Evaluation of transmission effects of the COVID-19 shock on major Asian stock markets

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Abstract: This paper aims to evaluate the spillover effect of the COVID-19 shock on major global stock markets, including Shanghai, Hong Kong, Japan's Nikkei, Korea, and Nasdaq stock markets, using daily data of stock prices during the beginning of the pandemic outbreak (December 2019–May 2020). Our findings indicate while shocks on some of these markets have a long-term impact, they are of short-term effect on other markets in the group. Impulse response function analysis indicate, the pandemic shock on Japan and Shanghai stock markets caused persistent effects on the Hong Kong stock market, but the shock on the Nasdaq stock market caused a transitory short-term effect on the Hong Kong stock market. The pandemic shock on Hong Kong, Japan, and Nasdaq stock markets caused a persistent impact on the Korean stock market, but transitory effects were evidenced on Shanghai and Nasdaq stock markets from the transmission of shocks on the other markets in the group.

Keywords: COVID-19; impulse response effect; Asia; stock markets.

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1 Introduction

The fast spread of the coronavirus (COVID-19), in about 120 countries by the first three weeks after the official announcement of the pandemic outbreak have raised havoc and fear around the globe and disrupted the world capital markets and airline activities. Due to uncertainty that prevailed about the control of the disease spread stock markets in the major world economies incurred losses of trillions of US dollars in the last weak of February 2019, which was viewed as the worst week for financial markets since the

global financial crisis in 2008. The same week China's Shenzhen stocks incurred significant losses, followed by Nikkei 225, and then Hong Kong's Hang Seng. As a response to the initial downfall of stock market indexes, government in these countries adopted stimulus measures that helped temporarily to rebound and gain earnings in some of these markets. Government's responses to the imminent economic crisis due to pandemic spread have taken different directions. While Bank of Japan, Bank of England, and the European Central bank have announced readiness to respond to the negative impact of the pandemic shock via financial stimulus, the US Federal Reserve bank cut the interest rate to 1%, and the Chinese Government endorsed 500 billion yuan ($71 billion) low interest rate loans to small-scale business units affected by the negative impact of the pandemic. Despite all these efforts by the governments of the countries mentioned, financial markets continued their slide down as the virus spread news became rampant and fearful.

The major problem facing the global economy due to the consequences of the epidemic, is that it is difficult to envisage complete containment of the virus outbreak despite globally adopted policy of social distancing. The production time for approved and effective coronavirus vaccine is estimated to be not less than 18 months, which by then the global economy already plunged into a deep recession. The International Monetary Fund disclosed that the pandemic was already driving the global economy into recession, urging countries to respond with 'very massive' spending to avoid dipping into recession that may cause debt defaults of emerging markets. As a response to the IMF call, policymakers in major economies including Asia announced massive fiscal and monetary measures that aim to stimulate their economies, but these measures are characterised as short-term measures that mitigate immediate damages to corporate funding to avoid looming credit crises.

It is well known that the transmission of exogenous shocks to the real economy is via capital markets. As stock markets fall and household wealth shrink, household savings increases and consumption fall, which lead into economic downturn. This effect can be very strong in economies where households are highly exposed to equity assets' volatility. COVID-19 seems to be a potentially powerful direct hit on household confidence, as they become pessimistic about the longer term.

The initial purpose of this paper to estimate the impact of the COVID-19 pandemic outbreak on major global stock markets, including the Shanghai Composite, Hong Kong's Hang Seng Index, Nikkei 225, Korean KOSPI, and Nasdaq stock market. The interactive association between these markets is important for investors as well as for policy-makers in these countries. The increasing departure of stock prices from their fundamental drivers, that is the common economic bonds linking these markets, implies an increased risk for investors in these stocks. The results in this paper can help us understand how these markets can react to common shocks that hit the global economies, and also help to indicate diversion of these markets from joint long-term trend or shared common cyclical path, can make these markets fundamentally weak and speculatively strong. The results in this paper can help us comprehend the magnitude and scale of a future pandemic crisis on major Asian capital markets.

