Effects of Monetary Easing Policy in Japan on the Markets in Hong Kong and China after the Global Financial Crisis

Hideaki OHTA *

Abstract

Following the Global Financial Crisis, the Bank of Japan's massive supply of funds through quantitative and qualitative monetary easing (QQE) has had a significant impact on markets in Hong Kong and China, where stock cross-trading between the Hong Kong and Shanghai markets (in November 2014) and between the Hong Kong and Shenzhen markets (in December 2016) has been liberalised.

This paper uses a Bayesian vector autoregressive (BVAR) model to analyse the impact of the Bank's monetary easing policy on the Hong Kong and China markets over the entire period from September 2008 to December 2019. The analysis shows that during the Comprehensive Quantitative Easing (CQE) period (October 2010 - March 2013), even before the introduction of QQE, the expansion of money flows from Japan to the Hong Kong and China markets had a significant positive impact on the Chinese market and the real economy, while after the introduction of QQE (April 2013), the impact on the Chinese and Hong Kong markets was more became more pronounced. Furthermore, capital inflows between Japan, Hong Kong and China have further increased following the expansion of monetary easing associated with QQE Phase II (November 2014) and the introduction of negative interest rates by the Bank of Japan (February 2016). Recently, the impact of increased investment from the Hong Kong/China markets on the Japanese market has been greater than the impact of Japan on the Hong Kong/China markets.

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Key Words: Comprehensive Monetary Easing (CME), Quantitative and Qualitative Monetary Easing (QQE), Spillover of monetary easing policy

* Professor, College/Graduate School of International Relations, Ritsumeikan University
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Introduction

This paper analyses the effect of cross-border capital flows on the markets in Japan, China and Hong Kong, considering the impact of Bank of Japan (BOJ)'s monetary easing policies, particularly Quantitative and Qualitative Easing (QQE), on the markets in Hong Kong and China after the Global Financial Crisis.

Since the Global Financial Crisis (2008), unconventional policies have been adopted as monetary easing policies introduced in major developed countries including Japan, the United States and Europe. Among them, non-traditional monetary policy such as LSAP (Large Scale Asset Purchase) introduced as the quantitative easing policy of the United States, so-called Quantitative Easing (QE 1, 2, 3) and European Central Bank (ECB) as well as Bank of Japan in purchase of government bonds and special loans.
The quantitative easing policies of Japan and the United States have contributed significantly to global markets with abundant financial resources. This paper examines how Japan's quantitative monetary easing policies, including comprehensive monetary easing (CME) and Quantitative and Qualitative Easing (QQE), have affected the Japanese, Chinese and Hong Kong markets in terms of international capital flows.

In the aftermath of the Global Financial Crisis, the excess liquidity associated with massive monetary easing in advanced economies led to an increase in international capital flows and short-term speculative financial investment. In Japan, the Bank of Japan's comprehensive monetary easing policy (October 2010-March 2013) was followed by quantitative and qualitative monetary easing (QQE) from April 2013, and since November 2014, when the United States ended its monetary easing (QE3), the Bank of Japan has continued QQE as Phase 2, which has provided large amounts of money through cross border capital flows.

Moreover, China expanded its quantitative monetary easing after the Global Financial Crisis, with liberalization of equity trading between Hong Kong and Shanghai markets in November 2014, followed by the liberalization between Shenzhen and Hong Kong markets in December 2016, which facilitated capital inflows into China's capital and financial markets. In this context, the depreciation of the RMB(Renminbi) in 2015 forced the adjustment of the "experiment in capital and financial liberalization" as part of the "internationalization of the RMB". At the same time, in addition to capital inflows to the non-banking sector, there was also an outflow of investment capital to global markets.

The purpose of this paper is to examine the spillover effects of the BOJ's monetary easing policy on the Hong Kong and Chinese markets through an analysis using a Bayesian vector autoregressive model (BVAR). The period covered is from September 2008 to December 2019 and considers the impact of market consolidation in Hong Kong and mainland China (Shanghai and Shenzhen), including after the global financial

crisis [1]. The analysis analysed not only the impact of Japan's monetary easing policy on the markets in China and Hong Kong, but also the effects of the Chinese and Hong Kong markets on the Japanese market. The results of analysis show that Japan's monetary base (MB) and money stock (M2) have had a significant impact on the Hong Kong and Chinese markets. However, when comparing pre- and post-QQE, the former had a stronger impact on MB and M2 in Hong Kong, but after QQE, there was a positive and significant impact on the markets not only in Hong Kong but also in China. More recently, the expansion of MB in Hong Kong led to an expansion of M2 in China, which had a positive impact on financial markets, but had a very limited impact on China's real economy (industrial production). In addition, the impact of capital investment from China on the Hong Kong has increased with the liberalisation of stock trading between HK and Shanghai markets in November 2014.

Moreover, while the Bank of Japan's QQE has extended its influence in both the Hong Kong and Chinese markets, its direct impact on China's financial markets has been significant, especially on the money stock (CNM2).At the same time, China's financial expansion, particularly China's M2 (CNM2), along with Hong Kong's monetary base (HKMB) and money stock (HKM2), has had a greater impact on Japan's financial markets.

1. Bank of Japan's Monetary Easing policy and Spillover to Overseas Market

1.1 Bank of Japan's monetary easing and the Global market

After the Global Financial Crisis (2008), non-traditional monetary easing policies have been introduced in advanced countries. The United States has introduced so-called Quantitative Easing (QE) mainly as Large-Scale Asset Purchases (LSAP), while the European Central Bank (ECB) introduced a significant monetary easing policy including special loan policy and purchase of government bonds.

Among these series of monetary easing, the size of BOJ's monetary base had already increased significantly even before 2008. Due to the World First Quantitative Monetary Easing during 2001-2006, although the growth rate of monetary base itself was lower than that of the US QE, after the Global Financial Crisis. While the Comprehensive Monetary Easing (CME) was implemented by the Bank of Japan (BOJ) during 2010 and 2012, its scale was limited, as compared to the subsequent Quantitative and Qualitative Monetary Easing (QQE). However, the BOJ's QQE, introduced in April 2013, was an unprecedented scale that far exceeds the previous expansion of the monetary base. Despite this, the inflation target of annual 2% set under the Abe Government has not been attained and the Japanese economy has not been recovered, as we see the average real GDP growth rate is only 0.3% (y/y) during the period under 'Abenomics' from

[1] The period of analysis for this paper is set to December 2019 to exclude the effects of corona shocks after spring 2020.

2013Q1 to 2020Q3 [2]. It should be noted that the average growth rate of 1.7% during the former government of Democratic party of Japan (DPJ) [Sept.2009-Dec.2012] (during which the Comprehensive Monetary Easing (CME) under former Governor Shirakawa) is higher than that of 'Abenomics' under the Abe government[Liberal Democratic Party. LDP] (Fig.1) [3].

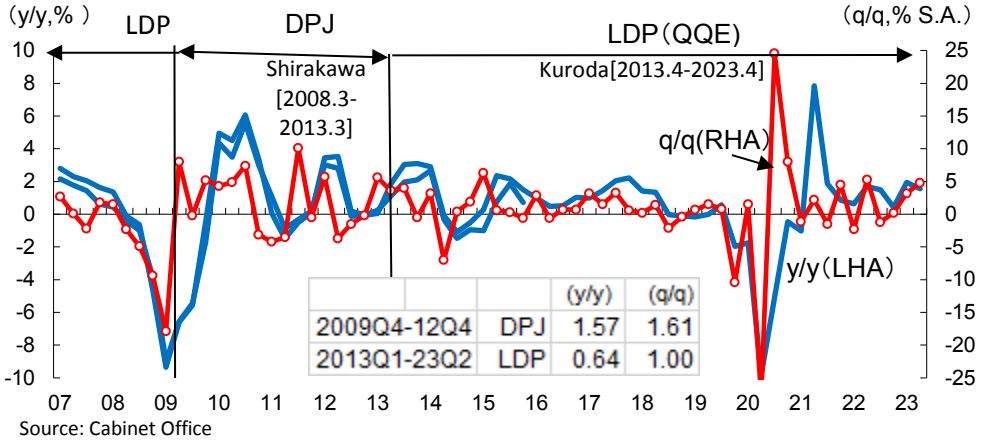

Fig.1: Real GDP Growth (Japan)

Due to the rapid growth of the monetary base (MB) under the Quantitative and Qualitative Monetary Easing (QQE), the BOJ introduced the world's largest quantitative easing in April 2013. The US Federal Reserve (Federal Reserve) already finished QE 3 in October 2014 and has been steadily on the way to normalization until 2019 (just before Corona Shock in 2020). On the other hand, the European ECB started quantitative easing on a small scale in March 2015, but on the scale, it is not beyond the Bank of Japan's supply, and the quantitative easing of the purchase of government bonds itself has a limited time limit. Under these circumstances, the BOJ's monetary easing has provided money to play an important role in supplying financial resources in the global market.

The second phase of QQE ("Bazooka Ⅱ") was introduced in November 2014, which was further strengthened in supply of monetary base. Simultaneously with this, stock transactions in Hong Kong and Shanghai markets were integrated in November 2014, and between HK and Shenzhen markets in December 2016. Meanwhile, the Bank of Japan has introduced negative interest rate policy (NIRP), which has applied a negative (-0.1%) interest rate to the new balance of current account balances at BOJ since February 2016. However, this negative interest rate policy has further deteriorated the bank's business situation and does not directly contribute to the increase in bank lending in Japan [4].

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[2] This period does not include the 2nd quarter of 2020, to exclude the effects of 'Corona 'Shock' which was significant in 2nd Quarter 2020. If the period of Q2 2020 included, the average real GDP growth is 0.2%.

[3] The real effect of monetary easing policy of CME under the former Governor Shirakawa was more effective than that of QQE in terms of positive effects on the real economy as well as financial market in Japan (see Ohta 2018).

[4] Although Bank of Japan's former President Kuroda adopted a negative interest rate on the Current

Under these circumstances, the Bank of Japan, which has introduced the only large-scale quantitative easing and negative interest rate policy in developed countries, has already reached the highest level of monetary base in the world. Japan's monetary base (MB) reached to 617 trillion yen (equivalent of more than 121% of Japan's GDP) as of December 2022, about 4.9 times higher than that in March 2013, just before the introduction of QQE, the BOJ Current Account increased by 11.2 times to 490trillion yen, which are the highest in the world (Fig. 2). However, QQE has not improved the Japanese economy, while it seems to have contributed to the recovery of the economies and markets in the US and other countries (incl. China) rather than Japan (Ohta, 2017, 2019).

Along with the massive monetary easing policy of developed countries, a large amount of money has been supplied to global markets. As a result, the excess supply of money has been utilized for financial investment and unproductive sectors, including the real estate market for speculative purposes. Under these circumstances, considering the "exit strategy" in the long term, continuing the quantitative easing policy has the risk of causing further destabilization of the global market as well as the domestic economy, fiscal and market.

1.2 BOJ's monetary easing and Changes in the Markets in HK and China

China's economy and market have expanded and increased the influences on the global market and economy in recent decades. Chinese authorities have promoted the internationalization of the renminbi to promote trade and investment, and the Chinese renminbi has been officially incorporated as the IMF's SDR (Special Drawing Right) currency. However, there are still several issues to be solved for Renminbi to become a global currency, since the currency has not yet fully convertible.

China's markets were liberalized in stock trading between the Hong Kong and Shanghai in November 2014 and Shenzhen markets in December 2016. Particularly, the period of integration of stock markets between HK and Shanghai was very critical, as the period was coinciding with BOJ's QQE Phase Ⅱ ("Bazooka II") and the US quantitative easing (QE3) ended in October 2014. At the time, it was believed that the massive influx of capital into the China-Hong Kong market, following the start of mutual trading between the Hong Kong and Shanghai markets at the same time (November 18, 2014). The large amount of money supply under the BOJ's QQE might have led to an expansion in China's money stock, which could cause a "bubble" of stock prices in the market.

As shown in this paper, there is a high association between money stock in Japan and

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Account of the BOJ (February 2016), but in fact this has indeed admitted the limit of monetary easing policy under QQE. In the House of Representatives Finance Committee on February 23, 2016, BOJ Governor Kuroda and Vice Governor Iwata admitted that the effects of monetary base expansion policy on the economy and market had been very weak on February 23, 2016.

China. In particular, the Bank of Japan's QQE seems to have led to a large inflow of capital into the Chinese market, especially in the stock market. The Hong Kong market is an offshore market with global financial capital flows, and funds from advanced economies like Japan, the US and Europe are also freely traded in the Hong Kong market. Therefore, the linkage between the Hong Kong and Shanghai markets can be described as a partial and de facto liberalization of capital and financial transactions in China. Moreover, direct exchange of the Chinese yuan for the Japanese yen has been in place since June 2012, allowing Japanese monetary base and money stock to be linked to Chinese stock prices starting in November 2014. The market integration in stock trading between the Hong Kong and Shanghai markets was an experiment of sorts in the process of "renminbi internationalization". [5]

On the other hand, the growth of the China's money stock (CNM2) has declined since 2015 but remains high (Fig.4). Thus, China's high money stock growth continued after the end of US QE3, and the level of stock prices in China (CNShare) has continued to be relatively high, which appears to have depended in part on foreign capital inflows, particularly by the expansion of money associated with the Bank of Japan's QQE and integration of Hong Kong-Shanghai stock markets since November 2014(Fig.6).

In the case of HK, M2 growth has closely correlated with stock prices in HK (HKShare), after the liberalization of stock trading between HK and Shanghai in November 2014 (Fig.5,7).

Figures 8 and 9 show the changes in foreign banks' balances at the Bank of Japan's current account (BOJAC) and stock prices in China and Hong Kong. The former shows that Chinese stock prices were highly correlated with foreign banks' BOJ current account (BOJACF) during the period: the correlation coefficient (R) is 0.7947 from 2013 and 2017 (R^2 [the coefficient of determination]: 0.6317). Similarly, the correlation coefficient between BOJACF and Hong Kong stock prices is 0.634 (with a coefficient of determination of 0.402) during 2008 and 2019, indicating that the two are closely correlated. This clearly indicates that the money from Japan's monetary easing was used to invest in Hong Kong and Chinese stocks. The capital flows from China have been restricted since November 2016, so that it might have affected financial investment between China and HK/Japan in recent years [6].

[5] The impact of the US interest rate hike in the summer of 2015 had a major impact on the Chinese market and caused stock prices to plummet It is important to consider seriously in what way to manage and regulate capital flows for China in the long-term.

[6] The measures include: (1) tighter restrictions on high value foreign remittances; (2) additional items to be reported in advance of outward investment; (3)tighter controls on the outward investment activities of private enterprises.

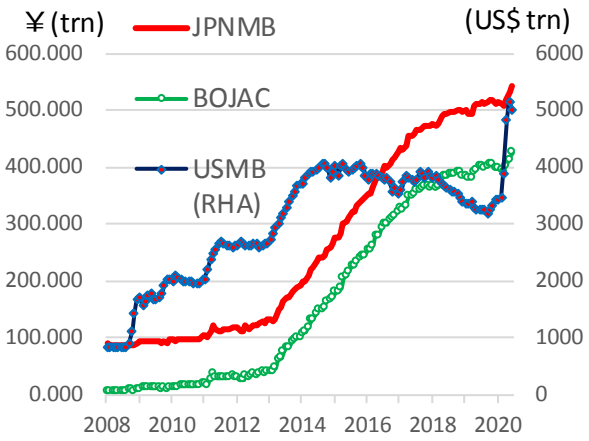

Fig.2: Monetary Base (US/Japan)and BOJ Current Account (Japan)

Source: FRB, Bank of Japan

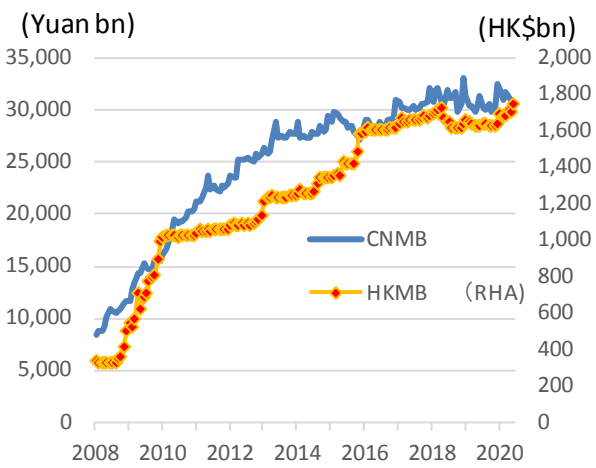

Fig.3: Monetary Base (HK/ China)

Sources: People's Bank of China, HK Monetary Authority, FRED

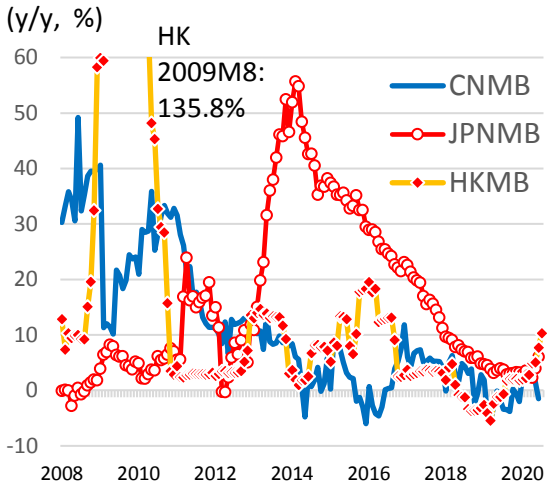

Fig.4: MB (Japan/ China/ HK)

Sources: Bank of Japan, People's Bank of China, HK monetary

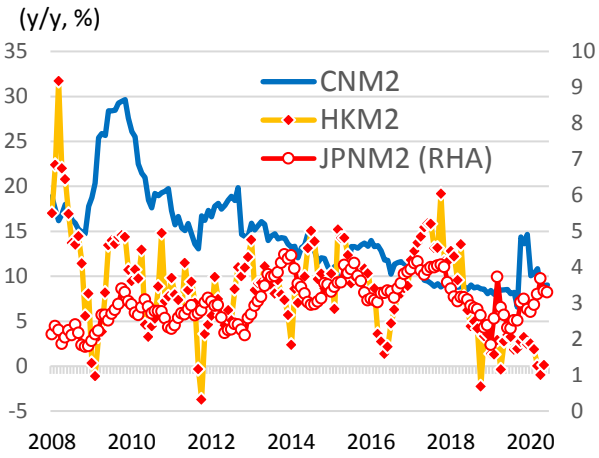

Fig.5: M2: China/HK/Japan

Sources: Bank of Japan, People's Bank of China, HK monetary Authority, FRED

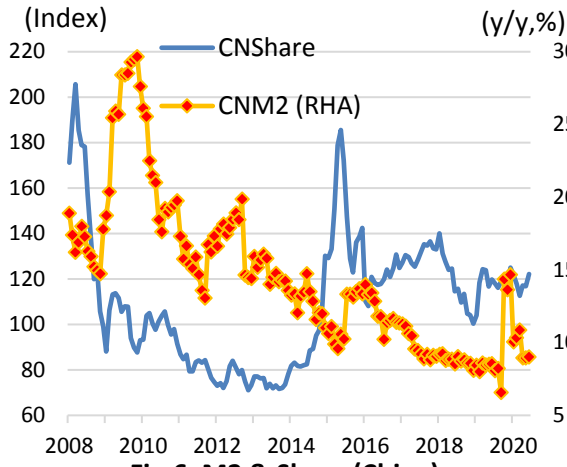

Fig.6: M2 & Share (China)

Sources: People's Bank of China, HK Monetary Authority, FRED

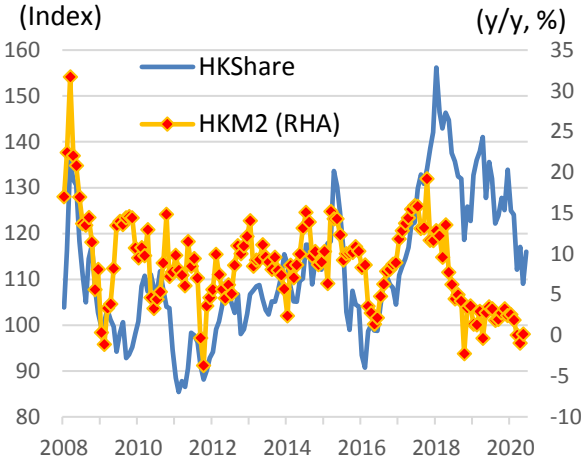

Fig.7: M2 & Share (HK)

Sources: People's Bank of China, HK Monetary Authority, FRED

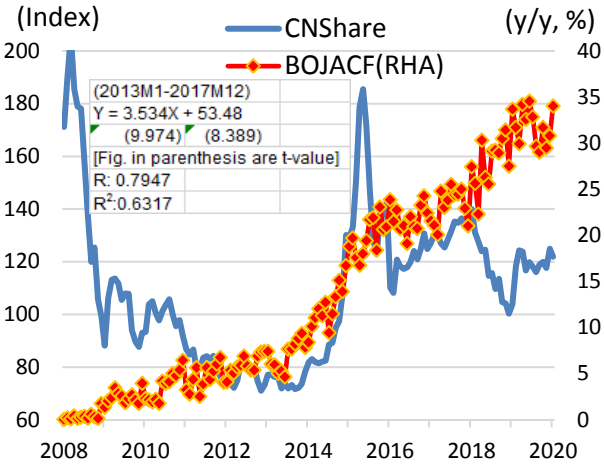

Fig.8: BOJAC(Foreign) & Share: China

Sources: People's Bank of China, HK Monetary Authority, FRED

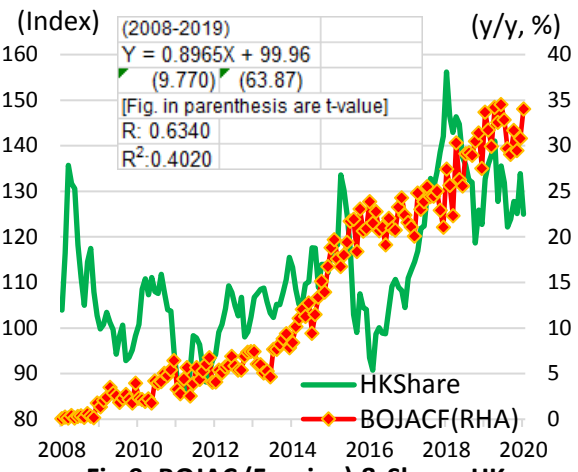

Fig.9: BOJAC (Foreign) & Share: HK

Sources: People's Bank of China, HK Monetary Authority, FRED

Prior to the start of Qualitative and Quantitative monetary easing (QQE) from April 2013, the impact on the mainland Chinese market was limited, and during the period of Comprehensive Monetary Easing (CME) (Oct.2010-Mar.2013) after the Global Financial Crisis (2008) capital flows were mainly via the Hong Kong market. The integration of stock trading in the Hong Kong and Shanghai markets in November 2014 might have facilitated direct transactions between the Japanese and Chinese markets, greatly increasing the outflow of funds and expanding their mutual influence.

