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

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Abstract

After the Global Financial Crisis, significant expansion of the Bank of Japan's monetary base, especially Quantitative and Qualitative Monetary Easing (QQE) policy has put spillover effects on the global markets. The massive money supply under QQE had a significant impact on the markets in China and Hong Kong which have been liberalized in mutual stock trading between the Hong Kong/ Shanghai markets in November 2014, followed by the Hong Kong/ Shenzhen markets in December 2016,

This paper analyses the effect of the BOJ's policy on the Hong Kong/China market over the entire period of the BOJ's QE policy from September 2008 to December 2019, using a Bayesian vector autoregressive (BVAR) model. The results of the analysis show that the Bank of Japan's monetary easing has had a significant impact on the financial and monetary sectors of Hong Kong and China. In particular, the expansion of money flows from Japan to the Hong Kong and Chinese markets had a significant positive impact on the Chinese market and the real economy even during the period of Comprehensive Monetary Easing (CQE) prior to the introduction of QQE (October 2010-March 2013), and that after the introduction of QQE (April 2013), the impact on the markets in China and Hong Kong became even more pronounced. In addition, following further monetary easing as QQE Phase II and the simultaneous integration of the Hong Kong and Shanghai stock markets in November 2014, capital inflows between Japan, Hong Kong and China have recently increased further, suggesting that the impact of Hong Kong and China investment growth on the market in Japan is growing more than that of Hong Kong and China from Japan

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

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Introduction

This paper analyses the effect of cross-border capital flows between 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 in 2008, 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.

After 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 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

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

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 markets in Hong Kong and China. 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 monetary base of the BOJ 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 0.9% during the period under 'Abenomics' from 2013Q1 to 2020Q1[2]. It should be noted that the average growth rate of 1.7% during the former government of Democratic party of Japan (DPJ) [September 2009-December 2012] (during which the Comprehensive Monetary Easing (CME) under former Governor Shirakawa) is higher than that of 'Abenomics' under the Abe government (Fig.1)[3].

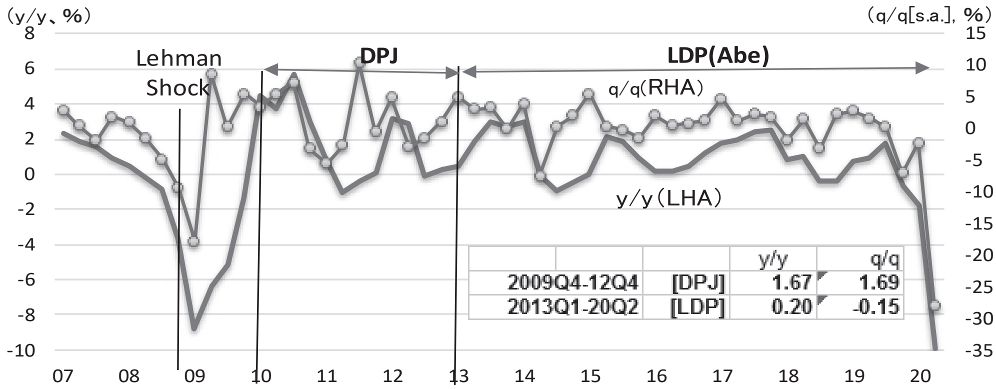

Fig.1: Real GDP Growth (Japan)

Source: Cabinet Office (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.

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 2019).

The second phase of QQE ("Bazooka Ⅱ") was introduced in November 2014, further strengthening the supply of monetary base. Simultaneously with this, stock transactions in Hong Kong and Shanghai markets was integrated in November 2014, and between HK and Shenzhen markets in December 2016. Meanwhile, the Bank of Japan has applied a negative (minus 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 loan growth rate in Japan[4].