2 Literature review

As to date, there are a few published studies available on the impact of the COVID-19 pandemic on capital markets, but more recently some researchers investigated the impact of the pandemic on the US economy. Dingel and Neiman (2020) study the feasibility of working at home for all occupations, to find out that 34% of US jobs, can be performed at home. On the other hand, Koren and Pető (2020) investigate the reliance of US businesses on human interaction, based on industry type and geographic location. Similarly, Leibovici et al. (2020) search the extent to which the pandemic shock can impact contact-intensive industries and its spillover effects on the rest of the economy. Their findings indicate that a 51% drop in the demand for goods and services from contact-intensive industries generates a 13% drop in the gross output of low-contact intensive industries and a 24% drop in gross domestic product. In a more comprehensive research project, Jordà et al. (2020) investigate rates of return on assets using a large set of data on 15 major pandemics in the past century where more than 100,000 people died. Their findings indicate significant macroeconomic effects of the pandemics spillover persist for several years after the shock with real rates of return significantly declined. A study by Hai and Riyana (2021) show *evidence of herding behaviours in Asian and Southeast Asian stock markets during the outbreak of COVID-19, which reveal stronger co-integration of markets during the start of the pandemic, compared to the periods before and later in the pandemic*. Ludvigson et al. (2020) employed VAR specification to estimate the cost of the COVID-19 pandemic for the next few months, while Cochrane (2020) investigates if the recovery from the COVID-19 shock will be U, V or L shaped. He et al. (2020) indicated evidence of direct and indirect effects of COVID-19 on major stock markets in Asia, Europe, and the USA. Their findings show that COVID-19 has a negative short-term impact on stock markets of affected countries, and bidirectional effects between Asian countries and European and American countries. Straub and Ulbricht (2013) and Van Nieuwerburgh and Veldkamp (2006) show a negative non-pandemic short-term shock to output raises uncertainty which in turn lowers output level, and that in turn creates more uncertainty. Fajgelbaum et al. (2014) combine this mechanism with an irreversible investment cost, to show a long-term impact of transitory shocks on output.

The current paper extends the existing literature on the spillover effect of COVID-19 on cross-country stock markets to investigate persistence versus the transitory impact of COVID-19 shock on major Asian and the USA stock markets.

3 Data and methodology

To estimate the impact of COVID-19 pandemic on stock markets in China, Japan, the USA and Korea, the current paper employs the impulse response and variance decomposition approach, on daily closing stock prices of the five stock markets: Shanghai (SSE Composite Index), Hong Kong (Hang Seng Index), the Korean (KOSPI Composite Index), the Japanese Nikkei 225, and NASDAQ composite index. The sample period covers from May-20-2019 to November-29-2019 (pre-COVID period) and from December-2-2019 to May-18-2020 (during COVID period), covering a sample of 120 observations for each sub-period.[1]

Impulse response, together with variance decomposition evaluates the impact of shocks transmission across interdependent capital markets. To highlight briefly the impulse response function consider the following VAR process:

$$y_t = A_0 + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_k y_{t-k} + u_t \tag{1}$$

where y_t is $n \times 1$ vector of variables, A_0 is an $n \times 1$ vector of intercept, A_t ($t = 1, \ldots, k$) are $n \times n$ matrices of coefficients, u_t is an n dimensional vector of white noise processes. For simplification purposes exogenous variables other than lagged y_t are omitted in the following specifications. VAR process of equation (1) above can be shown to have a moving average (MA) representation as follows:

$$y_t = C + u_t + \varnothing_1 u_{t-1} + \varnothing_2 u_{t-2} + \cdots \tag{2}$$

where $C = E(y_t) = (I - A_1 - \cdots - A_k)^{-1} A_0$ and $\varnothing_t$ can be computed from A_t recursively $\varnothing_t = A_1 \varnothing_{t-1} + A_2 \varnothing_{t-2} + \cdots A_k \varnothing_{t-k}$, $t = 1, 2, \ldots$ and $\varnothing_0 = I$ and $\varnothing_t = 0$ for $t < 0$.