The decline in M2 growth rates in China and Hong Kong since 2017 may be due to the capital controls introduced to avoid speculative capital investment and outflows. However, the financial inflows and outflows of the country may not be reflected in the statistics; there might have been increase in capital flows from informal financial channels and markets. Especially since 2017, the crypto assets transactions have increased. Although China has officially banned trading in crypto assets, there may be international capital transactions that would not be understood in a partially liberalized environment. These funds suggest that the flow of money into crypto assets from Chinese investors has accelerated[7]. In particular, the growth of money stock (CNM2) in China has been consistently declining because some of the official money stock has not been able to be incorporated into the banks' money stock statistics.

2. Research on the spillover effects of monetary easing policy in developed countries

Several studies have already been done on the spillover effects and impact on overseas markets by monetary easing policy in the US, Europe (ECB) and Japan.

[7] The majority of crypto assets mining and transactions such as Bitcoin are conducted by Chinese people, making it difficult to get an accurate picture of the amount of money in circulation in and out of China in the money stock that appears in official statistics Although the Chinese authority prohibits trading of cypto assets in general, there are no laws administrative regulations or departmental rules that negate the protectability of cryptocurrency itself as virtual property. See Qin (2022).

The effects of non-traditional quantitative monetary easing adopted by major central banks, including the US Federal Reserve Board (FRB) and the European Central Bank (ECB) have been studied by several authors. For example, Fratzscher et al. (2016) analysed the effects of monetary easing in the United States based on multiple regression models (QE1, 2, 3), concluded some effectiveness of the spillover effects of the US monetary easing in terms of securities investment towards developed countries and emerging countries. Likewise, Guindos (2019) warns that the euro area is not immune to spillovers from the shocks emanating from the United States in a globalised and financially integrated world.

On the other hand, in Europe, an analysis based on VAR by Kucharcukova et al. (2016) showed that ECB monetary easing might have had impact on the financial sector, but not significantly affected production in the six non-Euro EU countries. Furthermore, Kucharcukova et al. (2016) also analyses the ECB 's monetary easing policy with a global structure VAR model concluded that it was not so effective for the EU countries in the non-euro area. Churm et al. (2015), on the other hand, noted that monetary easing by the Bank of England had a significant and positive impact on the UK economy, by an analysis based on the BVAR model. Meanwhile, Migliardo (2010) analyzed the spillover effect of Italy's monetary policy on Italy based on the BVAR model, and as a result, the GDP and the financial market were influenced by the traditional macroeconomic framework.

There are studies that unconventional policies such as quantitative easing policy of developed countries have a remarkable influence on emerging countries. Lavigne et al. (2014) show that the monetary easing policy of developed countries can be an unstable factor due to the expansion of capital mobility and the impact on rising asset prices and foreign exchange rates in emerging countries. Anayaet et al. (2017) analysed the impact of US non-traditional monetary policy on emerging markets using a global structural VAR model. It found that an expansionary policy shock significantly increases portfolio flows from the U.S. to emerging market economies (EMEs) for almost two quarters.

Regarding the impact of US monetary policy on Asian countries, Xu & La (2017) concluded that the US monetary easing policy had impacted the market: the overall spillover effect was large but differed significantly in Asia by types of borrowing firms, financing purposes, and loan terms at different stages of the quantitative easing programs.

In addition, Cho & Rhee (2014) pointed out that the effects of the US monetary easing policy on Asian countries were causing rising pressures in Asian countries' exchange rates and real estate markets. Miyajima et al. (2014) showed that the non-traditional monetary easing in the US has affected the long-term interest rate levels of each country through long-term bonds mainly to Asian markets. Utlaut & Roye (2016) analyses the effect of global economic trends on Asian countries in general by using the BVAR

model, but it shows that it is greatly influenced by external factors.

Furthermore, Bhattarai & Chatterjee (2018) concluded that quantitative monetary easing (QE) in the United States had a significant impact on bond yields, stock prices and currency markets to emerging Asian countries based on the Panel VAR model.

In addition, Sun et al. (2018) assume that the quantitative monetary easing policy of the United States has significantly influenced the exchange rate of China in the pass-through effect. Ho et al. (2018) measures the spread of the US monetary easing policy to the Chinese economy and market based on the Factor-augmented VAR (FA-VAR) model, and it is pointed out that the influence on the market of housing, stocks and loans in China was large mainly through speculative funds (Hot Money). Chen and Tsang (2018) analysed the impact of US monetary rate shock on HK economy based on factor-augmented VAR model covering the period from 1998Q4 to 2015Q2, but it has mainly focused on GDP growth, which is sensitive to the economic conditions of China, while FRB's policy mainly affected interest rate.

The past analyses on the effects of BOJ's monetary easing policy have been concentrated on the impact on the domestic market and economy in Japan. However, there has not been persuasive argument and fair evaluation of the QQE among the literatures in the past. In this regard, several papers by Ohta (2013, 2014, 2017, 2019) suggest that non-traditional BOJ monetary easing policies, particularly QQE, have not had a major impact on the real economy and domestic financial market.

Although Miyao and Okimoto (2017) maintains the effectiveness of BOJ's monetary easing on the Japanese economy and market, his argument has not proved the effect of the recent QQE, since it examined the effects of BOJ's monetary easing during the period 2001-2015, which covered the first QE (2001 - 06) with fairly small in scale as compared to the QQE, which was covered only the short period of two years of QQE (until March 2015) [8].

There are few studies that verify the spillover effects to other countries and regions with fair evaluation of BOJ's QQE. The study by Dekle & Hamada (2015) includes the period since the 1970s whose target period is much older than the period of QQE, and the effect of the introduction of quantitative easing policy (2001 - present) can be proved distinguished from that before. However, there is little point in proving that monetary easing is effective by studies covering such an old era.

Ganelli & Tawk (2016) showed that Japan's quantitative monetary easing has had a spillover effect on Asian emerging markets. Ganelli and Tawk (2016) also suggested

[8] It should be noted that the scale of monetary easing under Quantitative Easing (2001-2006) was much smaller than that of the current QQE, so that the impact on the market and the real economy would be much different from that under the QE. Moreover, it is very uncertain and not reasonable to apply the GDP growth rate in the model as a variable of GDP converted from a quarterly figure to a monthly basis to the VAR model analysis, to see the realistic movement of the real economy. There is also a problem with robustness in the analysis because the VAR model itself used non-stationary variables that do not take the first-order difference, which would result in the problem of stationarity of the variables.

that spillover from QQE to emerging Asian countries tended to be positive using global VAR models, however, QQE with changes in the monetary base (rather than with an increase in equity prices) does not yield strong nor significant spillover effects on other countries in Asia during 2000 and 2014.

Fukuda (2017) has examined the effects of BOJ's negative interest policy on the Asian markets and found that QQE with negative interest rate policy (NIRP) had significant positive effects on Asian stock prices and that the spillover effects were especially significant in the sense that the long-term rate below zero might have benefited Asian economies.

Spiegel and Tai (2018) analysed the effects of BOJ's zero and negative interest rates on the economies in the US, China, Korea and Japan, but it is found that only modest effects were obtained. The paper has several problems which include the major analysis is made based on JGB 2-year bonds only and more importantly, the covered period was from 1998 to 2015, which may not justify fully the results of the spillover effects of monetary easing since 2008.

Since the Bank of Japan's monetary easing policy (especially QQE) leaked a large financial resource from Japan to other countries, the Bank of Japan's monetary policy has not been effective in the domestic economy or market in Japan, but effective in other countries. In this regard, Ohta (2014) and Ohta (2017) discuss the mutual influence of quantitative easing policy between Japan and the US, and the money provided under the QQE has spread to other countries such as the United States by international capital movement. It pointed out that the impact on the US market and economy has been substantial, and it was positive for stock price and production in the United States. Ohta (2017) pointed out that the BOJ's financial expansion may have contributed to the recovery of the US market and the economy based on the BVAR model. Ohta (2020) further suggested that the Bank of Japan's monetary easing had a substantial positive impact on the real economy and market in China [9].

On the other hand, there has been no research comparing monetary policy under the monetary easing of Bank of Japan during the post-Global Financial Crisis, including Comprehensive Monetary Easing (CME) with the current QQE, as a full-fledged study of the impact of the BOJ's non-traditional monetary policy on the other countries including China and HK economy and markets after the Global Financial Crisis until the latest period. However, there has no concrete studies on spillover effects of QQE on the markets in Japan and HK/ China.

This paper is one of the few attempts to examine the spillover effects of BOJ on China and HK market and vice versa covering the latest period from Sept.2008 to Dec.2019. In this thesis, the analysis is based on the Bayesian Vector Autoregressive

[9] Ohta(2018) covered the period until 2017 and written in Japanese, which is different from this paper that covers the period until Dec. 2019.

(BVAR) model about the spillover effects of the BOJ's Quantitative and Qualitative Monetary Easing policy on China and Hong Kong. As a result of the analysis, it was shown that the BOJ's easing policy had a significant positive influence not only on HK/ China's monetary base and money stock, but also on stock prices and production side. It is also confirmed that the impact on the Japanese market from China and Hong Kong has increased after the introduction of QQE.

3. Analysis

3.1 Model

In this section, we analyse the relationship of each market by impulse response function based on Bayesian (Bayesian) vector autoregressive (BVAR) model. In the BVAR model, Litterman (1980) first used the Bayesian analysis method as the coefficient of VAR. In the analysis, the definition of the prior condition and the posterior distribution is important, but the Bayesian estimate has the advantage of escaping unnecessary data analysis of the estimate.

Compared with the analysis based on the normal VAR model, the BVAR model tends to be more advantageous when there are variable constraints. Especially in Bayesian there is an advantage that it can be analyzed with comparatively limited parameter sizes by setting in advance [10]. In the Bayesian estimation, considering the random variable Y*t* (*t = 1, 2, ...* t) of the time series having the probability density function F (Y | θ), the parameter θ is also a random variable and its prior distribution is π (θ) . The posterior distribution *p* (θ | Y) at that time is as follows.

$$p\ (\theta|Y)\ = f\ (Y|\theta)\ \pi\ (\theta)\ /\Phi\ (Y)$$

Φ (Y) = ∫ *π (θ) f (Y | θ) d (θ)* = const. Since Φ (Y) does not depend on the parameter θ, Therefore, *p (θ | Y)* is proportional to *f (Y | θ) π (θ).* The Bayesian estimated amount θ̂ of the parameter θ is obtained as the average value of the posterior distribution.

$$\hat{\theta} = E\ [\theta|Y] = \int \theta\, p\ (\theta|Y)\ \mathrm{d}\ (\theta)$$

In this model, analysis is based on the Litterman / Minnesota method, with Σ being known as its premise and limited only to the coefficient β. To calculate the posterior distribution p (β | Y, Σ), the probability density function f (Y | θ) of Y and the prior distribution π (θ) of the parameter θ are required, and for f (Y | θ) And is defined as an ordinary likelihood function. In the Minnesota Prior, the variance covariance matrix is set, β is arbitrary, the coefficient of the variable of the lag l of the j-th variable of the i-th equation (random variable) is set to 1, the average of βl ij is 1, βl ij (l> 1) is 0, the

[10] For an overview of VAR and Bayesian VAR, see Sims et al. (1998), Christiano (2012).

variables are all prior distribution assuming a random walk.

Therefore, for the parameter, the average value is zero, but the prior average value is 1 except for the variable for the one-term lag of the explanatory variable. Furthermore, it is assumed that the prior parameters are independent of each other and there is no correlation (covariance is assumed to be zero). The case where the standard deviation of the coefficients concerning the dependent variable lag in the prior dispersion is larger than the coefficients of the other variables having other lags can also be included. The prior distribution of the parameter β is β to N (β_0, V_0).

Bayesian reasoning is said to require no special explanation of nonstationary. Particularly in the BVAR model, it has been pointed out that the existence of unit roots of data has no significant influence on likelihood with regard to non-stationarity, so it does not become a big problem (Sims 1990; Sims, Stock and Watson 1990). It is based entirely on the likelihood function, so we also measure the variables at the level in this analysis.

3.2 Variables and specifications in the Analysis

In the analysis, the variables used for Japan in the analysis include the Bank of Japan's monetary base (MB), current account (BOJAC), call rate, JGB yield with 10 years maturity (JGB10Y), and stock prices (Nikkei index) in our analysis (Table 1).

In the case of China, the variables used include China's monetary base (CNMB) [11], People's Bank of China's money stock (CNM2), stock prices (CNShare), and industrial production index (CNProd) in our analysis [12]. The reason why interest rates are not included among the variables for China in this analysis is that interest rate levels have been set by the authority in China and interbank interest rates were not freely determined in the market, so we cannot exclude the possibility of large errors in the results of the analysis.

For Hong Kong, the variables used include the Hong Kong monetary base (HKMB), the money stock (HKM2), the money market rate (HK interbank rate), and stock prices (HKShare). In the case of Hong Kong, the industrial production index is not included in the variables, since industrial sector is not a major sector in the economic activities in Hong Kong,

[11] The monetary base in China used here is the figures shown as 'Reserve money' in the IFS (IMF) database, since the official statistical data in China has not shown as monetary base as used in Japan, HK and other advanced nations including the US.

[12] Since the seasonally adjusted index for Chinese industrial production is not publicly available, the index is based on the EViews function for seasonal adjustment.

Table 1: Variables (Japan, Hong Kong, China)

Variables	Abbreviation	Sources
BOJ Monetary Base	JPMB	Bank of Japan (major data series)
Money Stock (Japan)	JPM2	Bank of Japan (major data series)
Government Bond (10 years) Yield (JPN)	JGB10Y	International inancial Statistics (IFS) database (IMF)
Stock Prices (JPN)	JPNShare	IFS database (IMF), FRED
HK Monetary Base	HK MB	IFS database (IMF) HK Monetary Authority
Money Stock (HK)	HK M2	IFS database (IMF) HK Monetary Authority
Money Market Rate (HK)	HK Intrate	IFS database (IMF) HK Monetary Authority
Stock Prices (HK)	HK Share	IFS database (IMF) Hang Seng Index
PBC Monetary Bae	CN MB	IFS database (IMF), People's Bank of China (PBC)
China Money Stock (M2)	CN M2	IFS database (IMF), People's Bank of China (PBC)
Stock Prices (China)	CN Share	IFS database (IMF), People's Bank of China (PBC)
Industrial Production (China) [y/y,%].	CN Prod	IFS database (IMF), FRED

Note: All variables are monthly figures

In the impulse response functions based on BVAR, each variable is estimated at the level (level) without taking first-order differences [13]. In the analysis based on BVAR model, the lag periods for impulse response functions are set four to measure enough responses of the shock of one variable (e.g., monetary base or money stock). The impact of the explanatory variables on Japan, China, and Hong Kong are adopted as one variable in each equation to account for the robustness of specific variables (e.g., monetary base) in Japan, China, and Hong Kong.

In the next section, the analysis is made to identify the spillover effects of the BOJ's monetary easing policy on the markets in China and Hong Kong as well as Japan using the impulse response function based on the BVAR model.

3.3 Analysis of Impulse Response Functions （Japan・HK・China）

This section compares the changes in the markets in China, Hong Kong and Japan before and after the Global Financial Crisis to analyze how quantitative and qualitative monetary easing (QQE) policies have affected both markets. After the Global Financial Crisis in 2008, the Bank of Japan introduced a Comprehensive Monetary Easing (CME) period (October 2010 - March 2013), but the QQE (April 2013- to date) is exceptionally large in scale, which is unprecedented before.

While the results of the analysis are largely consistent with the above reasoning, after the introduction of QQE, the money stock (M2) has been particularly positive in response to monetary easing in the economy and market. Moreover, a key feature of the post-QQE implementation is that only the movement of money in financial investment has been almost significantly affected by the movement of money in Japan, Hong Kong and China. In other words, this indicates that only unproductive financial investment may have expanded in the market. The covered period of this analysis (Sept.2008 - December 2019) is from the introduction of monetary easing after the Global Financial Crisis, including s Comprehensive Monetary Easing (CME) (introduced in October

[13] See also Sims, 1988 for a discussion of Bayesian analysis on unit roots.

2010) to the current QQE. In order to verify the transition of the influence on the Chinese / Hong Kong market due to change, the target period is classified, and it is verified by each period. The entire period (September 2008-December 2019) is divided into the following time periods to examine the evolution of the impact on the Chinese and Hong Kong markets of monetary policy changes since the Global Financial Crisis, including the CME and QQE [14].

(i) Post-Global Financial Crisis (September 2008 - March 2013) (including the period of Comprehensive Monetary Easing [CME, Oct.2010 – March 2013])
(ii) Early period of Quantitative Qualitative Easing (QQE), prior to the introduction of negative interest rate (April 2013 - January 2016)
(iii) QQE Phase II [+ Hong Kong-Shanghai stock market integration] (November 2014 - December 2019)
(iv) Later period of QQE with negative interest rate (February 2016 - December 2019)

3.3.1 Impact of BOJ monetary easing on the Chinese market

(a) Post-Global Financial Crisis [Sept. 2008-March 2013]

The monetary base (**JPMB**) and money stock (**JPM2**) in Japan had a positive impact on the market and economy in China during the period, mainly on the money stock (**CNM2**) and industrial production (**CNProd**) during the period (Fig.10-1). This may suggest that the transfer of the money shifted from Japan to China has been undertaken mainly through banks' money stock. On the other hand, the impact of government bond yields with 10 years maturity (**JGB10Y**) and Japanese stock prices (**JPShare**) in Japan on the Chinese market was limited during this period.

(b)Quantitative and Qualitative Monetary Policy(QQE) [Apr. 2013-Jan.2016] (early period of QQE)

[Impact of Japan's Monetary Policy on China]

Japan's monetary base (**JPMB**) and money stock (**JPM2**) had a positive and significant impact on China's money stock (**CNM2**), but not significantly on the monetary base (**CNMB**)(Fig.10-2). During this period, Japan's monetary easing had a significant effect on China's real economy, industrial production (**CNProd**) as well as share prices in China (**CNShare**). This could suggest that financial investment in China may have been invested in equities through bank money.

(c) QQE PhaseⅡ [Nov.2014-Dec.2019]

The Bank of Japan's QQE was strengthened in November 2014 (Bazooka Ⅱ), and at the same time, the mutual trading of stock markets between the

[14] In order to avoid a major impact of Covid-19 shocks after 2020, the period covered is limited to 2019.

Hong Kong and the Chinese market (Shanghai) was liberalised. The impact has therefore had a significant impact on financial transactions between China and Japan, as follows(Fig.10-3).

The impact of Japan's monetary base (JPMB) on China's monetary base (CNMB) and money stock (CNM2) is clearly less significant, while the impact of Japan's money stock (JPM2) on CNM2 was significant. JPM2 also has a positive and significant impact on China's industrial production. However, the impact of Japanese MB / M2 and stock prices on Chinese stock prices (CNShare) slightly decreased in this period compared to the early QQE period(April 2013-Jan.2016). This may be due to the fact that this period coincided with the start of mutual trading of stock prices in the Hong Kong and Shenzhen markets.

(d) **QQE (Late period with negative interest rates) [Feb. 2016-Dec. 2019]**

The money stock in Japan (**JPM2**) had a positive impact on the Chinese market and economy during the period, mainly on the money stock (**CNM2**) and industrial production (**CNProd**) (Fig.10-4).

In general, compared to the earlier period of QQE (Apr.2013-Jan.2016), the direct effects of Japanese financial markets on the Chinese market decreased during this period. The impact of Japanese stock prices (**JPShare**) on Chinese stock prices (**CNShare**) also decreased in this period compared to the previous QQE period.