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 ¥572 trillion yen (equivalent of more than 115% of Japan's GDP) as of August 2020, about 4.2 times higher than that in March 2013, just before the introduction of QQE, the BOJ Current Account increased by 9.6 times to 452 trillion 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

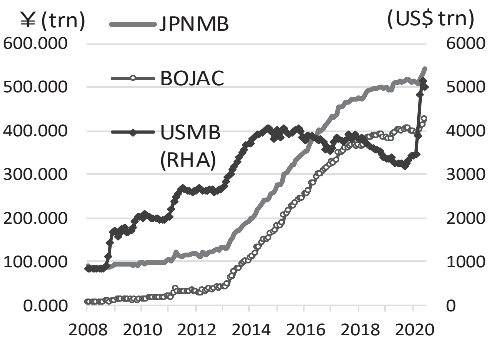

Fig.2: Monetary Base (US/Japan) and BOJ Current Account (Japan)

Source: FRB, Bank of Japan

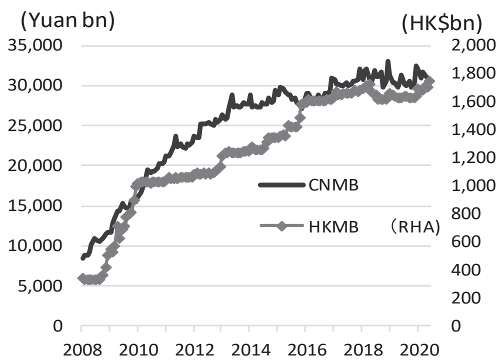

Fig.3: Monetary Base (HK/ China)

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

4. Although Bank of Japan's President Kuroda has adopted a negative interest rate on the Current 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.

countries 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 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 PhaseⅡ (“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 may 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 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 China’s 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

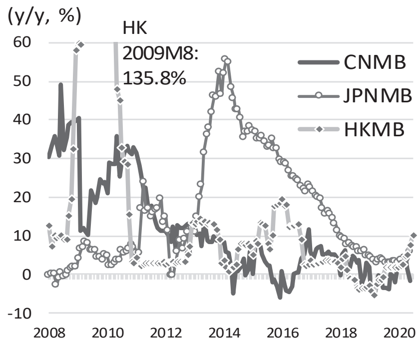

Fig.4: MB (Japan/ China/ HK)

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

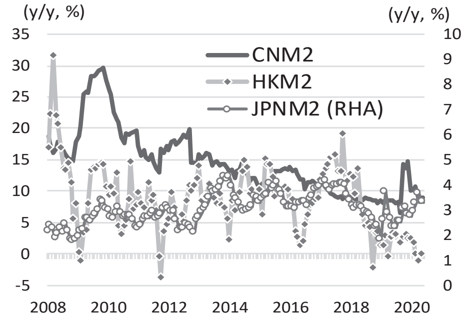

Fig.5: M2: China/HK/Japan

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

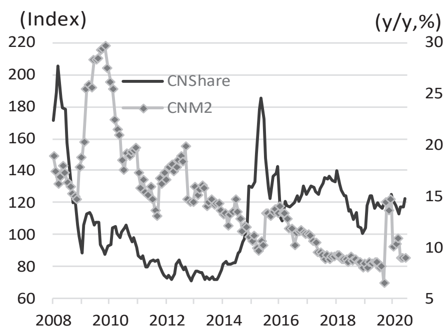

Fig.6: M2 & Share (China)

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

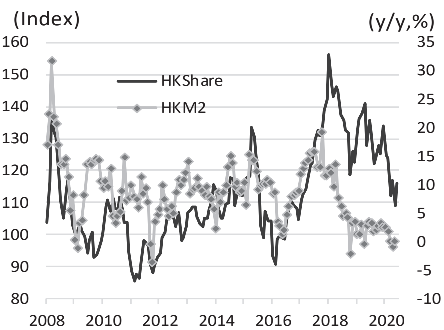

Fig.7: M2 & Share (HK)

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

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.

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 stook markets in Hong Kong and China. The capital flows from China has been restricted since November 2016 and 2017, so that it might have affected financial investment between China and HK/Japan in recent years[6].

