a peak (4.15) in period 4 during which more pronounced fluctuations occur subsequently.

As can be seen from the Figure 3, the economic shocks during the epidemic have a positive impact effect in all five countries at the time of the epidemic, i.e. when China is affected by the change in returns by the epidemic, the rest of the countries' returns are affected to some extent. Again, this effect is more pronounced at the beginning of the epidemic (i.e. where the graph fluctuates), and as the epidemic is controlled as well as slowed down, the impact of the shock diminishes and gradually tends to zero, indicating that the country's share price returns are less affected by the other countries.

3.3.4 Analysis of variance decomposition

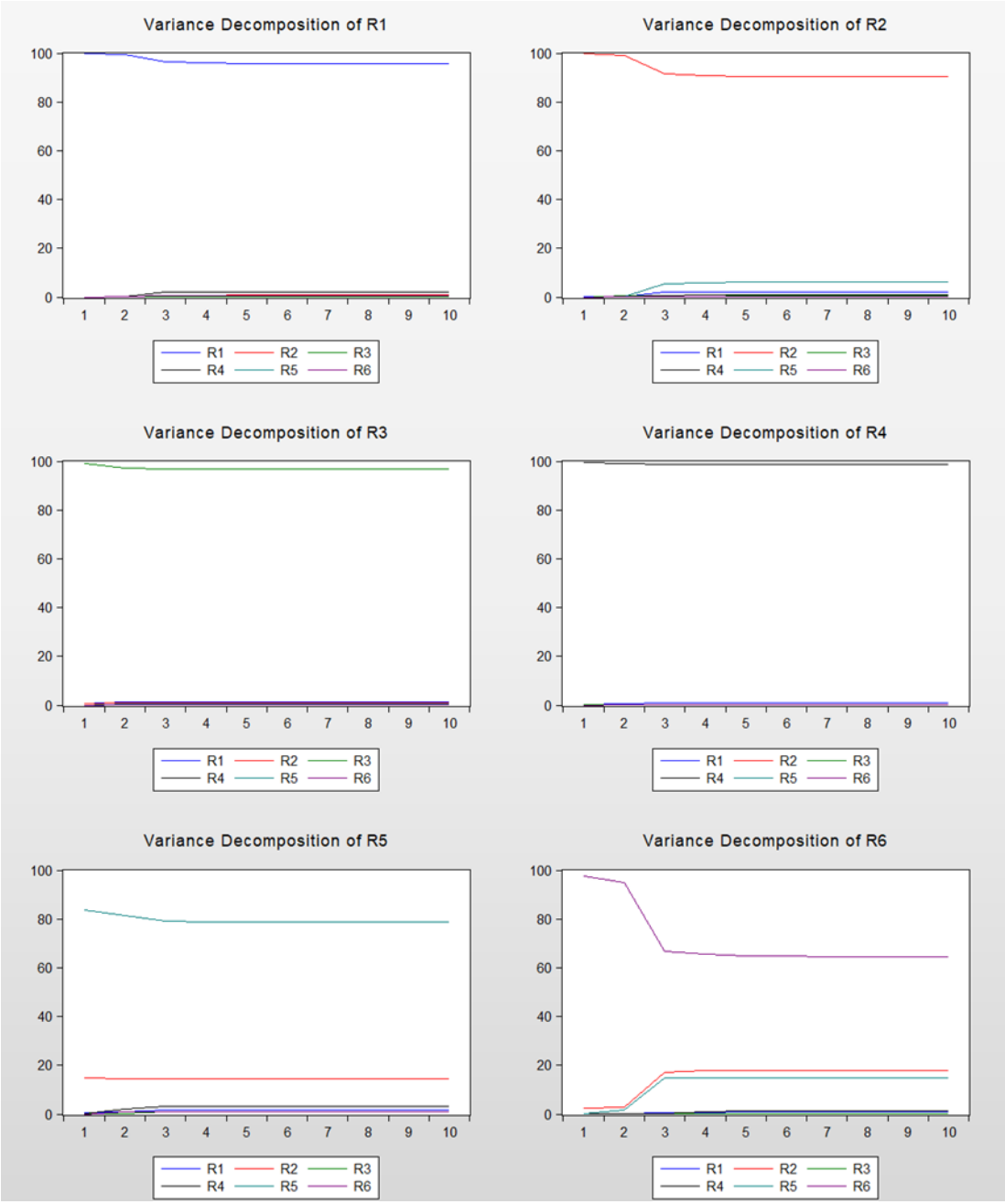

Fig 4. Variance Decomposition

Analysis of variance is used to measure the relative importance of the impact of each endogenous variable's disturbance or shock on each endogenous variable in the VAR model system.

As can be seen from the table, the largest factors affecting the returns of the national stock indices are all the effects of the national lags. Meanwhile other countries contributed more to China, the US, Japan and the UK, i.e. during the epidemic, other countries had a larger impact on these four countries; conversely, during the epidemic, other countries had a smaller impact on Germany and France.

4. Conclusion

In the time of monetary globalization, the connection between the monetary business sectors of different nations is connected with a specific degree. At the point when the pestilence happens, as well as controlling the scourge through clinical means and government strategies to relieve the effect of the plague on the monetary market, it is likewise conceivable to change the monetary market in

time by focusing on the progressions in the arrangements of different nations; The world economy has been seriously impacted by the pandemic, and the world ought to cooperate to control the plague and endeavor to advance typical and feasible financial turn of events.

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