However, the positive impact of the **JPMB/JPM2** and stock prices(**JPShare**) on Chinese industrial production(**CNProd**) during the entire QQE period, including this period, has continued.

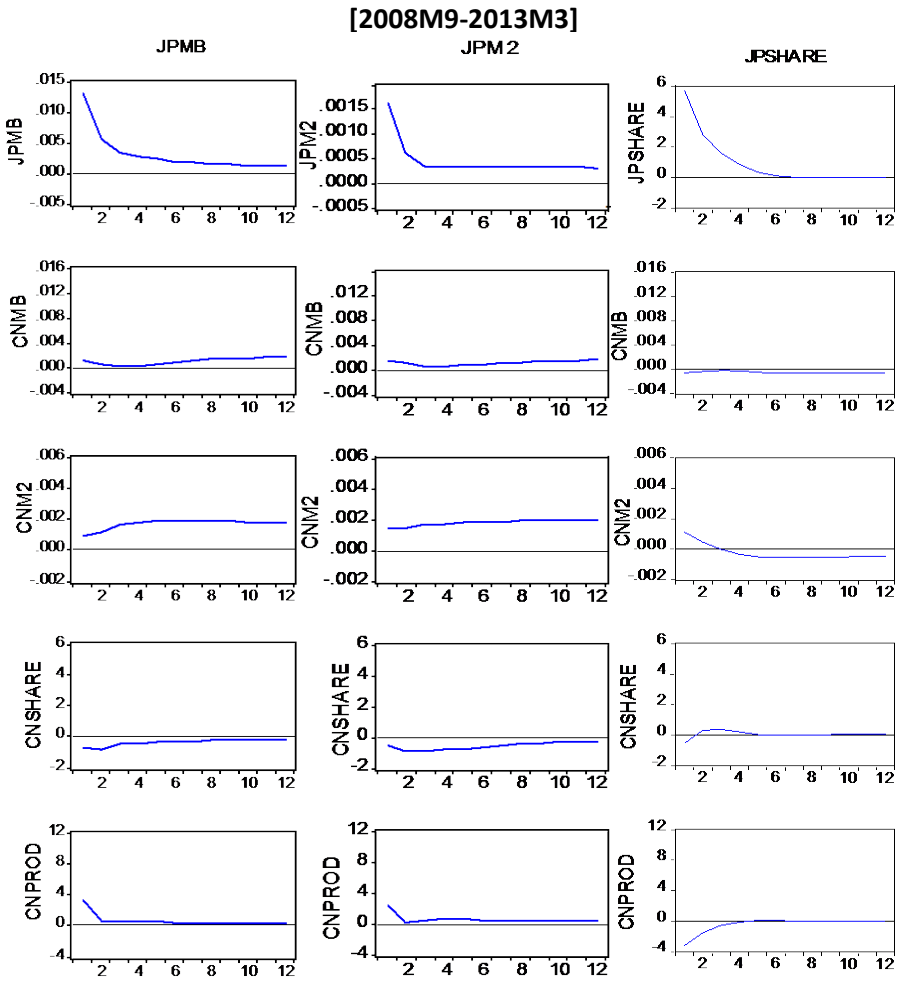

Fig.10-1: Impact of Japan on China (Sept.2008-Mar.2013)

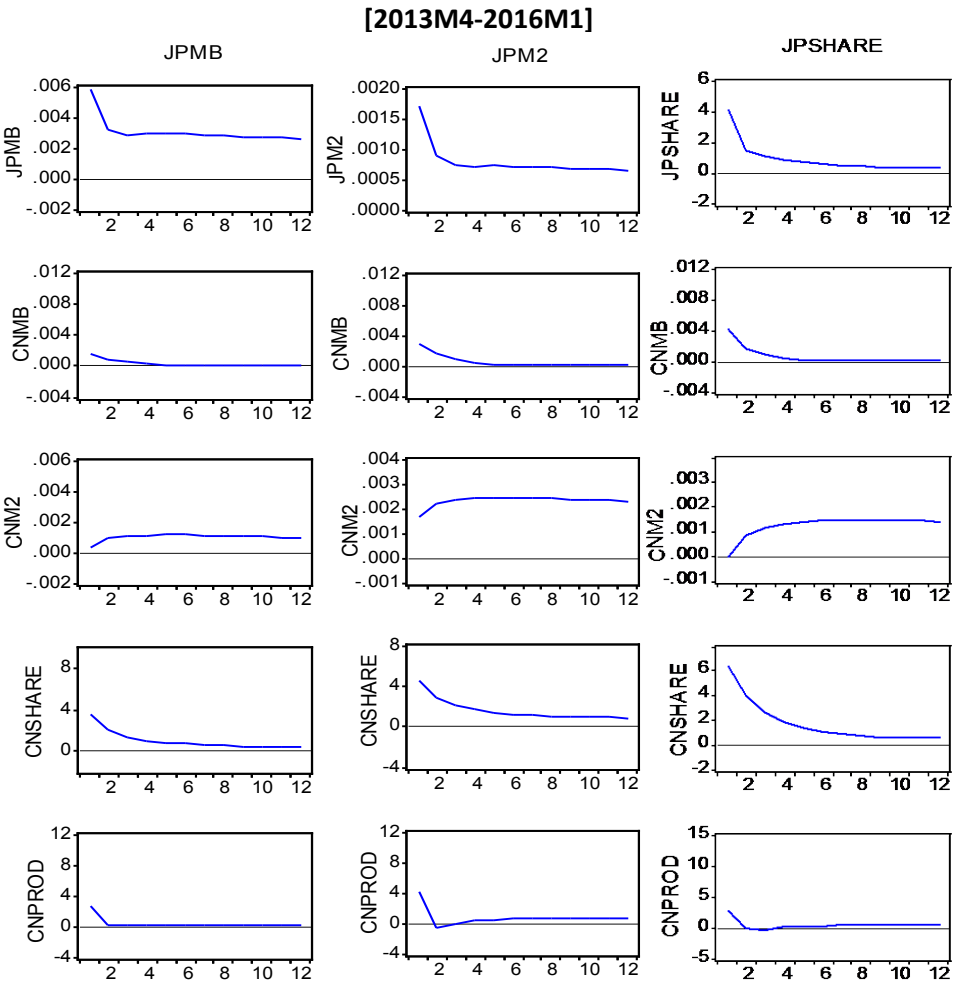

Fig.10-2: Impact of Japan on China (Apr2013.-Jan.2016)

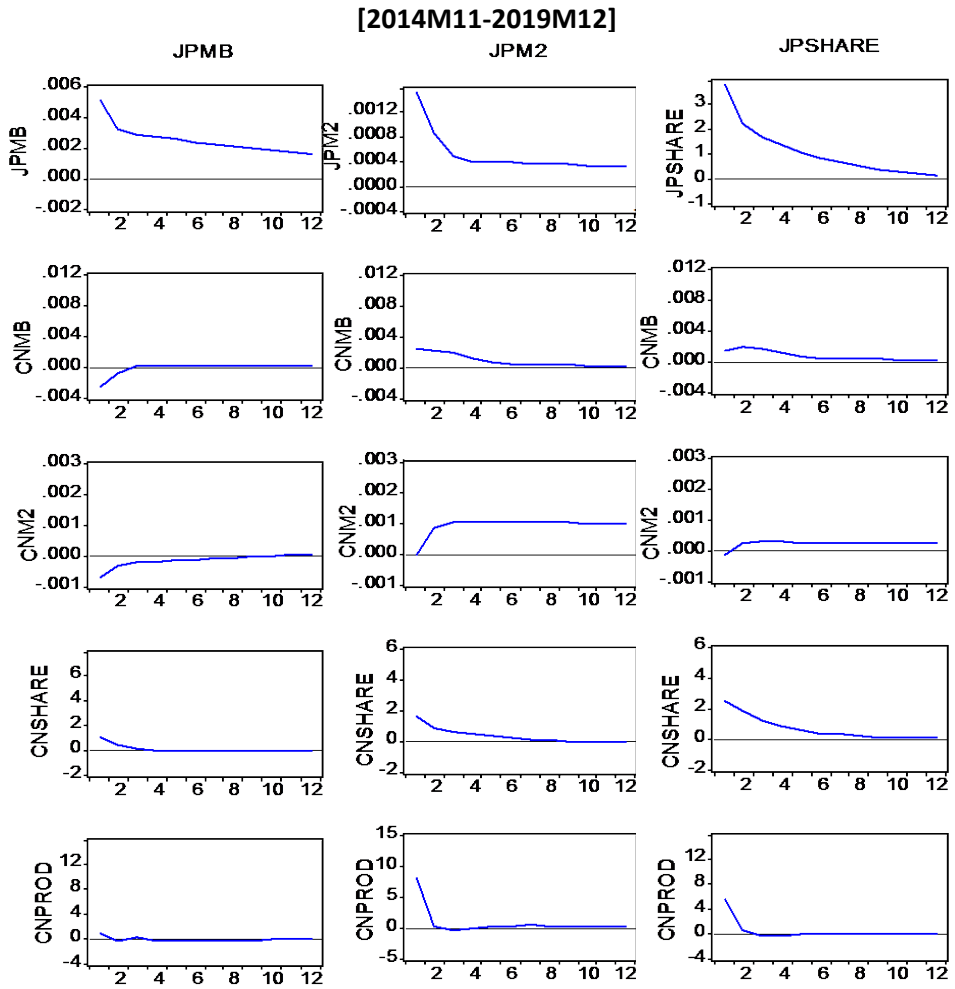

Fig.10-3: Impact of Japan on China (Nov.2014-Dec.2019)

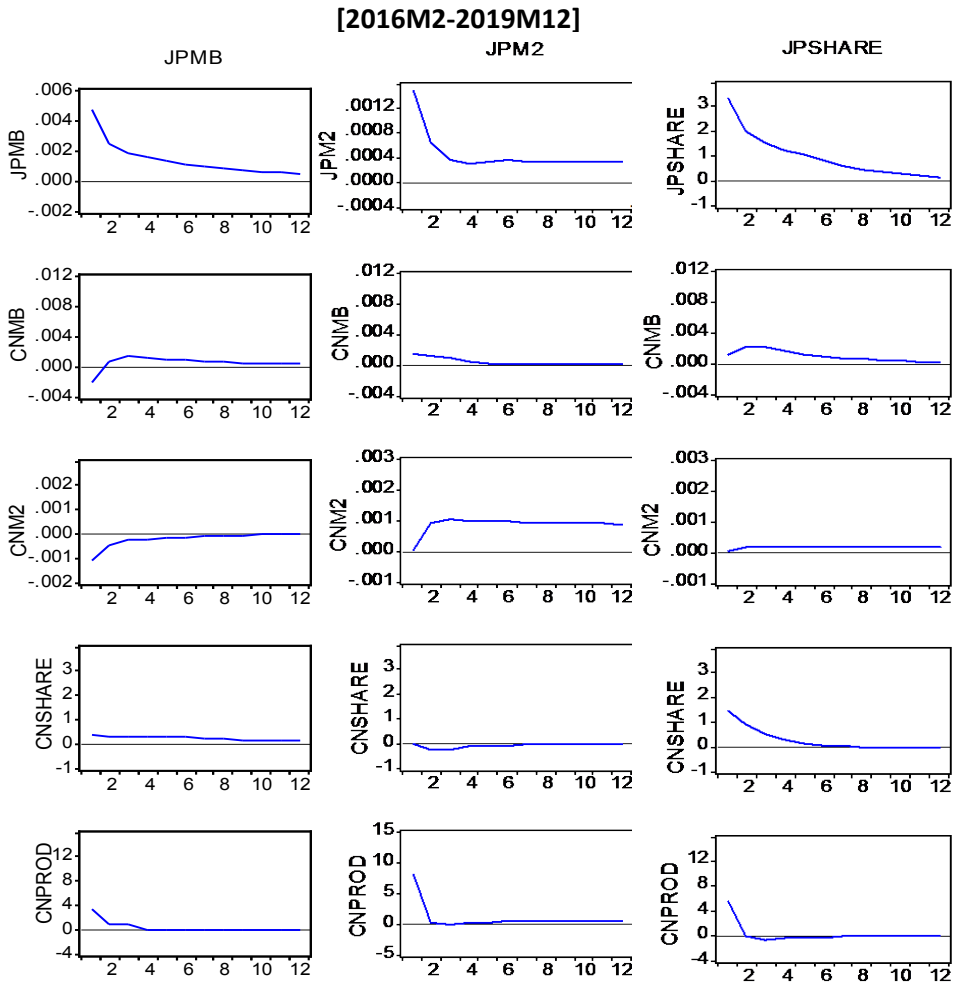

Fig.10-4: Impact of Japan on China (Feb.2016-Dec.2019)

3.3.2 Impact of China on the Japanese market

(a) Post-Global Financial Crisis [Sept.2008-Mar.2013]

The impact of the China's monetary base (**CNMB**) on the Japan's money stock (**JPM2**) market was significantly positive over this period (Fig.11-1). The money stock in China (**CNM2**) had also a significantly positive impact on the monetary base (**JPMB**) and money stock in Japan (**JPM2).** On the other hand, the impact of Chinese stock prices (CNShare) on Japanese stock prices (**JPShare**)was limited.

(b)Quantitative and Qualitative Monetary Policy (QQE)(1) [Apr.2013-Jan.2016]

China's money stock (**CNM2**) mainly had put positive effects on Japan's monetary base (**JPMB)** and money stock (**JPM2)**. Stock prices in China (**CNShare**) also had a significant impact on the money stock (**JPM2**) and stock prices in Japan (**JPShare**) (Fig.11-2). This suggests that the Chinese money stock (banks) may have increased investment in Japanese equities during this period.

(c) QQE Ⅱ [Nov.2014-Dec.2019]

Over this period, the impact of China's monetary base (CNMB) on Japan's monetary base (JPMB) and money stock (JPM2) was no longer significant(Fig.11-3). On the other hand, the impact of the China's money stock (**CNM2**) had a positive and significant effect on the Japan's money stock (**JPM2**) as well as JGB10Y yields (JGB10Y):CNM2 has lowered the yield on Japanese government bonds (JGB10Y).

China's stock prices (**CNShare**) also had a positive effect on Japan's share prices (**JPShare)**, while **CNShare** lifted JGB yields (**JGB10Y**). This indicates that equities and government bonds were alternative investments in the Japanese market from China.

(d) **QQE (2) (BOJ negative interest rates) [Feb.2016-Dec.2019]**

This period (Feb 2016-Dec 2019) includes the period after November 2016, when China tightened its capital controls, and the impact of financial investment from China on Japan has decreased compared to the earlier period (Fig.11-4). For example, the impact of Chinese stock prices (**CNShare**) on Japanese stock prices (**JPShare**) is acknowledged but slightly reduced. However, the Chinese money stock (**CNM2**) still had a positive and significant impact on the Japanese money stock (**JPM2**) .

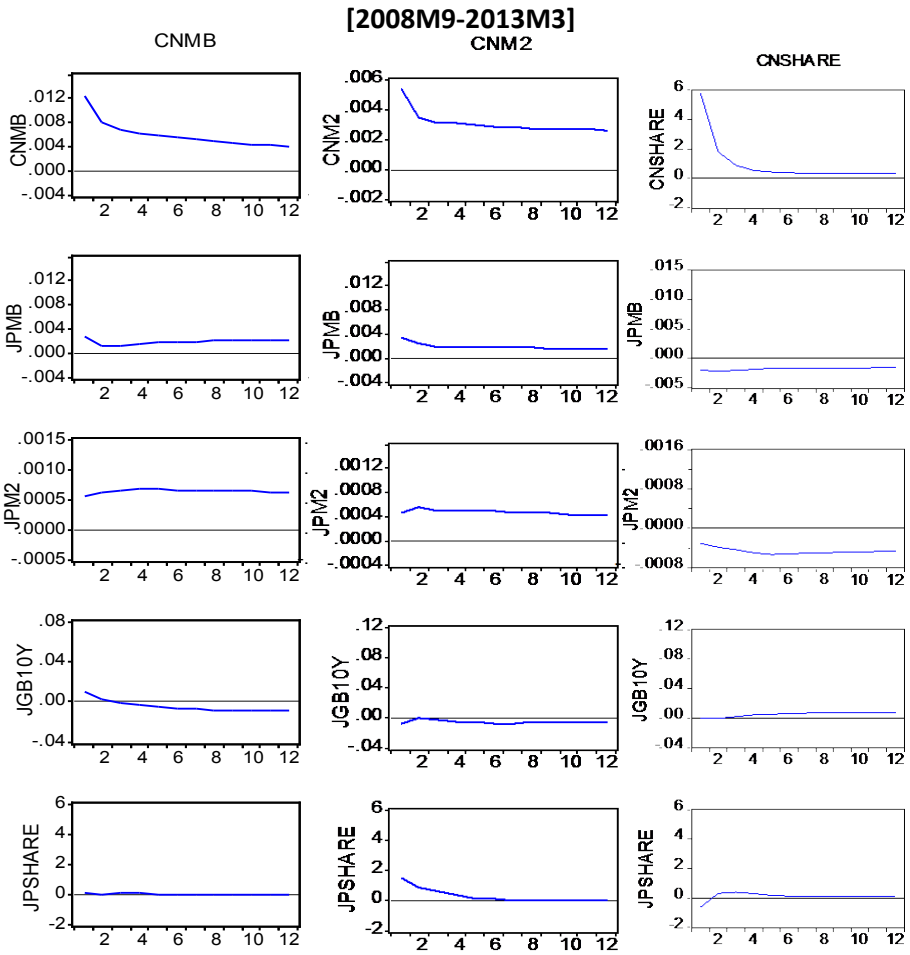

Fig.11-1: Impact of China on Japan (Sept.2008- Mar.2013)

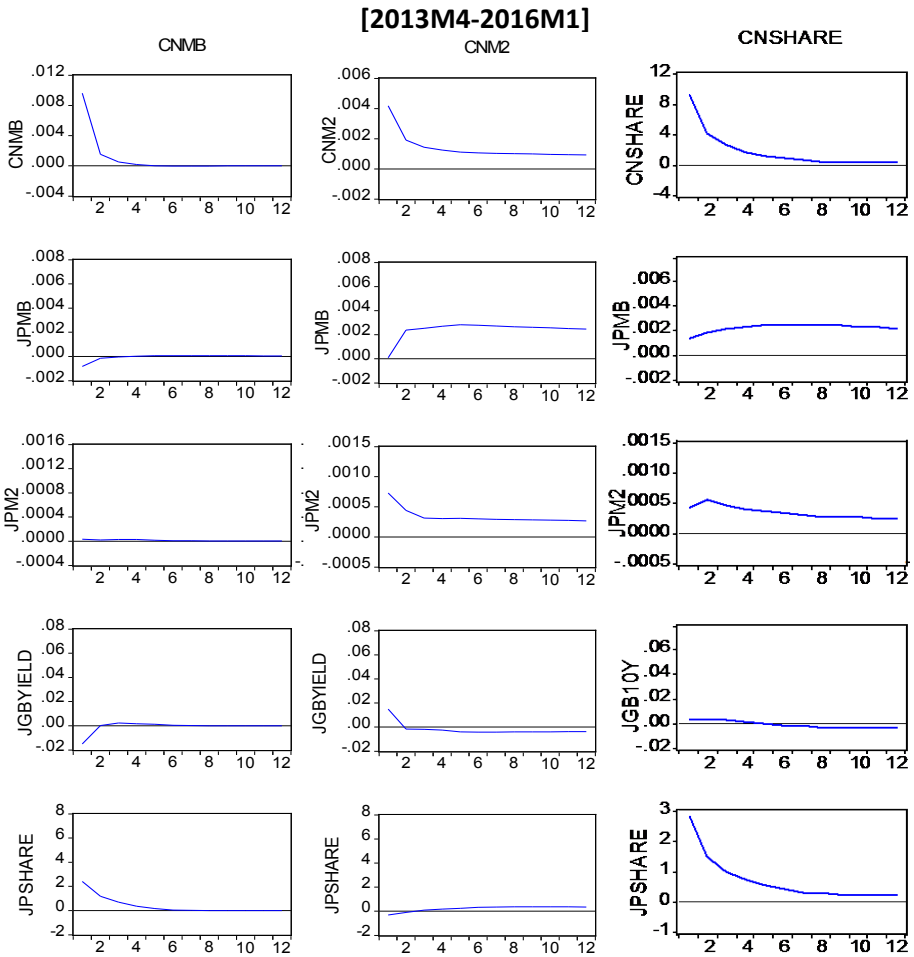

Fig.11-2: Impact of China on Japan (Apr.2013- Jan.2016)

[2014M11-2019M12]