The MA coefficients in equation (2), examine the interdependence between variables, or the impulse response function of the i^{th} variable to a shock t periods. For instance, the ij^{th} element of $\varnothing_k$ is the impulse response of the i^{th} variable to a shock t periods ago in the j^{th} variable, given that the effect is isolated from the influence of other shocks in the system. So, important issue related to impulse response function is isolation of the effect of a shock on specific variable from the influence of all other shocks, which is obtained thorough orthogonalisation, which is a transformation of the residuals with zero diagonal elements in the covariance matrix (for more details on this issue, see Peijie, 2009).

4 Empirical analysis

Descriptive summary statistics in Table 1 show the behaviour of daily stock returns, calculated as the change in closing price, for the five stock markets before the pandemic shock during the period from May-20-2019 to November-29-2019, and during the pandemic outbreak from December-2-2019 to May-18-2020. The mean return statistics, before and after the shock, reflect the impact of the COVID-19 pandemic on stock markets, indicating that the three markets incurred losses (negative returns) during the pandemic are Hong Kong (–17.13), Japan (–25.80), and Korea (–0.92) stock markets, whereas Shanghai and Nasdaq stock markets show positive mean returns of 0.189 and 5.14, respectively. The paired t-test results reveal there is no significant statistical difference between the stock returns in the five markets before the start of the pandemic and the period during the pandemic. Volatility measures of standard deviation indicate, during the pandemic outbreak volatility of all five markets decreased substantially compared to volatility before the pandemic announcement. The variance ratio test results show volatility of stock returns in the five markets differ significantly during the pandemic shock as compared to volatility before the pandemic period. Skewness statistics reveal that all five markets, except Japan stock market, were trending towards losses during the pandemic period. The range statistic indicates among the five markets, the least volatile during the pandemic outbreak was the Shanghai stock market, whereas the markets with the highest variation of stock returns are Hong Kong, Japan, and Korea stock markets. The range statistic also indicates the pandemic shock generated higher variability of stock returns, compared to the pre-shock period. Shanghai stocks return

variability jumped from 150 to 320 points at the post-crisis period, and for the Hong Kong market, variability was much higher, as it jumped from 1,762 to 2,203 points, and for Japan, from 907 to 2.582 which is the highest range in all five markets. In general, these results indicate evidence of a significant shock effect of COVID-19 on these stock markets. An important question we need to investigate in the following analysis is the degree of persistence of the effect of the shock.

Table 1 Descriptive statistic of daily price change

	Shanghai	*Hong Kong*	*Japan*	*Korea*	*Nasdaq*
Mean (1)	0.189	–17.13	–25.80	–0.92	5.14
Mean (2)	–0.10	–6.52	20.05	0.01	6.02
T-test (paired)	–0.06	0.25	1.14	0.24	0.04
p-value	(0.94)	(0.80)	(0.25)	(0.80)	(0.96)
Std. dev. (1)	3.55	36.81	35.27	3.45	20.47
Std. dev. (2)	2.14	25.03	15.6	1.50	7.08
p-value (3)	(0.000)*	(0.000)*	(0.000)*	(0.000)*	(0.000)*
Skewness (1)	–2.04	–0.44	0.25	–0.17	–0.77
Skewness (2)	–0.07	0.14	–0.16	–0.55	–0.80
Min. (1)	–229.92	–108.94	–1,128.58	–133.56	–970.29
Min. (2)	–77.69	–767.26	–453.83	–51.15	–278.03
Max. (1)	90.6	1,095.9	1,454.3	127.51	673.08
Max. (2)	69.3	995.38	454.05	39.72	176
Range (1)	320	2,203	2,582	260	1,643
Range (2)	147	1,762	907	90	472

Notes: (1) = During the pandemic crisis period.
(2) = Before pandemic crisis period.
(3) = H0: variance ratio = 1.
*Significant at 1% significance level.