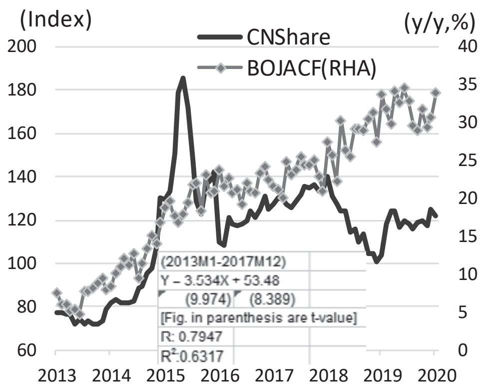

Fig.8: BOJAC (Foreign) & Share: China

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

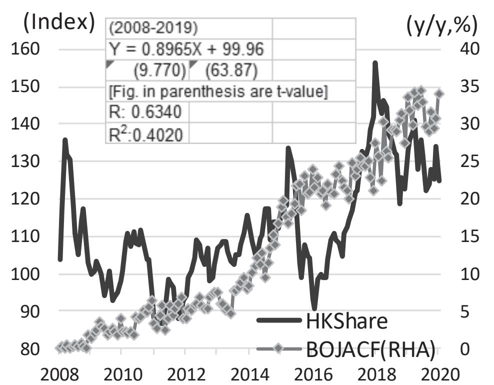

Fig.9: BOJAC (Foreign) & Share: HK

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 markets in mainland China was limited, and during the period of comprehensive monetary easing after the global financial crisis (2008) (October 2010-March 2013), it was 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 markets, in Japan and

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.

China 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 an increase in capital flows from informal financial channels and markets. Especially since 2017, the crypto assets transactions have increased, and its value has risen rapidly. Although China has officially banned trading in crypto assets (currencies), 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.

On the other hand, China has traditionally limited the convertibility of its currency and restricted capital transactions, but as mentioned above, the capital markets are at risk of experiencing a major shock if they are only partially liberalized.

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. Since the Global Financial Crisis (2008), unconventional policies have been introduced as monetary easing policies 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 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

7. The majority of virtual currency mining (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

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 block-restricted structural 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 influence on GDP and the financial market was 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 and 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 under certain conditions. 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 (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

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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.

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 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.

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 amount of financial resources 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 (2018) further suggested that the Bank of Japan's monetary easing had a substantial positive impact on the and 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.

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

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 September 2008 to December 2019. In this thesis, the analysis is based on the Bayesian Vector Autoregressive (BVAR) model about the spillover effects of the BOJ's Quantitative and Qualitative Monetary Easing (QQE) on China and Hong Kong. As a result of the analysis, it is 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 was 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 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. Normal VAR model is expressed as follows:

$$Y_{it} = d_{it} + \Sigma b_{i1k} Y_{1,\, t\text{-}k} + \ldots + \Sigma b_{ink} Y_{n,\, t\text{-}k} + e_{it}$$

(However, d_i is a numeric value determined by Y_{it}, but it includes constants and dummy variables. Litterman's prior variance is based on the idea that changes in variables are presumed in a timely manner, and random walk based on undetermined variable. In the i-th formula, the distribution is based on the following definition.

$$Y_{it} = d_{it} + Y_{1,\, t\text{-}k} + \mathrm{e}_{it}$$

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

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

the random variable Yt (t = $1, 2, \dots$ 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.

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

$\Phi(Y) = \int \pi(\theta) f(Y \mid \theta)\, d(\theta)$ = const. Since φ (Y) does not depend on the parameter θ, Therefore, $p(\theta \mid Y)$ is proportional to $f(Y \mid \theta)\ \varpi(\theta)$. The Bayesian estimated amount θ⁻ of the parameter θ is obtained as the average value of the posterior distribution.

$$\theta^{-}\ =\ E\ [\theta|Y]\ =\ \int\ \theta\ \ (\theta|\mathrm{Y})\ \ \mathrm{d}\ \ (\theta)$$

In prior distribution in this analysis, as a prior distribution of θ = (β, Σ)

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 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). Therefore, the posterior distribution (Posterior) is derived as follows.

$$P\ \ (\theta|Y)\ \ \alpha\, exp\ \ (-\ \ (\beta-\beta_0)'\ \ [V_0-1+\ \ (\Sigma\ \otimes\ (X'X)\,)\,]-1\ \ (\beta-\beta_0)\,)$$

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

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 and interbank interest rates were not freely determined in the market in China, 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,