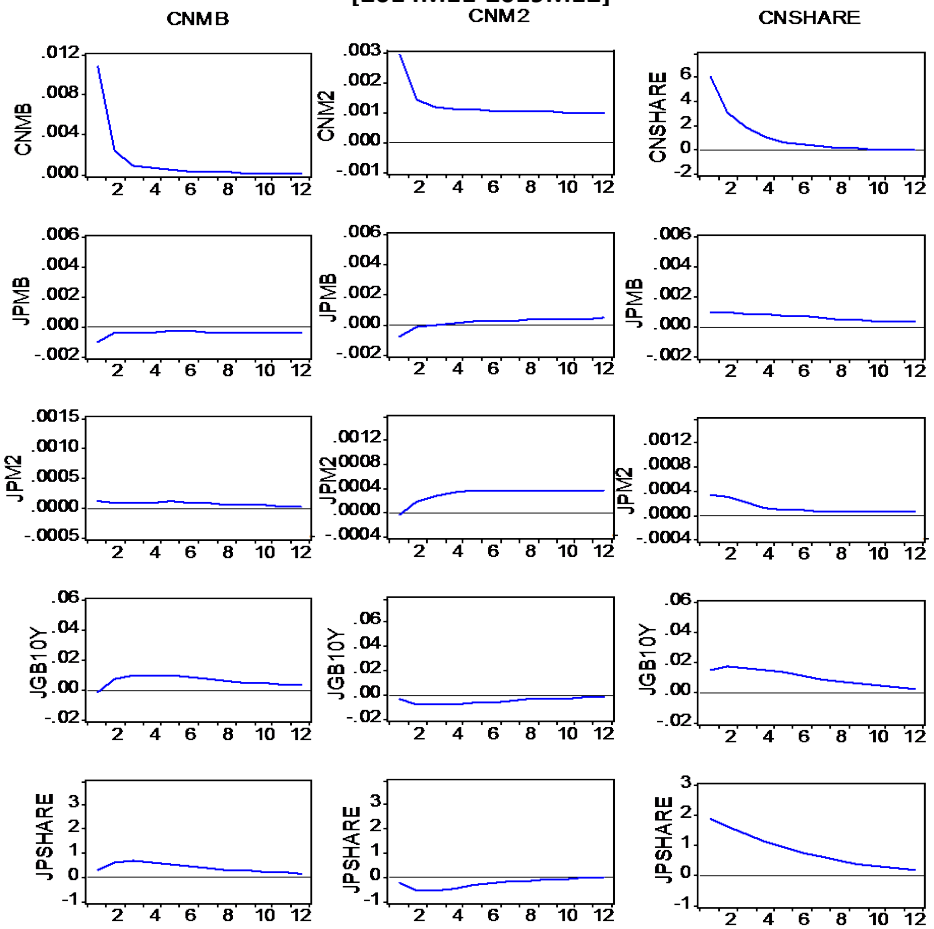

Fig.11-3: Impact of China on Japan (Nov.2014-Dec.2019)

[2016M2-2019M12]

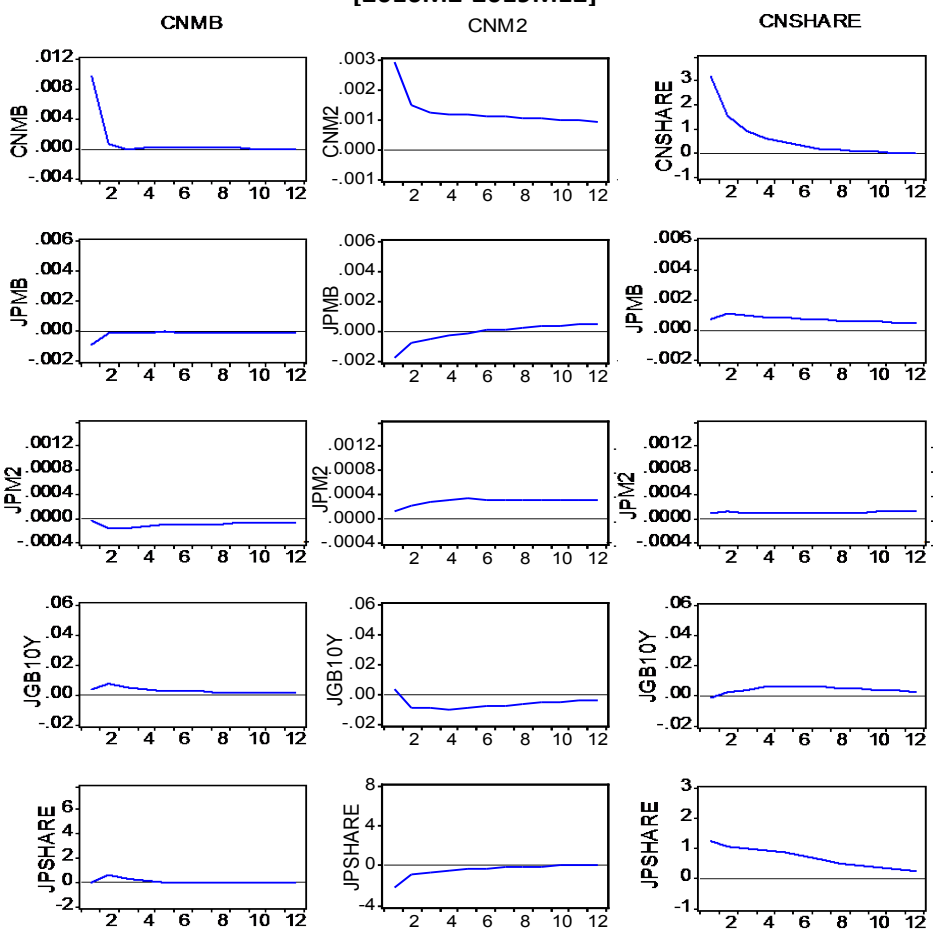

Fig.11-4: Impact of China on Japan (Feb.2016-Dec.2019)

3.3.3 Impact of BOJ monetary easing on the HK market

Japan's monetary base (**JPMB**) and money stock (**JPM2**) had a positive and significant impact on both of the monetary base (**HKMB**) and money stock (**HKM**2) in Hong Kong, though the latter had a more pronounced effect. While **t**he yield of government bonds (**JGB 10Y**) had a negative impact on **HKM2**, rising JGB yields are driving down HK interbank rates (HKIntrate) and put negative impact on HK stock prices (**HKShare**). Stock prices in Japan (**JPShare**) also had a significantly positive impact on Hong Kong stock prices (**HKShare**) .

(a) Post-Global Financial Crisis（incl. Comprehensive Monetary Easing, CME）[Sept. 2008-Mar.2013]

The money base (**JPMB**)and money stock in Japan (**JPM2**) had a positive and significant impact on the Hong Kong money stock (**HKM2**) (Fig. 12-1). Japan's stock prices (**JPShare**) put a negative impact on the Hong Kong monetary base (HKMB) and money stock (**HKM2**) and decrease in HK interbank rate (HKInterbank). At the same time, Japan's stock prices (**JPShare**) had a positive effect on Hong Kong equity prices (HKShare). These results may indicate that short-term investments from Japan were fairly active through commercial banks even before the QQE.

(b) Quantitative and Qualitative Monetary Easing (QQE）(1) (before negative interest rate policy [Apr. 2013-Jan.2016]

During the QQE period from April 2013 to January 2016 under the "zero interest rate" policy prior to the negative interest rate policy (Fig.12-2), the Bank of Japan's monetary base (**JPMB**) and money stock (**JPM2**) as well as Share prices (**JPShare**) had a significant impact on the Hong Kong share prices (**HKShare**) during this period.

(c) QQE Ⅱ [Nov.2014-Dec.2019]

When the Bank of Japan introduced further expansion of monetary easing as the second phase of QQE (QQE II) in November 2014, stock trading in Hong Kong and Shanghai markets were integrated. These have facilitated further capital and financial liberalization between mainland China and Hong Kong.

In the Hong Kong market, the Japan's monetary base (**JPMB)** and money stock (JPM2) had a significant positive impact on the Hong Kong money stock (**HKM2)** (Fig.12-3). The expansion of Japan's money stock (**JPM2**) had also an impact on the Hong Kong interbank interest rate **(HKInterbank).** Furthermore, Japanese stock prices (JPShare) have a positive and significant impact on Hong Kong stock prices (HKShare), which also reduces Hong Kong's interbank interest rate. It indicates that investment from Japan to Hong Kong market was expanding during this period.

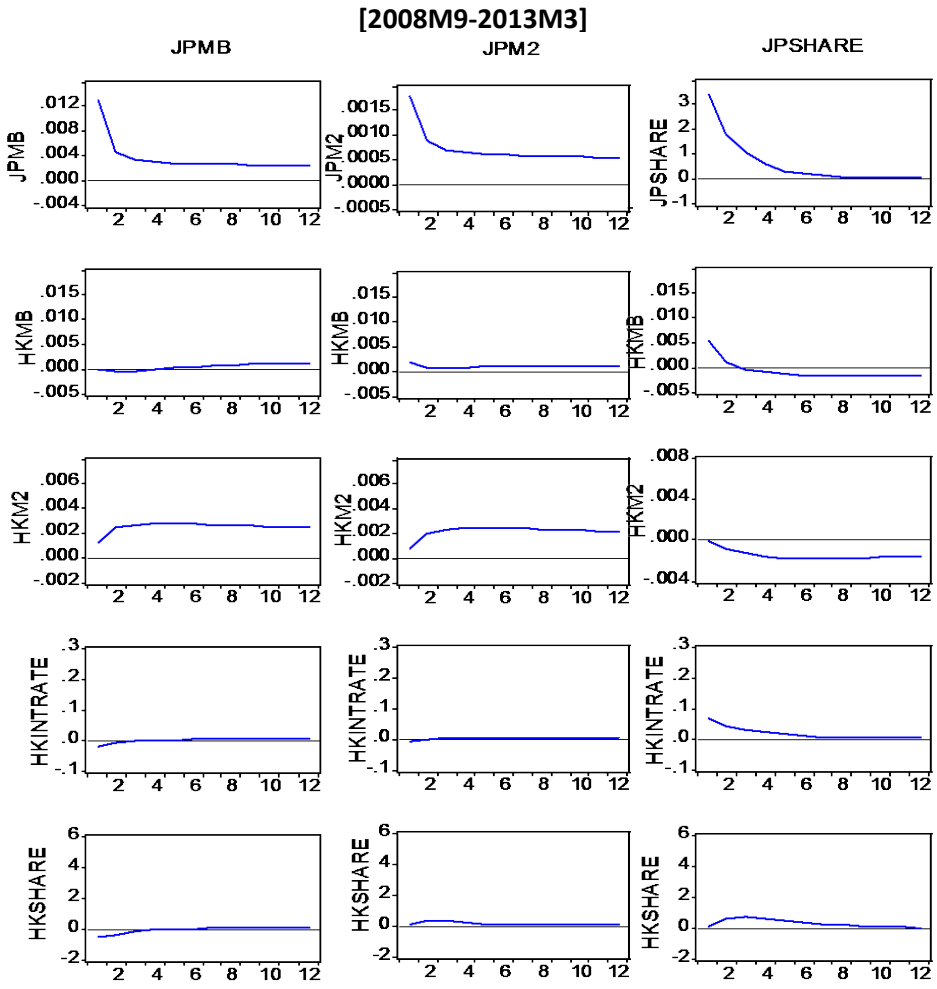

Fig.12-1: Impact of Japan on HK (Sept.2008- Mar.2013)

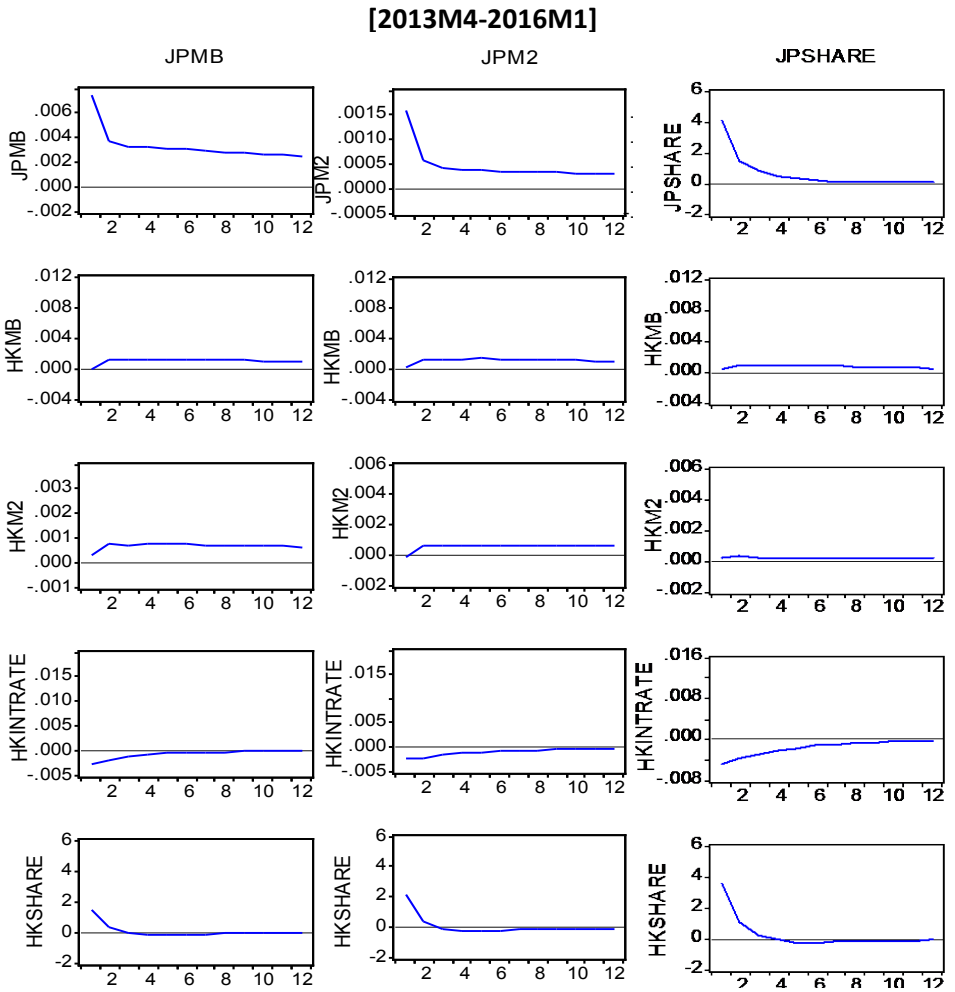

Fig.12-2: Impact of Japan on HK (Apr.2013- Jan.2016)

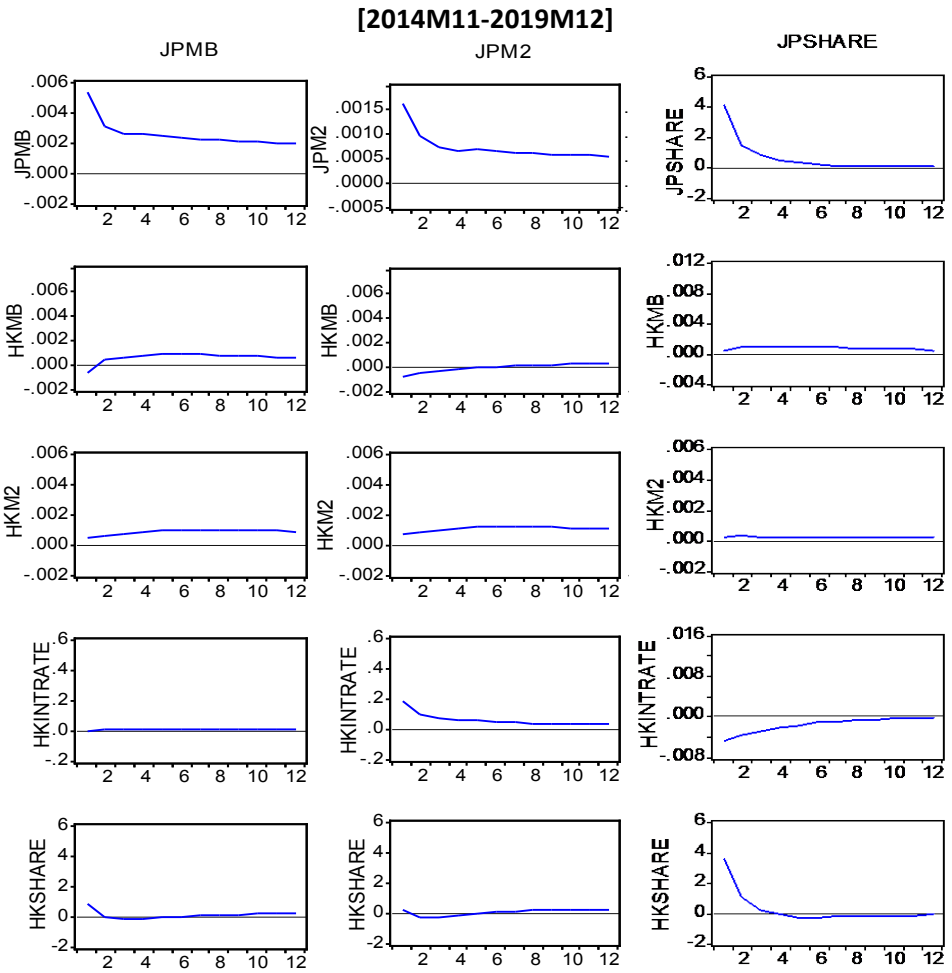

Fig.12-3: Impact of HK on Japan (Nov.2014-Dec.2019)

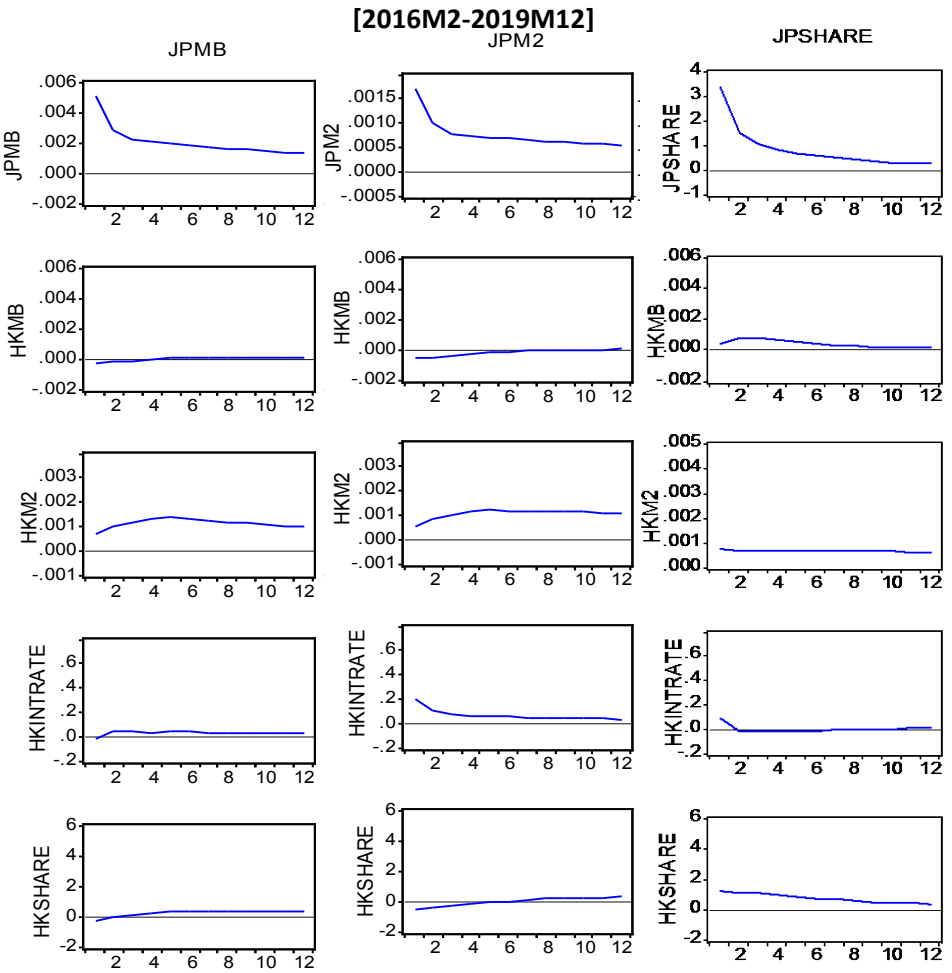

Fig.12-4: Impact of HK on Japan (Feb.2016-Dec.2019)

(d) QQE (2) (under Negative Interest, Feb.2016-Dec.2019)

After introduction of negative interest rate policy by BOJ, the impact of the mutual liberalization of stock trading between Hong Kong and Shenzhen markets from December 2016 has had a significant impact on trading between Japan, Hong Kong and China.

The Japan's monetary base (**JPMB**) and money stock (**JPM2**) had a significant positive effect on the Hong Kong money stock (**HKM2**). JPMB and JPM2 put some impact on the interbank interest rate in Hong Kong (**HK interbank**)(Fig.12-4). However, the impact of Japanese stock (**JPShare**) prices on Hong Kong interbank rates(**HK interbank**) and share prices (**HKShare**) has been limited during this period. This is likely to have been influenced by the integration of the Hong Kong and mainland China stock markets and the introduction of capital controls by the Chinese authorities.

3.3.4 Impact from HK to Japan

(a) Post-Global Financial Crisis（incl. Comprehensive Monetary Easing, CME）[Sept.2008-Mar.2013]

HK money stock (**HKM2**) also put positive effects on Japan's monetary base (**JPMB**) as well as money stock (**JPM2**), while Hong Kong Monetary base (**HKMB**) had some effect on share prices in Japan and government bonds in Japan (**JGB10Y**) in decreasing the yield. Hong Kong stock prices also generated a decline in JGB yields, (**JGB10Y**) but had little impact on Japanese stock prices (**JPShare**) (Fig.13-1). Thus, the impact on the Japanese market was limited during this period.