Source: Stock prices data collected from Major World Indices – Yahoo Finance

Results of COVID-19 shock persistence included in Tables 2–6 reveal while the shock on some of these markets display a short-term effect, but on other markets have a persistent longer period impact. As indicated in Table 2, during the COVID-19 pandemic outbreak, Hong Kong stock market price behaviour was influenced by lagged own price changes, as well as shocks originated from Japan and Shanghai stock markets that caused a significant persistent impact. However, the influence of the COVID-19 shock on the Nasdaq stock market transmitted a short-term impact on Hong Kong stock market's behaviour. Tables 3 and 4 reveal that shocks originated from Hong Kong, Japan, and Nasdaq stock markets left a significant persistent impact on the Korean stock market. But for Japan stock market, shocks that originate from lagged own price effect and those originated from Nasdaq have a significant persistent impact, and those originated from Hong Kong, Korea, and Shanghai stock markets have short-term impact. However, the spillover effect of the COVID-19 shock on Korea and Shanghai has an adverse impact on Japan's stock market. As for Shanghai and Nasdaq stock markets, lagged own price returns display persistent impact on their future stock price behaviour, while shocks

originate at Nasdaq stock market have a short-term impact on Shanghai stock market. However, the transmission effect of shocks originates at Hong Kong and Korean stock markets have a short-term adverse impact on Nasdaq stock market. Figures 1 to 8 also support the above-mentioned findings.

Table 2 Hong Kong stock market (HIS)

Stock return	*Shocks*	*Coef.*	*Std. err.*	*p-value*
Hong Kong	Hong Kong			
	L1	0.49*	0.16	0.002
	L2	0.31	0.17	0.075
	Korea			
	L1	0.16	1.80	0.928
	L2	–1.87	1.83	0.307
	Japan			
	L1	0.37*	0.12	0.003
	L2	–0.10	0.12	0.418
	Shanghai			
	L1	–2.03	1.11	0.068
	L2	2.67**	1.09	0.015
	Nasdaq			
	L1	0.48**	0.21	0.022
	L2	–0.41**	0.20	0.045
	_cons	171.43	1,325.73	0.897

Notes: *Significant at 1% significance level.
**Significant at 5% sig. level.

Source: Stock prices data collected from Major World Indices – Yahoo Finance

Figure 1 Hong Kong and Japan (see online version for colours)

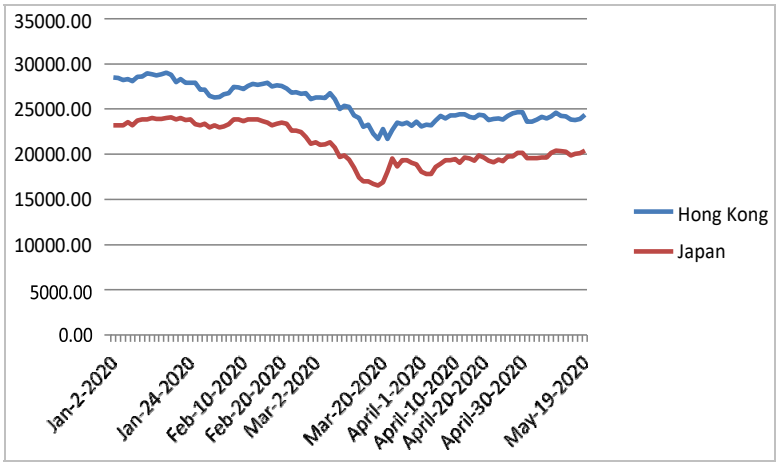


Table 3 Korea stock market (KOSPI)

Stock return	*Shocks*	*Coef.*	*Std. err.*	*p-value*
Korea	Hong Kong			
	L1	–0.03	0.02	0.065
	L2	0.03	0.02	0.123
	Korea			
	L1	0.68*	0.17	0.000
	L2	–0.07	0.17	0.674
	Japan			
	L1	0.03**	0.01	0.018
	L2	0.00	0.01	0.914
	Shanghai			
	L1	0.01	0.11	0.905
	L2	0.01	0.10	0.903
	Nasdaq			
	L1	0.07*	0.02	0.001
	L2	–0.04	0.02	0.052
	_cons	–47.96	126.47	0.705

Notes: *Significant at 1% significance level.
**Significant at 5% sig. level.