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

Country/ Region	Variables	Abbriviation	Sources
Japan	Monetary Base	JPMB	Bank of Japan
	BOJ Current Account	BOJ AC	Bank of Japan
	Money Stocks	JPM2	Bank of Japan
	Overnight interbank rate	Call Rate	Bank of Japan
	Government Bond Yields (av.)	JGB10Y	IFS database (IMF)
	Nikkei Stock Prices (Index based)	JPShare	Nikkei Profile IFS (IMF)
China (Mailand)	Monetary Base (Reserve Money)	CNMB	IFS database (IMF)
	Money Stock (QuasiMoney)	CNM2	IFS database (IMF), FRED
	Stock Prices (Shanghai)	CNShare	World Federation of Exchanges
	Industrial Production (S.A.)	CNProd	IFS database (IMF)
Hong Kong	Monetary Base (Reserve Money)	HKMB	HK Monetary Authority, IFS (IMF)
	Money Stock (M2) [Includes foreign currency deposits]]	HKM2	HK Monetary Authority, IFS (IMF)
	HK Interbank Rate	HKInterbank	HK Monetary Authority, IFS (IMF)
	Stock Prices	HKSHare	Hang Seng Index

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.

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 analyzes 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 very 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 (September 2008 - December 2019) is from the introduction of monetary easing after the Global Financial Crisis, including s Comprehensive Monetary Easing (CME) (introduced in October 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.

(i) Post-Global Financial Crisis (September 2008 - March 2013) (including the

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

period of Comprehensive Monetary Easing[CME, October 2010 – March 2013])

(ii) Early period of Quantitative Qualitative Easing (QQE), prior to the introduction of negative interest rate (April 2013 - January 2016)

(iii) Later period of QQE with negative interest rate (December 2016 - December 2019)

(iv) QQE Phase II [+ Hong Kong-Shanghai stock market integration] (November 2014 - December 2019)

The results of the impulse response functions are shown in the **appendix** and the summary tables are given in the main text in Table 2-1, 2-2-, 2-3.

3.3.1 Post-Global Financial Crisis (incl. Comprehensive Monetary Easing, CME) [September 2008 – March 2013]

(a) Impact from Japan to China and China to Japan

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**), while the BOJ current account (**BOJAC**) had a negative impact on monetary base (**CNMB**) during the period (Table 2-1, Appendix Fig.1-1). This may suggest that the money at the BOJAC is caused by the transfer of the money shifted from China to be utilized for investment through banks' money stock. Although **call rate** had some effect on China's monetary base (**CNMB**)**,** 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.

On the other hand, the impact of the China's monetary base (**CNMB**) on the Japan's money stock (**JPM2**) market was significantly positive over this period.

The money stock in China (**CNM2**) had also a significantly positive impact on the monetary base (**JPMB**), **BOJAC** and money stock in Japan (**JPM2**). In addition, China's stock prices (**CNShare**) acted in raising **call rate**, as well as stock prices in Japan (**JPShare**) (Table 2-2, Appendix Fig.1-3).

Table 2-1: Impulse Response of China/ HK to Japan's monetary Policy

	CNMB	CNM2	CNShare	CNProd	HKMB	HKM2	HKInt	HKShare	
				2008m9-2013m3					
JPMB		+	▲	**+**		**+**			JPNMB
BOJAC	**▲**	+		+		**+**			BOJAC
JPM2	+	**+**		+		**+**			JPM2
Call Rate	▲					+	**+**		Call Rate
JGB10Y			**+**			**▲**	▲		JGB10Y
JPShare							**+**	+	JPShare
				2013m4-2016m1					
	CNMB	CNM2	CNShare	CNProd	HKMB	HKM2	HKInt	HKShare	
JPMB		**+**	+	**+**	**+**	**+**		+	JPNMB
BOJAC		+	+	**+**	+	**+**		+	BOJAC
JPM2		**+**	**+**	**+**	**+**	**+**		+	JPM2
Call Rate		+	▲			▲		▲	Call Rate
JGB10Y			**▲**			▲		▲	JGB10Y
JPShare	+	+	**+**			**+**	+	+	JPShare
				2016m2-2019m12					
	CNMB	CNM2	CNShare	CNProd	HKMB	HKM2	HKInt	HKShare	
JPMB	+					**+**			JPNMB
BOJAC			**+**			**+**		+	BOJAC
JPM2		**+**		+	▲	**+**	+		JPM2
Call Rate		+	+			▲	+		Call Rate
JGB10Y	**+**	▲			+		▲		JGB10Y
JPShare	+	+	+			+		+	JPShare
				2014m11-2019m12					
	CNMB	CNM2	CNShare	CNProd	HKMB	HKM2	HKInt	HKShare	
JPMB					**+**	+			JPNMB
BOJAC					**+**	+			BOJAC
JPM2	**+**	**+**		**+**		**+**	**+**		JPM2
Call Rate	▲	+	+			▲			Call Rate
JGB10Y	+	▲					▲	+	JGB10Y
JPShare	+	**+**	+			+		+	JPShare