(b) Quantitative and Qualitative Monetary Easing (QQE）(1) (before negative interest rate policy [Apr.2013-Jan.2016]

Both of Hong Kong monetary base **(HKMB**) and money stock (**HKM2**) had positive responses of Japan's monetary base (**JPMB**) and money stock (**JPM2**). However, Hong Kong HKMB and HKM2 had not significant effect on Japan's stock prices (**JPShare**) (Fig.13-2). However, Hong Kong share prices**(HKShare**) had a positive and significant effect on Japanese share prices(**JPShare**).

(c) QQE Ⅱ [Nov.2014-Dec.2019]

Hong Kong's monetary base (**HKMB**) had positive effect on Japan's monetary base (JPMB). Hong Kong money stock **(HKM2**) also had a positive and significant impact on Japan's money stock in Japan (**JPM2**). (Fig.13-3). The Hong Kong money stock (**HKM2**) positively affected on the stock price in Japan (**JPShare**). It should be noted here that the response function of **JGB10Y** to **HKMB** is negative. Furthermore, Hong Kong stock prices (**HKShare**) have increased the yield on JGBs (**JGB10Y**), which in turn has significantly increased the Japanese stock prices (**JPShare**). This may indicate

that JGBs have been used as an alternative financial investment to Japanese equities for Hong Kong investors. As in the case of China, investment from Japan had a significant impact from the financial markets in Hong Kong.

(d) QQE (2) (under Negative Interest) [Feb.2016-Dec.2019]

Hong Kong's monetary base (**HKMB**) had positive effects on Japan's monetary base (**JPMB**) as well as stock prices significantly in Japan (**JPShare**). Money stock in HK (**HKM2**) also had a positive response of Japan's monetary base (**JPMB**) and the money stock in Japan (**JPM2**) (Fig13-4). Furthermore, Hong Kong share prices (**HKShare**) have caused Japanese share prices (**JPShare)** to rise.

The above results may suggest that stocks and bonds are traded as alternative investments for Hong Kong investors. In other words, substantial investment from the Hong Kong market was made through equity trading, and JGBs were used as an alternative investment to stocks in the market in Japan.

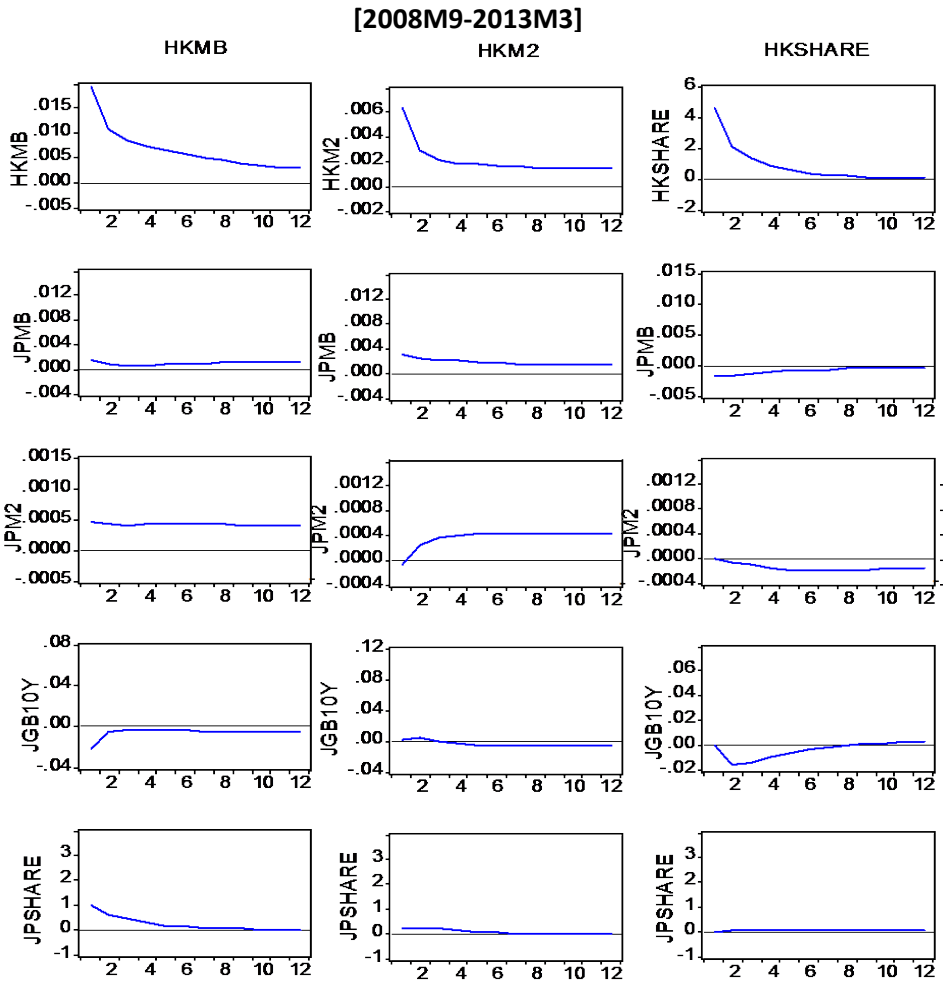

Fig.13-1: Impact from HK to Japan (Sept.2008-Mar.2013)

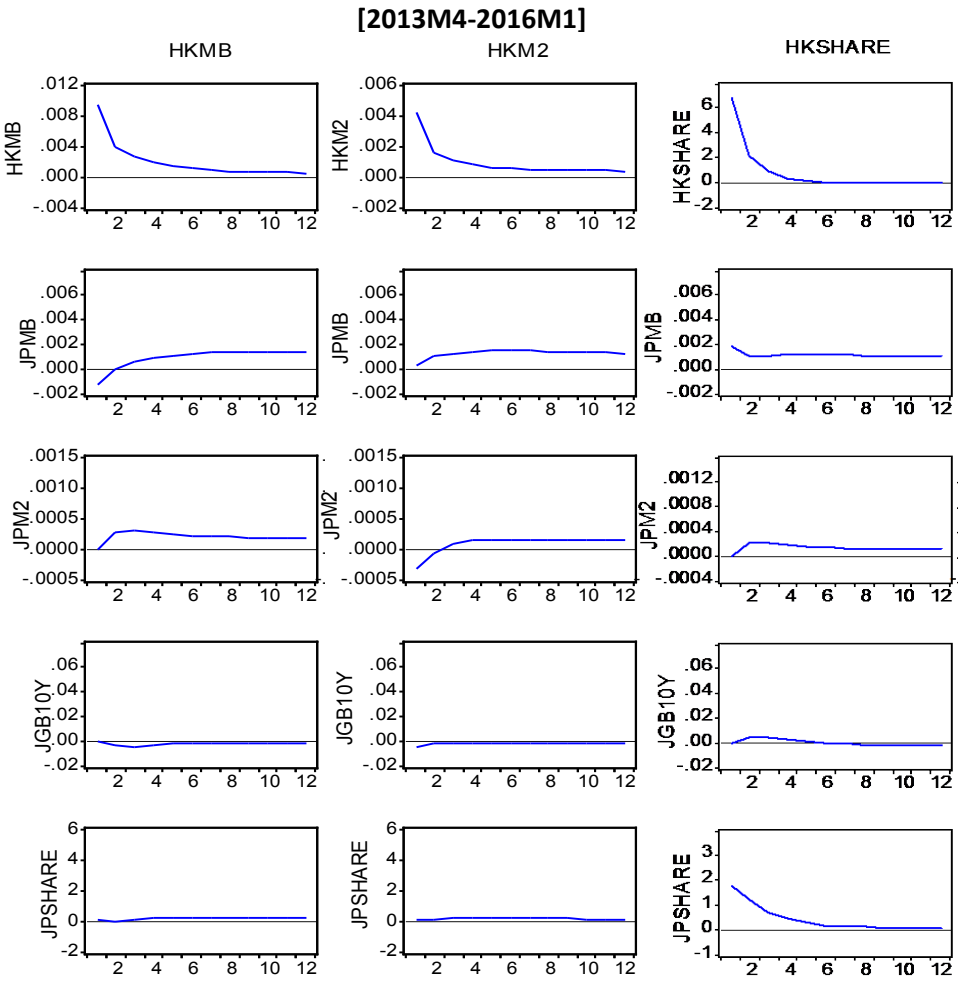

Fig.13-2: Impact from HK to Japan (Apr.2013-Jan.2016)

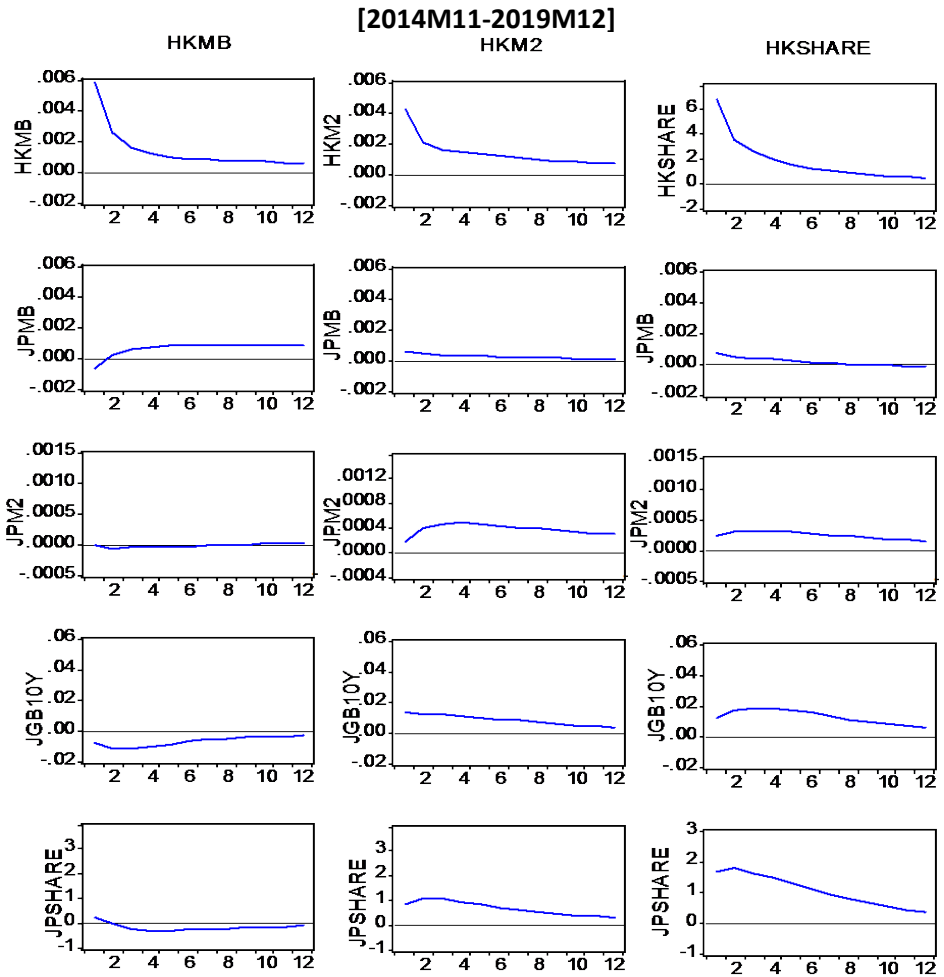

Fig.13-3: Impact from HK to Japan (Nov.2014-Dec.2019)

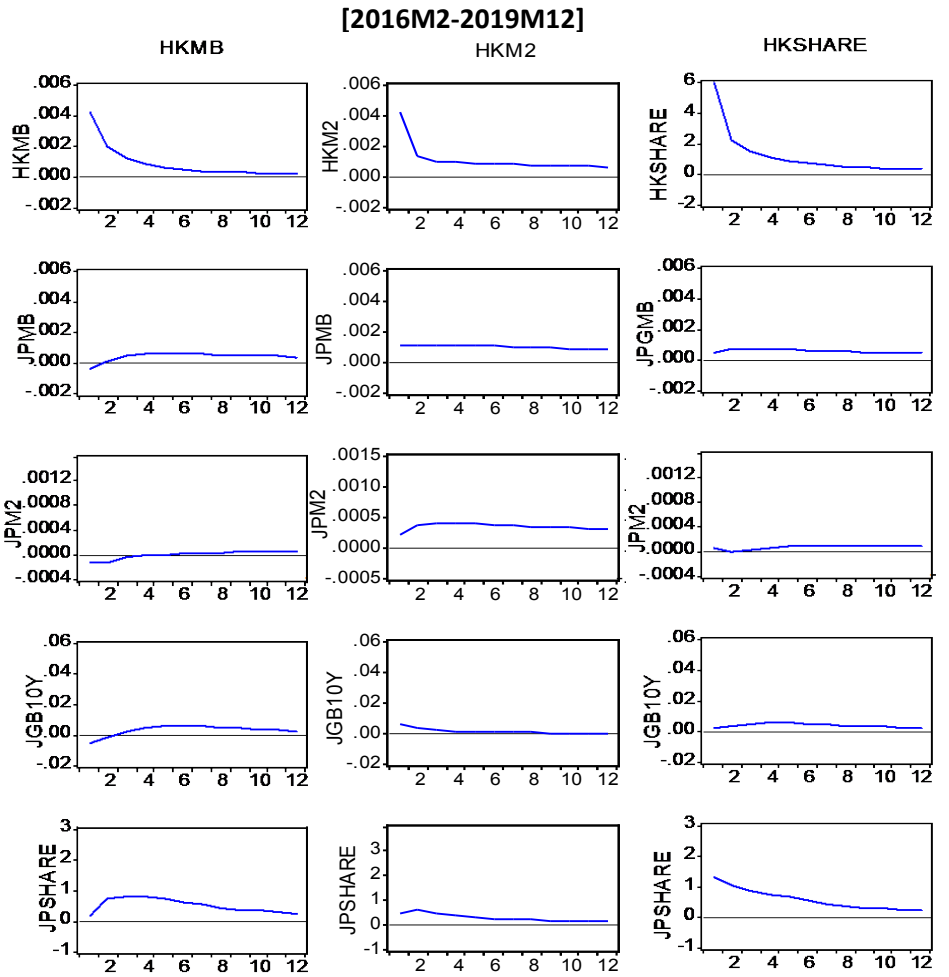

Fig.13-4: Impact from HK to Japan (Feb.2016-Dec.2019

3.3.5 Impact of HK on China

(a) Post-Global Financial Crisis（incl. Comprehensive Monetary Easing, CME）[Sept. 2008-March 2013]

Hong Kong's monetary base (**HKMB**) and money stock (**HKM2**) had a positive impact on China's monetary base (**CNMB**), while **HKM2** had a negative response of **CNMB** (Fig.14-1)**.** Both **HKMB and HKM2** had no significant response of industrial production (**CNProd**) in China. On the other hand, Hong Kong monetary base(**HKMB**) had a positive and significant impact on China's stock prices (**CNShare**).

(b) QQE (1) (before negative interest rate policy [Apr.2013-Jan.2016]

Both Hong Kong monetary base (**HKMB**) and money stock (**HKM2**) had a significantly positive impact on China's money stock (**CNM2**) (Fig.14-2).
On the other hand, the HK stock prices (**HKShare**) had a significant positive impact on **CNShare**. During this period, BOJ's monetary easing (QQE) might have put some impact upon the money flows from HK to China.

(c) QQE Ⅱ [Nov.2014-Dec.2019]

Due to the stock market integration between Hong Kong (HK) and Shanghai since November 2014, the capital flows between HK and China might have significantly changed during this period (Fig.14-3). Hong Kong's share price (**HKShare**) had a significant and positive impact on China's share price (**CNShare**) [15], while the impact of China's monetary base (**CNMB**) and money stock (**CNM2**) on Hong Kong's money stock (**HKM2**) was limited.

(d) QQE (2) Negative Interest [Feb.2016-Dec.2019]

The HK monetary base (**HKMB**) and money stock (**HKM2**) had limited effects on monetary base (**CNMB**) and money stock (**CNM2**) in China during this period (Fig.14-4). However, both **HKMB** and **HKM2** as well as China's Stock prices (**CNShare**) had a positive and significant impact on China's stock prices **(CNShare**). The integration of the stock markets between Hong Kong (HK) and Shenzhen in December 2016, in addition to Shanghai from November 2014, appears to have contributed mainly to capital flows from Hong Kong to China, mainly to equity trading.

[15] This has been proved by the author's estimation in a separate study.

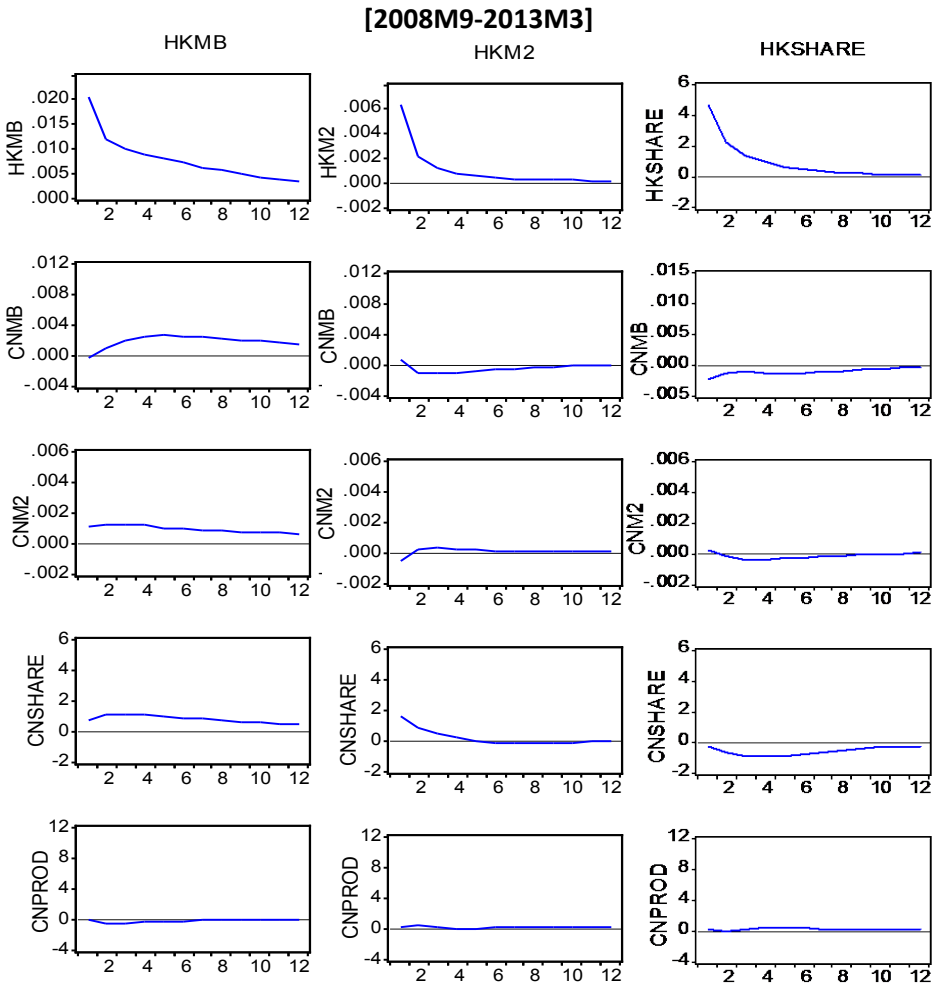

Fig.14-1: Impact of HK on China (Sept.2008- Mar.2013)

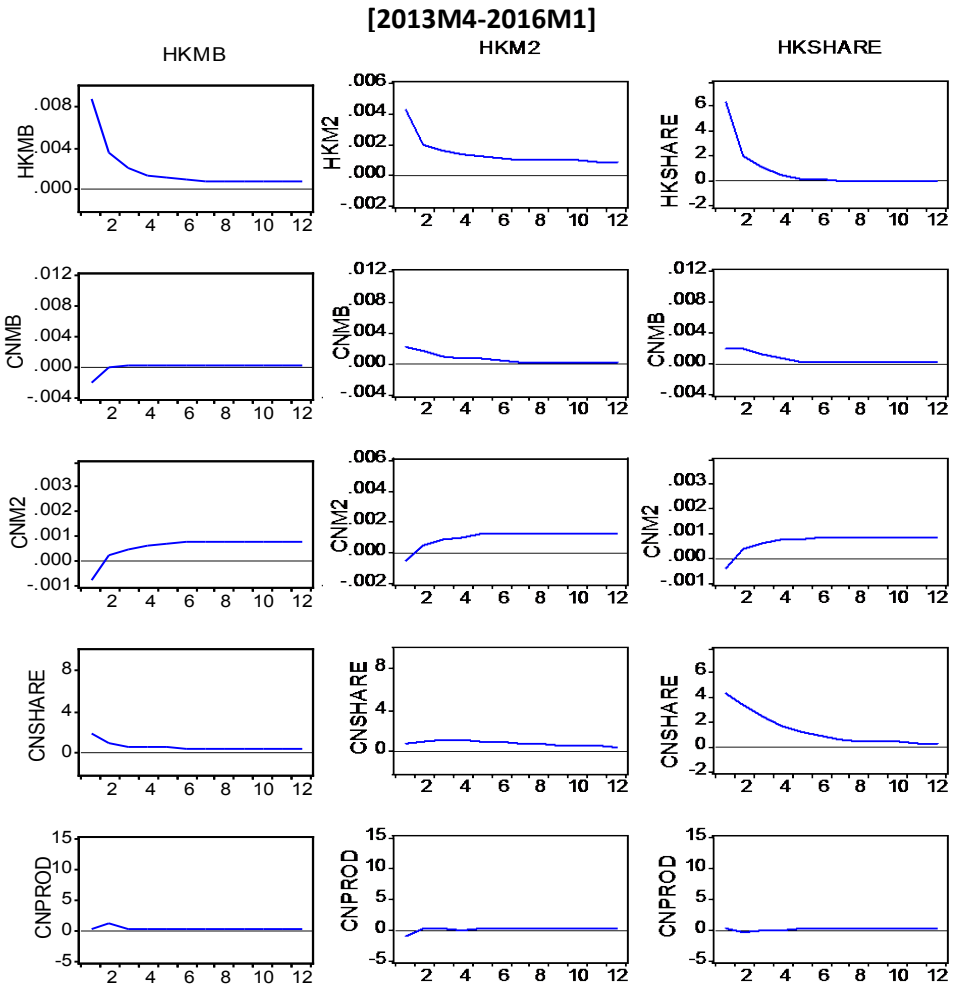

Fig.14-2: Impact of HK on China (Apr.2013- Jan.2016)