Source: Stock prices data collected from Major World Indices – Yahoo Finance

Table 4 Japan stock market (Nikki 225)

Stock return	*Shocks*	*Coef.*	*Std. err.*	*p-value*
Japan	Hong Kong			
	L1	0.06	0.18	0.725
	L2	0.38**	0.19	0.042
	Korea			
	L1	–1.13	1.94	0.561
	L2	–4.21**	1.99	0.034
	Japan			
	L1	0.88*	0.13	0.000
	L2	–0.02	0.13	0.901
	Shanghai			
	L1	–2.33*	1.20	0.053
	L2	0.83	1.18	0.483
	Nasdaq			
	L1	0.71*	0.23	0.002
	L2	0.13	0.22	0.547
	_cons	–752.16	1,435.56	0.6

Notes: *Significant at 1% significance level.
**Significant at 5% sig. level.

Source: Stock prices data collected from Major World Indices – Yahoo Finance

Table 5 Shanghai stock market

Stock return	*Shocks*	*Coef.*	*Std. err.*	*p-value*
Shanghai	Hong Kong			
	L1	0.00	0.02	0.994
	L2	0.03	0.02	0.116
	Korea			
	L1	–0.30	0.19	0.12
	L2	–0.11	0.20	0.585
	Japan			
	L1	0.01	0.01	0.366
	L2	–0.02	0.01	0.232
	Shanghai			
	L1	0.83*	0.12	0.000
	L2	–0.01	0.12	0.933
	Nasdaq			
	L1	0.05**	0.02	0.042
	L2	0.02	0.02	0.294
	_cons	76.42	141.03	0.588

Notes: *Significant at 1% significance level.
**Significant at 5% sig. level.

Source: Stock prices data collected from Major World Indices – Yahoo Finance

Table 6 Nasdaq stock market

Stock return	*Shocks*	*Coef.*	*Std. err.*	*p-value*
Nasdaq	Hong Kong			
	L1	-0.21**	0.10	0.031
	L2	0.17	0.10	0.094
	Korea			
	L1	2.13**	1.06	0.045
	L2	-2.15**	1.09	0.048
	Japan			
	L1	0.09	0.07	0.226
	L2	-0.02	0.07	0.735
	Shanghai			
	L1	-0.50	0.66	0.449
	L2	-0.06	0.65	0.929
	Nasdaq			
	L1	0.49*	0.12	0.000
	L2	0.44*	0.12	0.000
	_cons	1817.56**	785.29	0.021

Notes: *Significant at 1% significance level.
**Significant at 5% sig. level.

Source: Stock prices data collected from Major World Indices – Yahoo Finance

Figure 2 Hong Kong and Nasdaq (see online version for colours)

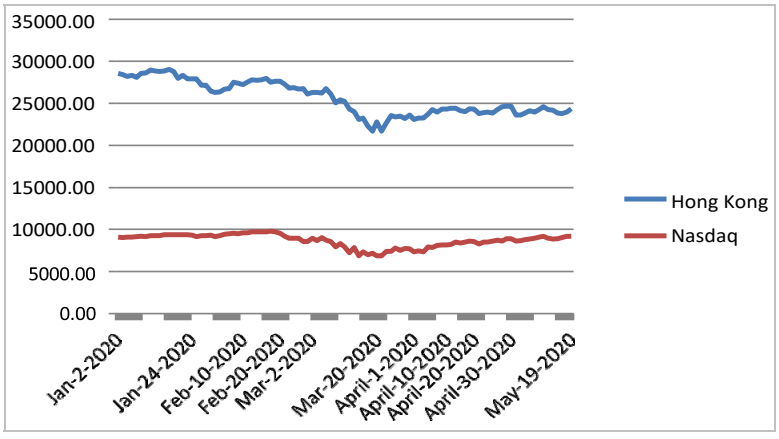


Figure 3 Hong Kong and Shanghai (see online version for colours)