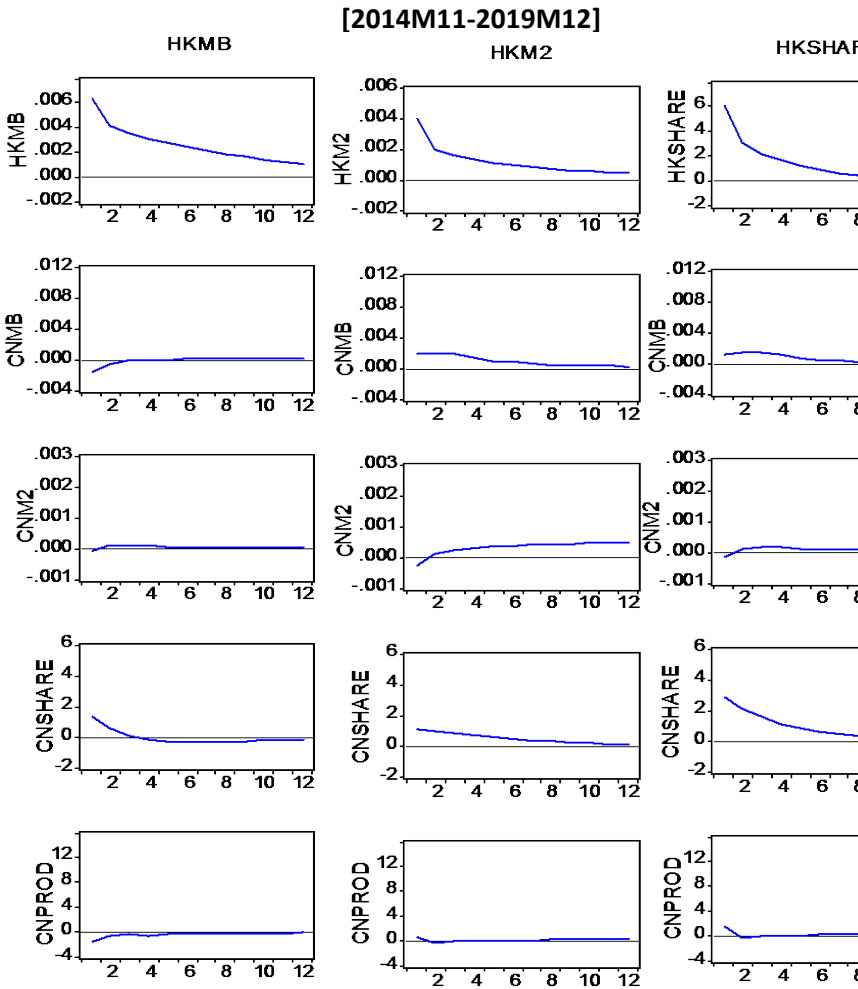

Fig.14-3: Impact of HK on China (Nov.2014-Dec.2019)

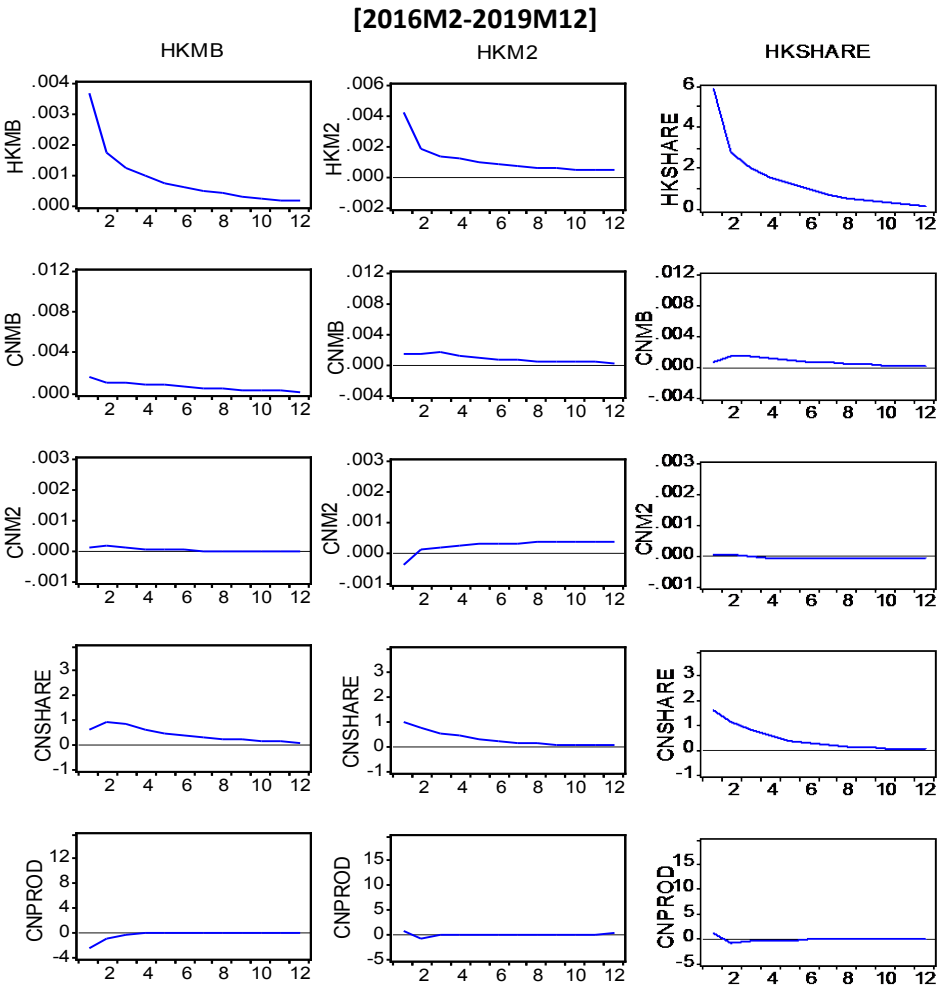

Fig.14-4: Impact of HK on China (Feb.2016-Dec.2019)

3.3.6 Impact of China on HK

(a) Post-Global Financial Crisis [Sept.2008-Mar.2013]

CNMB and **CNM2** had a positive and significant impact on **HKM2**, although that on **HKMB** was not statistically significant. Both **CNMB** and **CNM2** had limited effects on HK interest rates and stock prices during this period (Fig.15-1) [16].

(b) QQE (1) (before negative interest rate policy [Apr.2013-Jan.2016]

Although China's money stock (**CNM2**) had positive impact on the HK monetary base (**HKMB**), China's monetary base (**CNMB**) had little impact on both **HKMB** and **HKM2** (Fig.15-2). This may indicate that resources of commercial banks were the main source of investment in both the Chinese market.

On the other hand, Chinese stock prices (**HKShare**) have a very significant impact on Hong Kong interbank rates (**HKInterbank**) and stock prices (**HKShare**).

(c) QQE Ⅱ [Nov.2014-Dec.2019]

Due to the stock market integration between Hong Kong (HK) and Shanghai since November 2014, the capital flows between HK and China have significantly changed during this period (Fig.15-3).

China's monetary base(**CNMB**) and money stock (**CNM2**) had some positive impact on HK money stock (**HKM2**). Monetary base in China (**CNMB**) and China's share prices (**CNShare**) put a significant effect on HK stock prices (**HKShare**). Thus, the impact of the stock market consolidation in Hong Kong and Shanghai was more pronounced on money flows from China to the Hong Kong market.

(d) QQE (2) Negative Interest [Feb.2016-Dec.2019]

China's monetary base(**CNMB**) had significantly positive towards **HKMB**. **CNM2** also put significantly positive response of **HKM2** during the period (Fig.15-4). It is also noted that **HKShare** had significant response effect from Monetary base in China (**CNMB**).

Overall, the response to the Hong Kong market was limited in this period compared to the previous QQE period (Apr 2013 - Jan 2016). This appears to be due to the fact that financial investment from China was expanding towards the Japanese market during this period.

[16] As mentioned above, while stock prices in China (CNShare) had a significant positive impact on HK stock prices (HKShare), which may indicate that China's investment might be directed to the stock market in HK during the period. This can be confirmed by the fact that Hong Kong stocks have reacted positively to Chinese stock prices over the period.

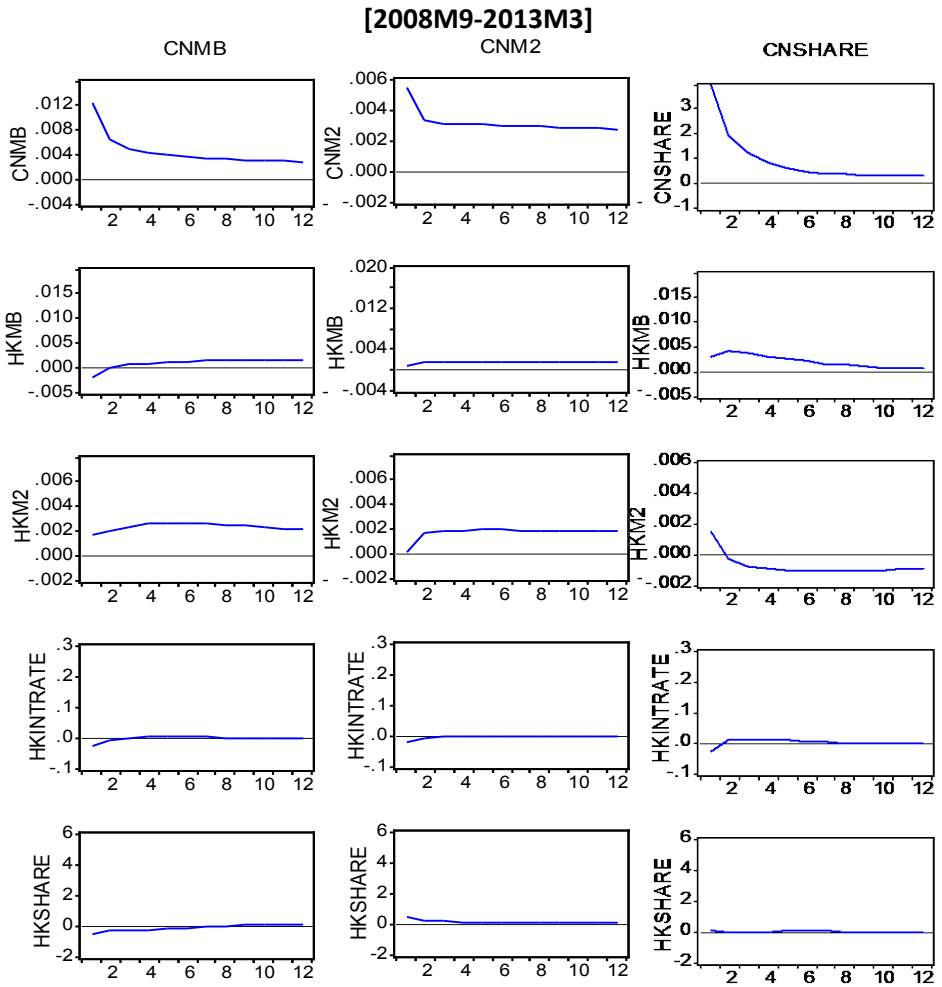

Fig.15-1: Impact of China on HK (Sept.2008- Mnr.2013)

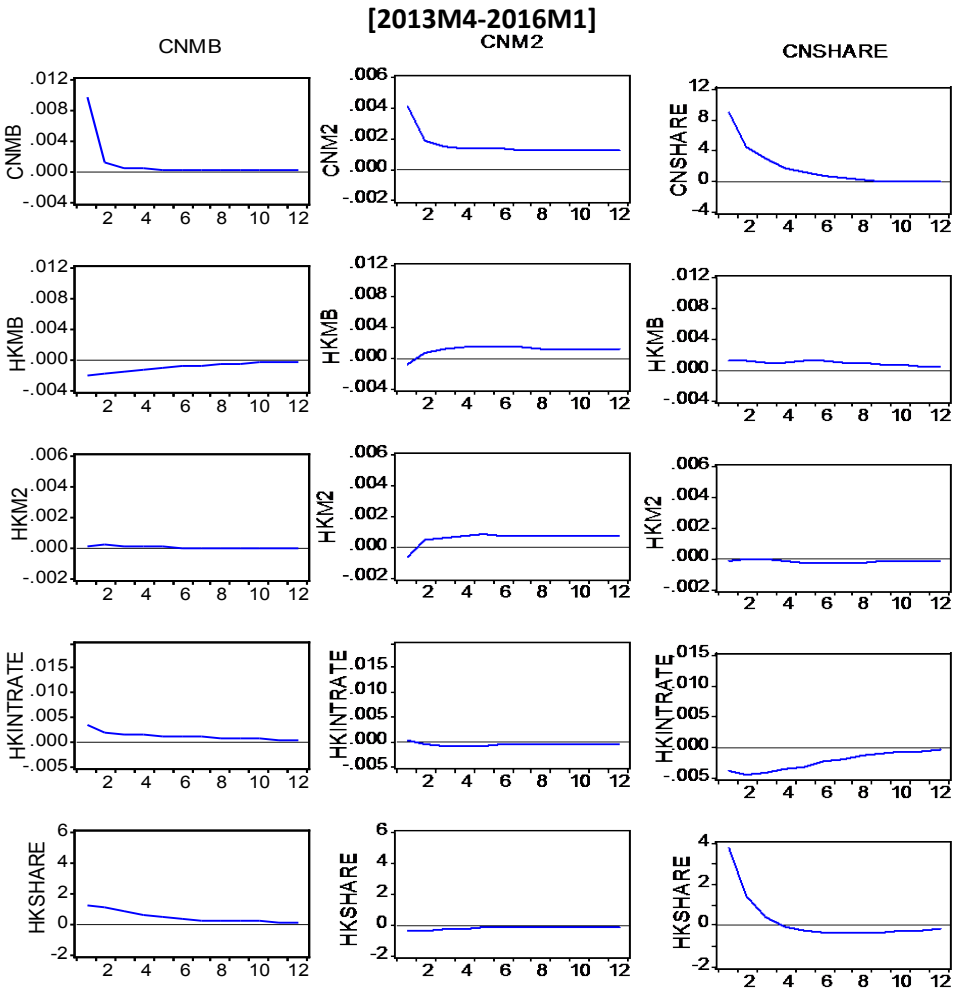

Fig.15-2: Impact of China on HK (Apr.2013- Jan.2016)

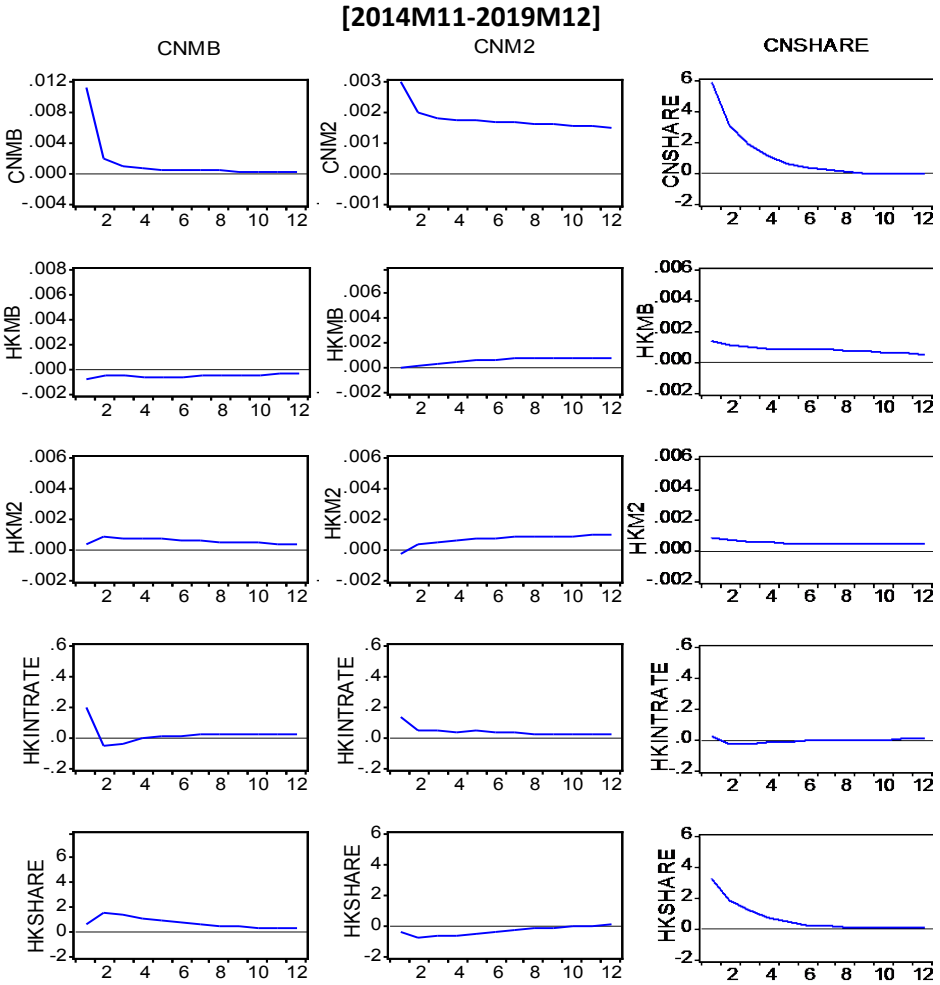

Fig.15-3: Impact of China on HK (Nov.2014-Dec.2019)

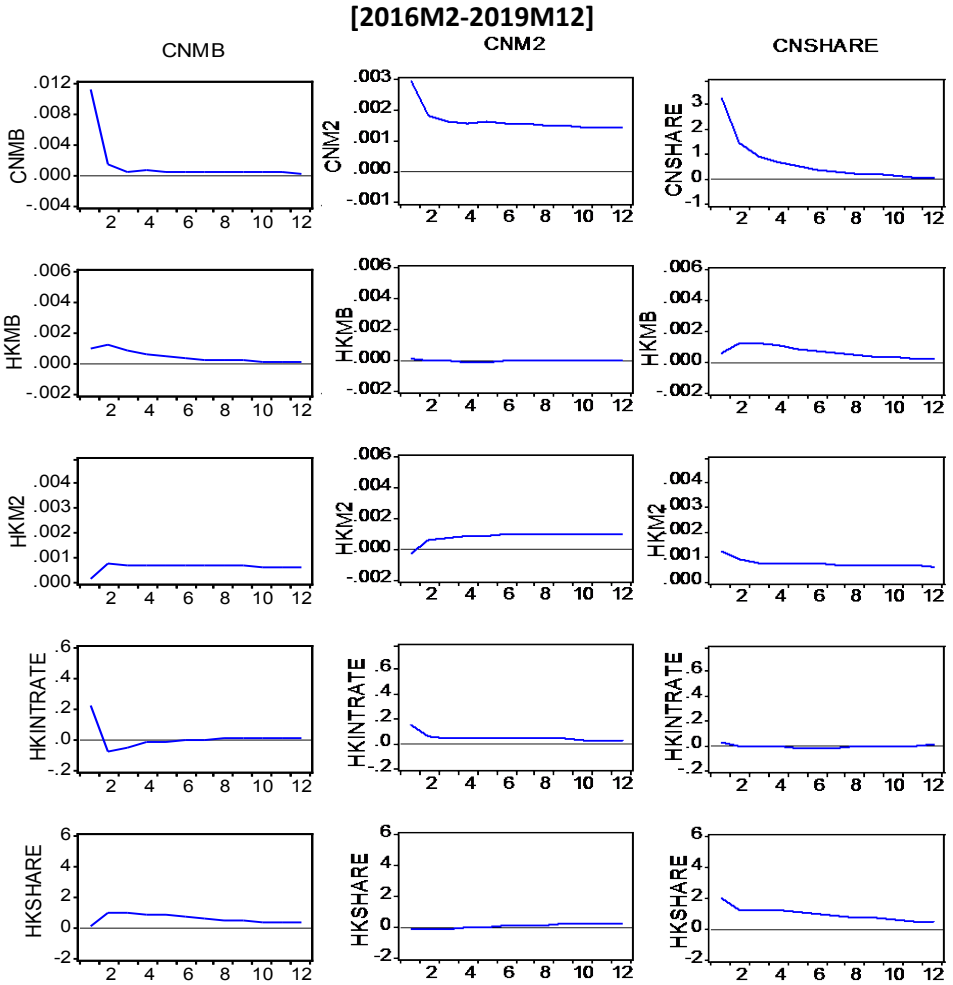

Fig.15-4: Impact of China on HK (Feb.2016-Dec.2019)

The above facts may indicate that official flows of investment from China to the HK market has increased, and that the stock markets integration between China and HK have had significant impact on the HK market since 2014.

It is also noted that commercial banks in China and Hong Kong were making full use of the BOJ's money supply in the financial markets, as well as the real economy in the case of China. The increased impact of Japan's money stock (**JPM2**) on the HK and China's money stock (**HKM2** and **CNM2**) was one of the consequences of the significant changes in money flows between the markets in Japan, Hong Kong and China.

3.3.7 Summary of Impulse Response Functions

Using the impulse response function based on the BVAR model, the spillover effects of the Bank of Japan (BOJ)'s monetary easing policy on the China and Hong Kong markets can be summarized as follows.

During the period from the Global Financial Crisis (2008) to just before the QQE, including the Comprehensive Monetary Easing (CME) [Oct.2010-Mar.2013], the financial market had a significant positive impact on the Hong Kong/China markets in terms of monetary base and money stock. The Bank of Japan's introduction of QQE in April 2013 triggered massive capital inflows into the Hong Kong and Chinese markets as a spillover effect of the Bank's extraordinary monetary easing.This had a significant direct impact on China's money stock (M2) rather than the monetary base.

The above results show that the BOJ's monetary easing mainly had an effect on the Hong Kong market money stock (HKM2), whereas the Chinese monetary base (CNMB) and money stock (CNM2) had a positive effect on the money stock in Japan (JPM2). It also shows that the monetary easing introduced by the BOJ during this period led to increased capital inflows into the Chinese market and Hong Kong bank accounts. Furthermore, the integration of the capital markets of Hong Kong and mainland markets (Shanghai [Nov.2014] and Shenzhen[Dec.2016]) has greatly facilitated and changed the capital flows between China, Hong Kong and Japan. Particularly, financial investments from China to Japan are now made not only via Hong Kong but also directly.

Therefore, the impact of capital inflows from China to Hong Kong and Japan tends to be larger than the impact of capital inflows from Japan to Hong Kong and China these days. In other words, the BOJ's QQE not only had a significant impact on the Chinese and Hong Kong markets, but conversely had a significant impact on the Japanese financial and capital markets (e.g., stock prices) from China and Hong Kong.

3.4 Variance Decomposition

The variance decomposition is basically based on BVAR models for each period. In this section, variance decomposition of relevant variables will be examined to identify to what extent the BOJ's monetary easing has affected and influenced on the markets in

HK and China, and how HK and China have put impact on the market in Japan.

3.4.1 Variance Decomposition of Japan's monetary base (JPMB), money stock (JPM2) on the markets in China

In the tenth period of the variance decomposition of China's monetary base (CNMB) before the introduction of the Bank of Japan's Quantitative and Qualitative easing (QQE) (September 2008-March 2013), the share of Japan's monetary base (JPMB) was limited(Fig.16). However, the impact of Japan's monetary base (JPMB) and money stock (JPM2) on China's money stock (CNM2) in the early QQE period (April 2013-January 2016), before the introduction of the negative interest rate period of the Bank of Japan, rose in the 10th period. Moreover, in the same period, the share of Japanese money stock (JPM2) in the 10th period of variance decomposition on Chinese money stock (CNM2) increased significantly to more than 60% in the 10th period. However, in the second period of QQE, i.e., after November 2014 when the markets with Hong Kong and China were integrated (-December 2019), the share was slightly declined to about 30% and this trend continued in the late period of QQE after the period from February 2016 to December 2019.

On the other hand, in the tenth period of the variance decomposition of China's stock price (CNShare) before the introduction of QQE (September 2008 to March 2013), both the Japanese monetary base (JPMB) and money stock (JPM2) did not account for a large share. However, in the QQE period (April 2013-January 2016), their shares of JPMB and JPM2 increased significantly. In the share of variance decomposition of stock prices in China (CNShare) Japan's Share prices (JPShare) also rose significantly in that of during the period. However, in both the QQE II period (November 2014-December 2019) after the integration of the China-Hong Kong market and during February 2016-December 2019, the shares of JPMB and JPM2 as JPShare in the variance decomposition of Chinese stock prices has declined significantly.

This can be attributed to the liberalisation of equity trading in Hong Kong and Shanghai (Nov.2014)/ Shenzhen(Dec. 2016), as well as the tighter capital controls introduced by the Chinese government from late 2016. It also indicates that substantial investment from China, which had already seen an increase in inflows into the Hong Kong market since the integration of the stock markets, had already taken place and that funds from Japan had declined over this period.

The share of JPM2 in the 10th period of the variance decomposition of Chinese industrial production (CNProd) was 11.5% in the Apr. 2013-Jan.2016 period, while the shares of JPM2 in the QQE II period and the late QQE period (Feb.2016-Dec19), the share of Japan's money stock(JPM2) rose to around 20%. The results show that QQE has had a significant impact on Chinese industrial production.

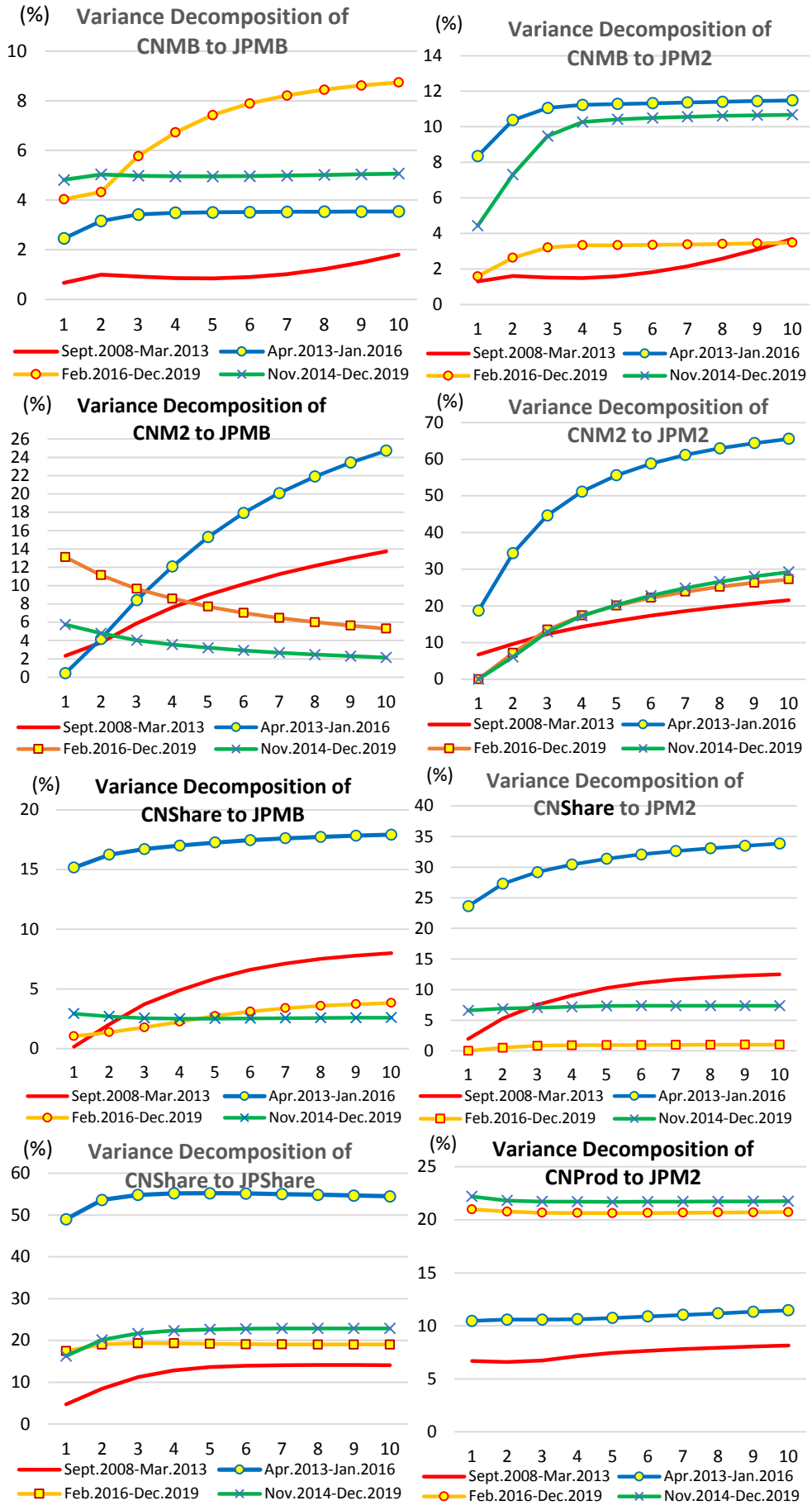

Fig.16: Variance Decomposition (Impact of Japan on China)

3.4.2 Variance Decomposition of China's monetary base (CNMB), money stock (CNM2) on the markets in Japan

China's monetary base (CNMB) and money stock (CNM2) have had some impact on Japan's monetary base (JPMB) and money stock (JPM2) even before the introduction of QQE as shown in the shares of China's monetary base (CNMB) and M2 (CNM2) in the 10th period (September 2008-March 2013) (Fig.17). In the early QQE period (April 2013-January 2016) before the introduction of the negative interest rate policy, the share of CNM2 increased significantly to 31.3% in the 10th period of variance decomposition of JPMB. However, in the late QQE period (February 2016-December 2019) after the introduction of the negative interest rate of the Bank of Japan, the share of CNMB in the variance decomposition of JPMB was almost negligible, and the influence of CNM2 has become the majority.

In the variance decomposition analysis of the Japanese money stock (JPM2) in the 10th period, the shares of CNMB and CNM2 were relatively large before the introduction of QQE (September 2008 - March 2013); the share of CNMB in the variance decomposition of JPM2 declined in the early stages of QQE, but remained high during QQE II (November 2014 - December) and maintained a high share of around 20% in the late QQE period (after the introduction of negative interest rates, February-December 2016), and around 30% in the late QQE period (after the introduction of negative interest rates, February-December 2016). Furthermore, CNM2's share in the variance decomposition of JPM2 decreased to just under 20% in QQE II (November 2014-December 2019) and in the late QQE period.

The impact of China's money stock (CNM2) on the yield on 10-year Japanese government bonds (JGB10Y) has risen to 12.9% in the 10th period of variance decomposition recently (February 2016-December 2019). Moreover, The share of CNMB in the variance decomposition of Japanese stock prices (JPShare) increased in the first half of the QQE, and CNM2's share slightly increased in the second half of the QQE (2016.2-2019.12). On the other hand, Chinese stock prices (CNShare) accounted for a large share in the tenth period of the variance decomposition of Japanese stock prices (JPShare) during the early period of QQE (April 2013-January 2016), However, in the late QQE period, the share of Chinese stock prices in the variance decomposition of Japanese stock prices (CNShare) has decreased. The results suggest that Chinese money invested in the Japanese market after the introduction of QQE has shifted significantly from the monetary base (CNMB) to the money stock (CNM2). It is worth noting here that this shift has also been evident in the financial market and the possibility of diversification in investment in Japan. Chinese inflows have recently had an impact on other assets rather than on the financial sector in Japan. In particular, this can be seen in the recent increase in Chinese investment in Japanese real estate.

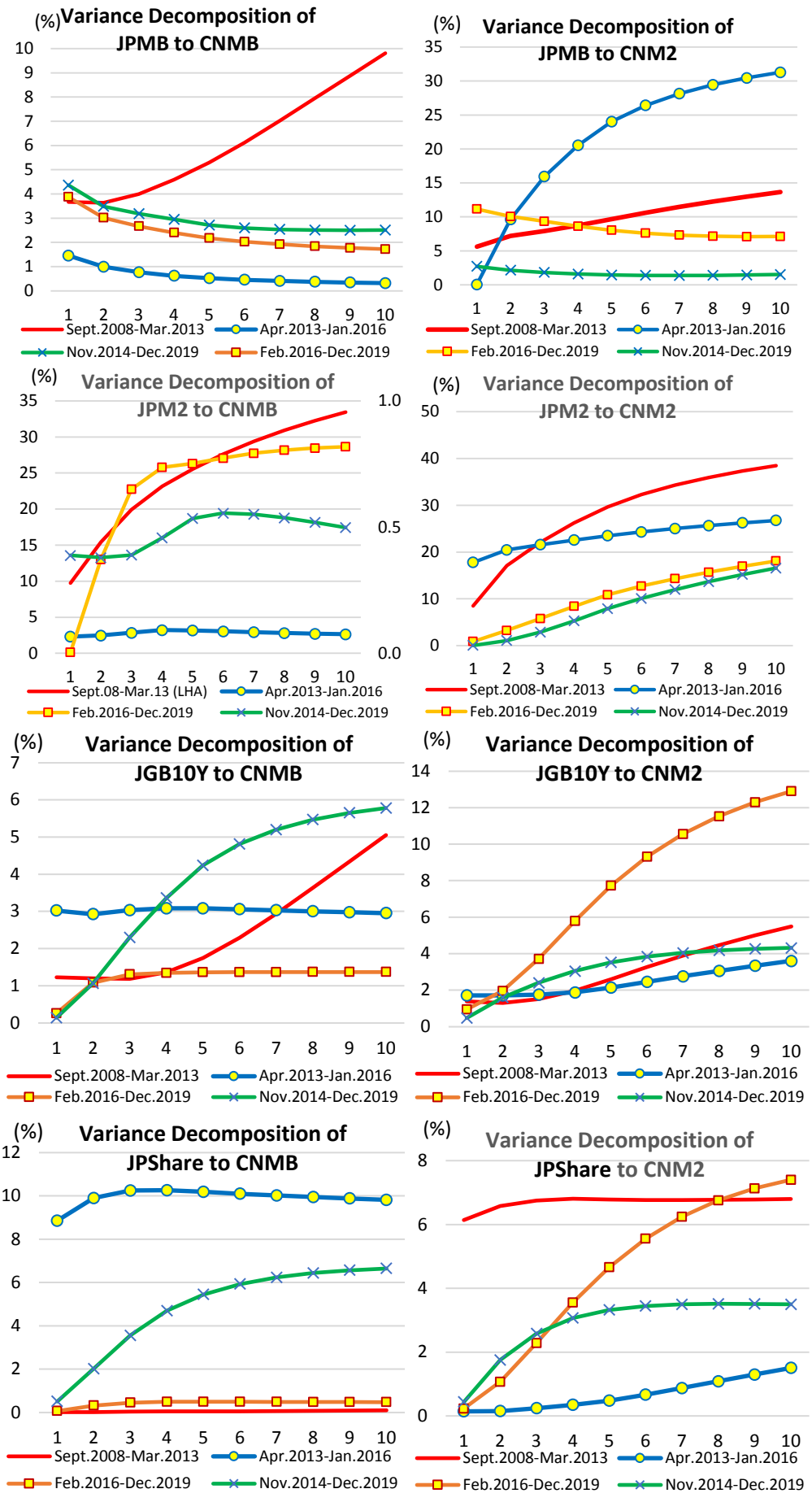

Fig.17: Variance Decomposition (Impact of China on Japan)

3.4.3 Variance Decomposition of the effects of Japan's monetary base (JPMB) and money stock (JPM2) on the markets in Hong Kong

The share of the Japanese monetary base (JPMB) in the variance decomposition of HK monetary base (HKMB) was low before the Introduction of QQE. The share of JPMB in the variance decomposition of HK money stock (HKM2) increased in the late QQE period (Feb.2016-Dec.2019) (Fig.18). While the share of JPM2 in the variance decomposition of HKMB has declined during the late periods of QQE in both QQEⅡ（Nov.2014-Dec.2019）and negative interest period (Feb.2016 to Dec.2019), the share of JPM2 in the variance decomposition of HKM2 has increased. This indicates that the Hong Kong Money Stock (HKM2) has increased due to the large inflow of funds from private financial institutions from Japan since the integration of the Hong Kong and Chinese stock markets.

On the other hand, the share of Japanese money stock (JPM2) in the variance decomposition of the Hong Kong Interbank Rate (HKInterbank) in Period 10 was extremely low before the introduction of QQE and had a limited impact on interest rates after QQE. However, during QQE II (Nov 2014-Dec 2019) and late QQE (Feb 2016-Dec 2019), the share of JPM2 in the variance decomposition of HKInterbank increased to around 15%.

Furthermore, the share of JPMB and JPM2 in the variance decomposition of the Hong Kong Stock Price (HKShare) in the 10th period increased in the early QQE (April 2013 - January 2016), but declined significantly in the subsequent period. The share of Japanese stock prices in the variance decomposition of Hong Kong stock prices also declined in the late QQE period (Nov 2014 - Dec 2019 and Feb 2016 - Dec 2019) compared to the early QQE period. This can be attributed to the liberalisation of stock trading between Hong Kong and Shanghai in November 2014, as well as the capital controls introduced by the Chinese government from late 2016. It also shows that since the integration of the Chinese and Hong Kong markets of the stock markets, there had already been significant investment from China into the HK market, with decreasing capital flows from Japan during the period.

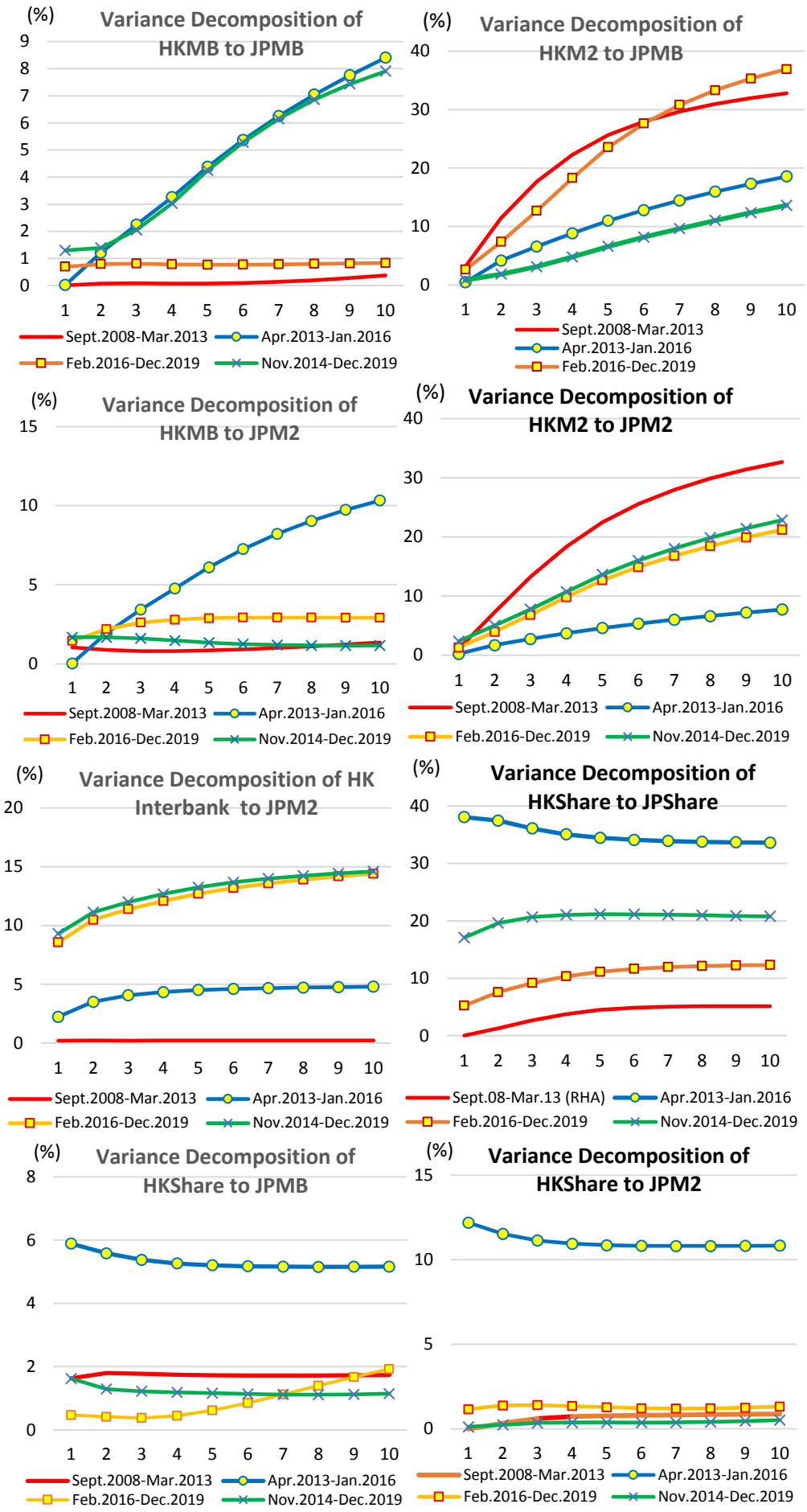

Fig.18: : Variance Decomposition (Impact of Japan on HK)

3.4.4 Variance Decomposition of the effects of HK on the market in Japan

The share of HKMB in the variance decomposition of Japan's monetary base (JPMB) in period 10 was relatively low in all periods, but relatively high in the early (Apr 2013-Jan 2016) and late (Feb 2016-Dec 2019) phases of QQE implementation(Fig.19). On the other hand, the share of HKMB in the variance decomposition of the Japanese money stock (JPM2) was relatively high in the early QQE period, but has declined in the period since November 2014. The share of HKM2 in the variance decomposition of JPM2 has also increased in QQE II (Nov.2014-Dec.2019) and later periods (Feb.2016-Dec.2019) compared to the early period of QQE introduction. This can be attributed to the liberalisation of stock trading in the Hong Kong and mainland China (Shanghai) markets.