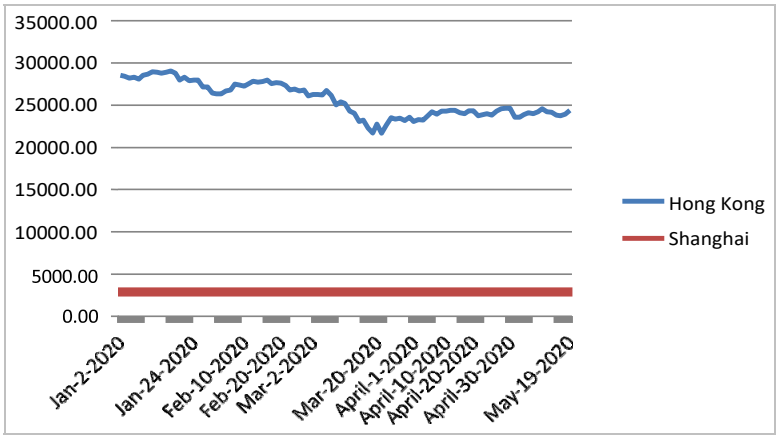


Figure 4 Japan and Shanghai (see online version for colours)

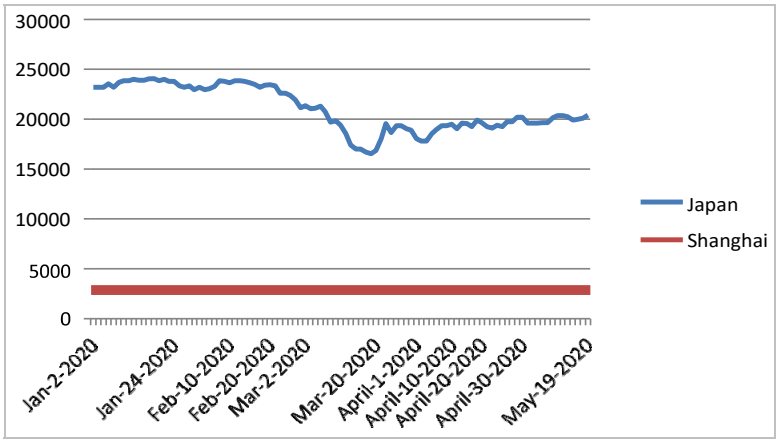


Figure 5 Shanghai and Nasdaq (see online version for colours)

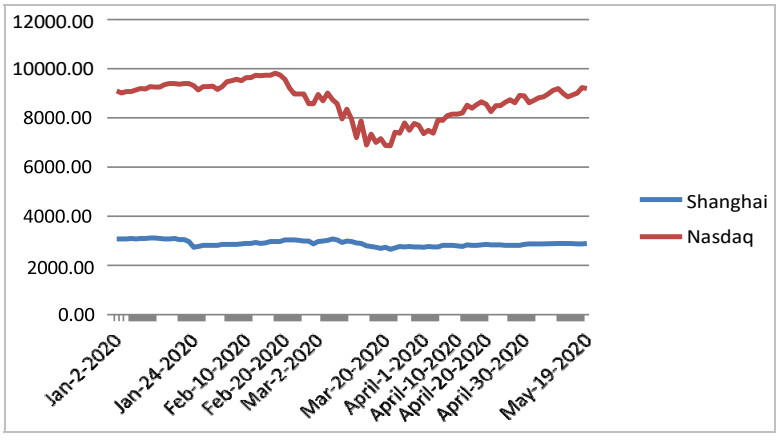


Figure 6 Korea and Shanghai (see online version for colours)

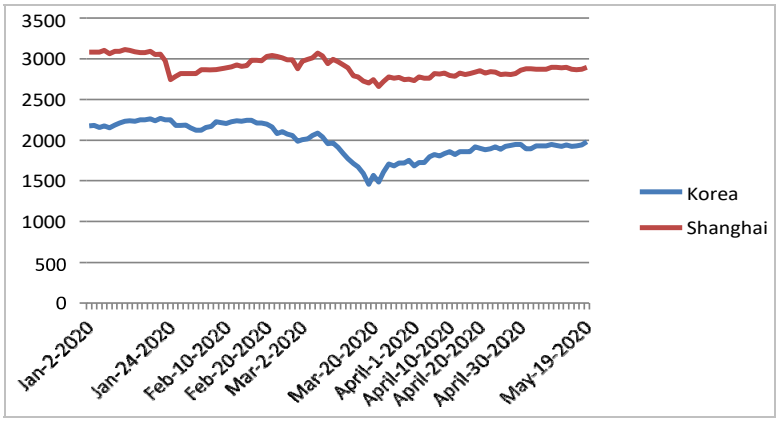


Figure 7 Nasdaq and Korea (see online version for colours)