Meanwhile, the share of the variance decomposition of Hong Kong M2 (HKM2) into Japanese government bond (JGB10Y) yields has increased significantly in the 10th period of QQE Ⅱ (2014.11-2019.12). This indicates that since the integration of the Hong Kong and Shenzhen and Shanghai stock markets, financial investment has been mainly through money stocks (HKM2).

Furthermore, the share of Hong Kong's monetary base (HKMB) and money stock (HKM2) in the 10th period of the Japanese stock price (JPShare) variance decomposition was less than 2% in the early QQE period (April 2013 – Jan. 2016). However, the share of the Hong Kong monetary base (HKMB) in the variance decomposition of the JPShare (JPShare) increased significantly (around 20%) in the late QQE (Feb.2016-Dec.2019). Meanwhile, the share of Hong Kong money stock (HKM2) in the variance decomposition of Japanese stock prices (JPShare) increased during QQE II (2014.11-2019.12) but has decreased since the introduction of negative interest rates (February 2016). Similarly, the share of Hong Kong stock prices (HKShare) in the variance decomposition of Japanese stock prices (JPShare) increased to around 20% during QQE II (2014.11-2019.12), but has decreased since the introduction of negative interest rates (February 2016).

The above results suggest that the liberalisation of market transactions between Hong Kong and mainland China (Shanghai and Shenzhen) has led to an increase in Chinese market investment in Japan as Chinese money has utilised the Japanese money stock via Hong Kong. However, since the introduction of negative interest rates by the Bank of Japan (February 2016) and the stock market integration with the Hong Kong and Shanghai markets (112/2016), direct investment in the Japanese market has become more common, which may have caused these changes.

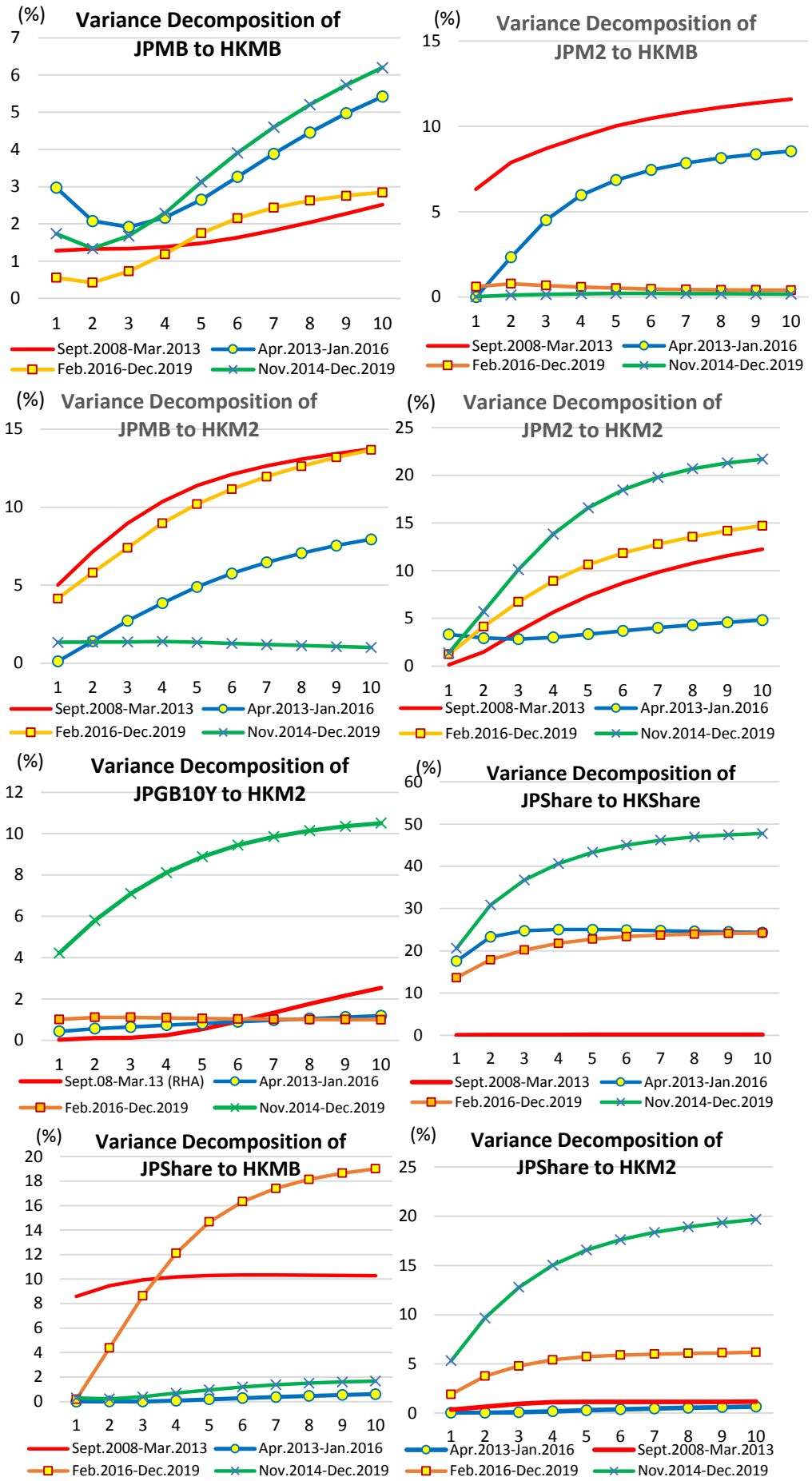

Fig.19: : Variance Decomposition (Impact of HK on Japan)

3.4.5 Variance Decomposition of the effects of HKMB and HKM2 on the China markets

The share of Hong Kong's monetary base (HKMB) in the variance decomposition of China's monetary base (CNMB) was relatively high before the introduction of QQE, at around 16%, but has been fairly low since the introduction of QQE, at less than 6% in both cases (Fig.20). In addition, the share of Hong Kong's monetary base (HKMB) in the variance decomposition of China's money stock (CNM2) has rather decreased in the post-QQE period.

The share of Hong Kong money stock (HKM2) in the dispersion decomposition of China's money stock (CNM2) rose to 20.3% in the period before the introduction of QQE (April 2013 - January 2016) (Figure 20). However, since November 2014 (Nov 2014-Dec 2019) and in the second half of QQE (Feb 2016-Dec 2019), the share of HKM2 has declined further. This can be attributed to the impact of direct inflows of funds from Japan rather than Hong Kong into the Chinese market since BOJ QQE II (Nov 2014-Dec 2019). In other words, it suggests that inflows from Japan, rather than from Hong Kong, directly affected the Chinese market in the later stages of QQE.

On the other hand, the shares of Hong Kong's monetary base (HKMB) and money stock (CNM2) in the variance decomposition of the Chinese stock market (CNShare) both increased in the late QQE period. In addition, the share of Hong Kong stock market (HKShare) in the variance decomposition of China's stock market (CNShare) was around 10% before the introduction of QQE (September 2008-March 2013), but has been relatively high during QQE (30-35%).

Furthermore, Hong Kong's monetary base（HKMB) has little impact on China's industrial production. A variance decomposition of the impact of Hong Kong's monetary base (MBHK) on China's industrial production (CNProd) shows that the share of HKMB in CNProd has remained limited at less than 3% since the introduction of QQE. This indicates that investment from Hong Kong in China has been mainly financial investment rather than investment in the real economy.

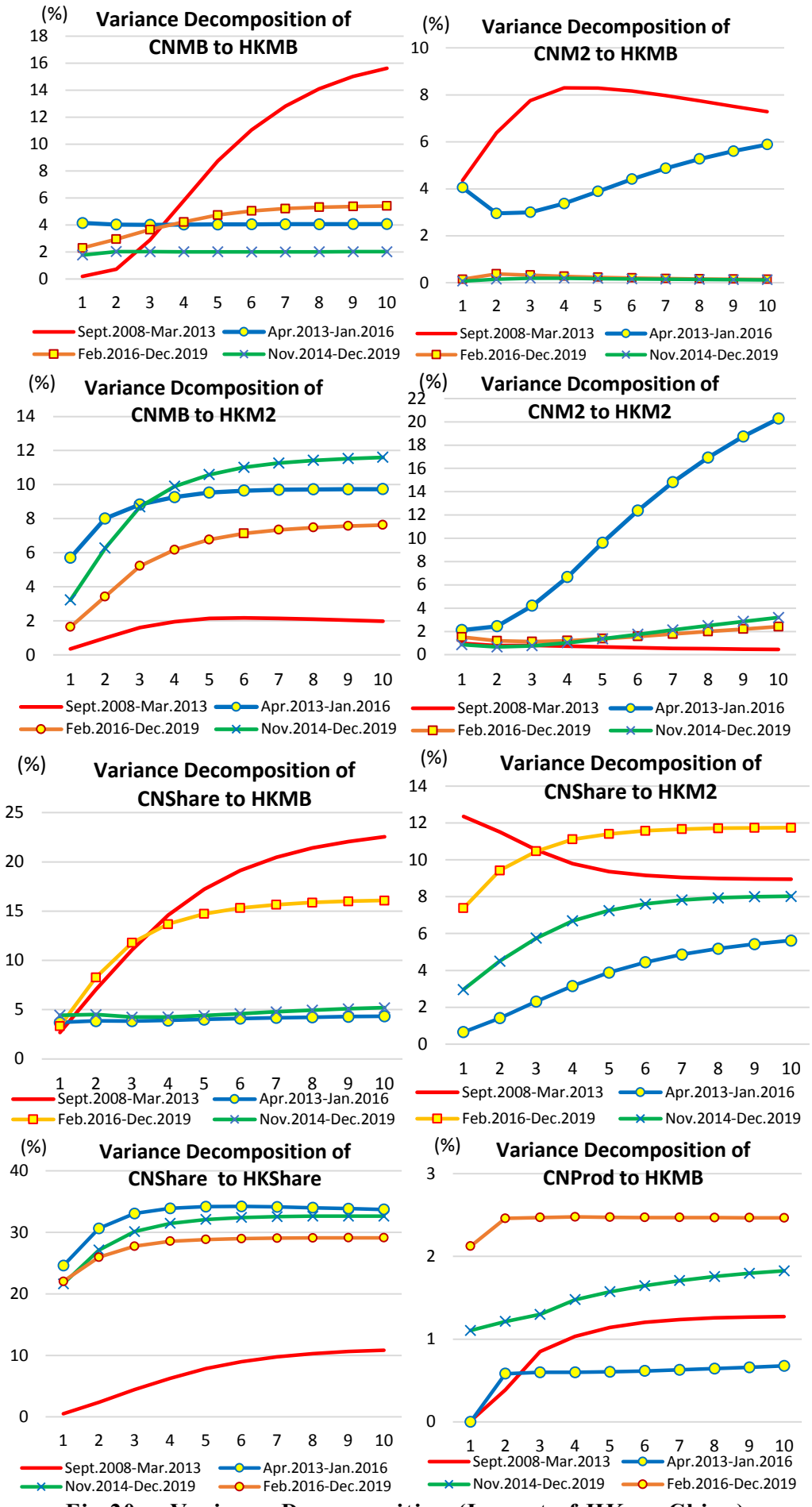

Fig.20: : Variance Decomposition (Impact of HK on China)

3.4.6 Variance Decomposition of the effects of CNMB and CNM2 on the HK markets

The share of China's monetary base (CNMB) in the variance decomposition of Hong Kong's monetary base (HKMB) in period 10 shows that it was not significantly affected by before QQE (September 2008 - April 2013). (Fig.21). However, in the late QQE period (Feb 2016-Dec 2019), its share increased to 12.4%. The liberalisation of trading between the Hong Kong and Shanghai (Shenzhen) markets also increased the impact of China's money stock (CNM2) on the variance decomposition of Hong Kong's money stock (HKM2).

On the one hand, the impact of China's money stock (CNM2) on Hong Kong's monetary base (HKMB) had a certain impact on the variance decomposition in the first half of QQE, but declined significantly in the second half of QQE. On the other hand, the share of CNM2 in the variance decomposition of the Hong Kong money stock (HKM2) did not change significantly throughout the entire QQE period. This can be attributed to the impact of the inflow of direct investment funds from Japan into the Chinese market since the BOJ's QQE II (Nov 2014-Dec 2019). In other words, it suggests that in the post-QQE period, inflows from Japan had a more direct impact on the Chinese market than inflows from Hong Kong.

The Hong Kong interbank rate (HKInterbank) had a limited impact on China's monetary base (CNMB) in the early QQE period (Sept. 2008-March 2013), but its share in the variance decomposition of the Hong Kong interbank rate increased in the QQE II and late QQE periods. Similarly, the share of CNM2 in the variance decomposition of HKInterbank also increased in both QQE II and late QQE.

On the other hand, CNMB and its share in the variance decomposition of Hong Kong Stocks (HKShare) in Period 10 have decreased in the late QQE, especially after February 2016. In addition, the share of Chinese share prices (CNShare) in Hong Kong equities (HKShare) accounted for 40-50% in the early period of QQE (Apr.2013-Jan.2016), but it declined in the late periods of QQE (Nov.2014-2019, Feb.2016-Dec.2019). This can be attributed to the fact that investment from China has been diversified investment portfolio in overseas markets (including Japan) outside Hong Kong.

The above results indicate the fact that the liberalisation of stock trading in the Mainland China and Hong Kong markets since November 2014 has led to large capital inflows between Hong Kong and Chinese markets, and that financial investment from China into overseas markets, including Japan outside Hong Kong, has increased following the BOJ's introduction of QQE II.

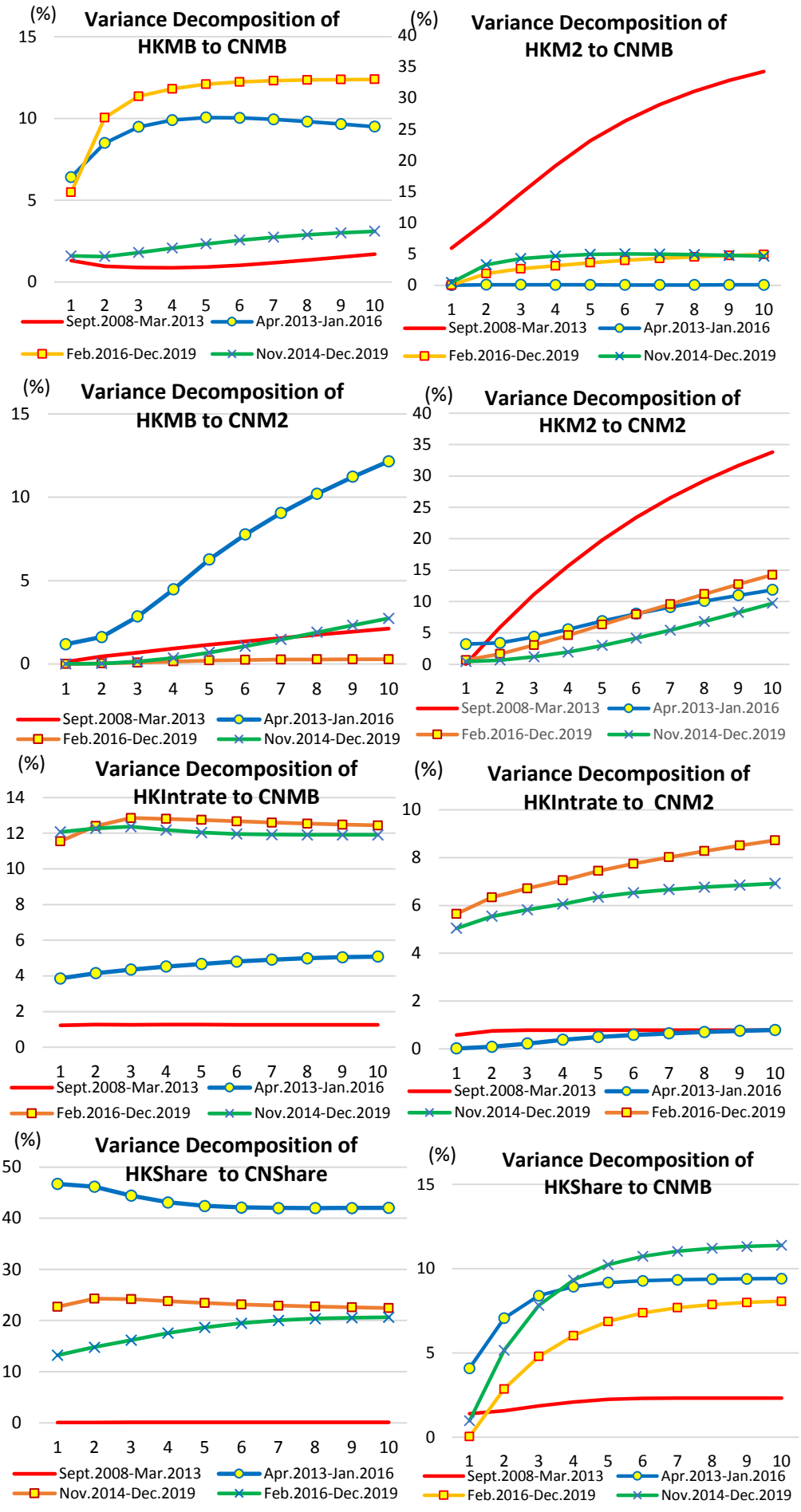

Fig.21: Variance Decomposition (Impact of China on HK)

3.4.7 Summary of Variance Decomposition

The above results of the variance decomposition of the monetary base, money stock and stock prices for Japan, China, and Hong Kong as well as industrial production in China are generally consistent with the results from the impulse response functions in the former section.

In the Post-Global Financial Crisis, even before the introduction of Quantitative and Qualitative Easing (QQE), the capital flows between Japan, Hong Kong and China were already active and Japanese funds were being used in the China and Hong Kong markets. However, while Chinese money stock (**CNM2**) had consistently maintained a high share in the Japanese money stock (**JPM2**) in the variance decomposition, especially after the introduction of QQE, Chinese and Hong Kong investment funds have increased, and they have significantly influenced the market in Japan.

On the other hand, since November 2014, when the stock trading between Hong Kong and mainland China was liberalized, the capital flows have increased not only from China to Hong Kong but also to Japan. Particularly, China's Money Stock (**CNM2**) has significantly increased its transactions between Hong Kong and China, which has increased impact of investment flows from China on the market in Japan. In other words, in recent years, the impact of China's influence on the Japanese market has been more pronounced through the money stock (**CNM2**) than through the Central Bank-led monetary base (**CNMB**).

4. Conclusion

This paper examines the impact of Japan's monetary easing policy after the Global Financial Crisis (2008) on the markets in China and Hong Kong through the analysis of impulse response functions and variance decomposition by the BVAR model. The analysis period is from September 2008 to December 2019 in order to avoid the period of the Covid-19 crisis after 2020. The BOJ's Quantitative and Qualitative monetary Easing (QQE) can be divided into two periods: before the introduction of negative interest rates (April 2013 to January 2016) and after the introduction of negative interest rates (February 2016 to December 2019). In addition, since November 2014, when the second round of QQE (Phase II) was launched, coincides with the start of liberalisation of stock trading in the Shanghai and Hong Kong markets, that period is also included in the analysis.

The analysis confirms that the integration of the Hong Kong and Shanghai/Shenzhen markets has led to a significant increase in financial transactions not only between China and Hong Kong, but also between China/HK and Japan, which has had a significant impact on variables such as the monetary base (M2), interest rates and stock prices in both countries. It is noteworthy that since the post-Global Financial Crisis, monetary easing under QQE has also had a positive and significant impact on China's monetary base and commercial banks' money stock. Meanwhile, capital investment from China had a significant impact on the markets in Hong Kong and Japan as well.

Since the introduction of QQE, the Hong Kong money stock (HKM2) has had a significant impact on the financial market in Japan. Moreover, the impact of China on the Japanese market was steadily growing even before the QQE. China's influence on Japan's financial market has been very significant, especially the expansion of Chinese commercial banks' money stock has had a significant impact on Japan's money stock (M2). This is indicative of the substitutability of equities for other financial instruments (e.g. JGB) and may reflect investment activity from China and Hong Kong.

Recent increases in financial transactions that do not appear in China's official statistics may be

the result of inflows of funds, especially from Chinese investors, into informal financial markets, including crypto asset markets. This trend has become even more pronounced since November 2016, when the Chinese authorities tightened capital controls. Recent increases in financial transactions that do not appear in official Chinese statistics may be the result of inflows into informal financial markets, including crypto asset markets. It is therefore necessary to analyse future capital flows between Japan, Hong Kong and China in this light.

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