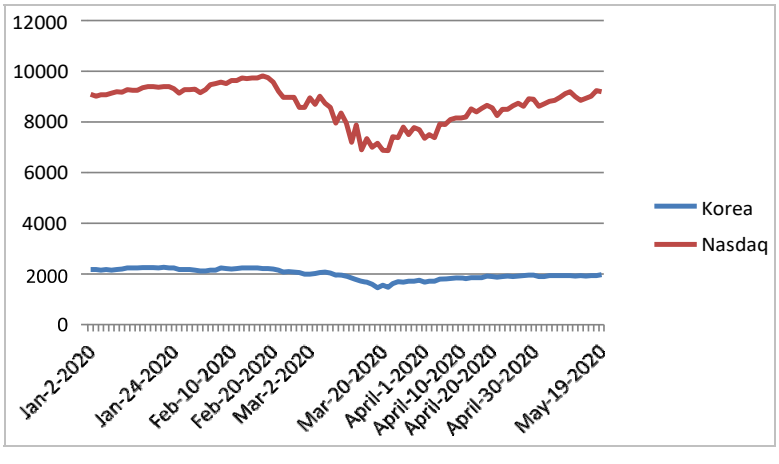
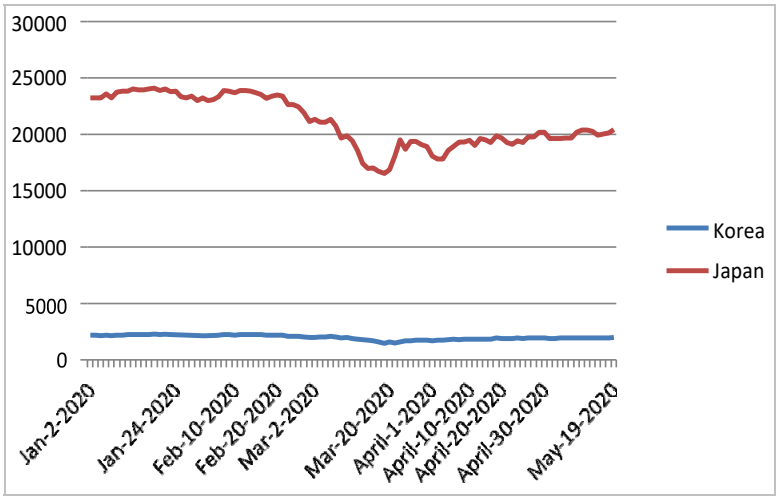


Figure 8 Korea and Japan (see online version for colours)



5 Concluding remarks

To assess persistence of the effects of COVID-19 shock on major Asian markets and Nasdaq stock market, this paper investigates the transmission effect of the COVID-19 pandemic on the behaviour of Hong Kong (SEHK), Shanghai, Korea Stock Price Index (KOSPI), Japan's Nikkei 225 and Nasdaq stock market. Results of persistence of the shock reveal while shocks on some of these markets have significant short-term impact on some of these markets, but on other markets have persistent longer period impact. The difference in duration and magnitude of transmission effects of COVID-19 pandemic shock on the stock markets behaviour could be due to differences in government's intervention policies. Transmission effects of COVID-19 shock indicate, Hong Kong stock market influenced by lagged own effects, and shocks originated from Japan, Nasdaq and Shanghai stock markets. Shocks emanating from Hong Kong, Japan, and Nasdaq stock markets have a significant persistent impact on the Korean stock market.

The findings of the study also indicate shocks that originate from Nasdaq have a significant persistent impact on Japan stock market, while those originating from Hong Kong, Korea, and Shanghai stock markets have short-term impact on Japan stock market.

The findings in the paper also confirm evidences of stronger herding behaviour among these markets during the outbreak of the pandemic, as compared to later periods of the pandemic spread, implying stronger and faster spillover effects among the markets during the first wave of the disease spread.

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Notes

1 The data source is Major World Indices – Yahoo Finance.