Notes: + and ▲ denote positive and negative responses, respectively
Bold letters show significance at 10% error or less.

Sources: Author's calculation based on the database of IFS (IMF), Bank of Japan, BIS, METI Statistic of China, HK monetary Authority World Federation of Exchanges, FRED.

(b) Impact of Japan on HK and impact of HK on Japan

The money base (**JPMB**), BOJ current account (**BOJAC**) and money stock in Japan (**JPM2**) had a positive and significant impact on the Hong Kong money stock (**HKM2**) (Table 2-1 and Appendix Figures 1-2). While call rate had a significant effect on the Hong Kong interbank rate (**HKInterbank**), the government bond yield with 10-years maturity (**JGB10Y**) put a significant impact on the Hong Kong money stock (**HKM2**). At the same time, Japan's stock prices (**JPShare**) had a positive effect on Hong Kong interbank rate (**HKInterbank**). These results may indicate that short-term investments from Japan were fairly active even before the QQE.

On the other hand, Hong Kong's monetary base (**HKMB**) had a positive impact on money stock (**JPM2**) as well as **call rate** in Japan (Table 2-2, Appendix Fig1-3). HK money stock (**HKM2**) also put significant effects on Japan's monetary base (**JPMB**) as well as money stock (**JPM2**), while Hong Kong stock prices (**HKShare**)

Table 2-2: Impulse Response of Japan's variables to China/ HK

	JPMB	BOJAC	JPM2	Call Rate	JGB10Y	JPShare
2008m9-2013m3						
CNMB	+		**+**	**▲**	▲	
CNM2	**+**	**+**	**+**	▲		+
CNShare	▲		▲	+	**+**	**+**
CNProd						
HKMB			+	**▲**	▲	+
HKM2	**+**	+	**+**			
HKInt				+		
HKShare	▲	**▲**	▲	+	**▲**	+
2013m4-2016m1						
CNMB			**+**		+	+
CNM2	**+**	**+**	**+**		▲	
CNShare	**+**	+	**+**		▲	**+**
CNProd	**+**	**+**	**+**			▲
HKMB	+	▲	**+**	+		
HKM2	+	**+**	+	▲		+
HKInt			+	+	▲	+
HKShare				▲		**+**
2016m2-2019m12						
CNMB					**+**	+
CNM2	+		**+**			
CNShare						+
CNProd						
HKMB	+					+
HKM2	+	+	**+**			+
HKInt						
HKShare	+					+
2014m11-2019m12						
CNMB				▲	**+**	+
CNM2			**+**	+		
CNShare	+	**+**	+	+	+	**+**
CNProd						
HKMB	**+**			▲	**▲**	
HKM2	+		**+**		+	**+**
HKInt			+		▲	▲
HKShare			+	+	**+**	**+**

Notes: + denotes positive responses, and ▲ negative responses.
Bold letters show significance at 10% error or less.
Sources: Author's calculation based on the database of IFS (IMF), Bank of Japan, BIS, METI Statistic of China, HK monetary Authority, World Federation of Exchanges, FRED.

had a significant effect on government bonds in Japan (**JGB10Y**),

This 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 government bonds were used as an alternative to stocks in the market in Japan. This suggests that Japanese financial markets were more likely to trade with the Hong Kong market than with the China's market at this time.

(c) Interdependence between Hong Kong and China Market

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**, and a positive response of money stock (**CNM2**) and industrial production (**CNProd**) in China. Hong Kong stock prices (**HKShare**) also had a positive and significant impact on stock prices (**CNShare**) (Table 2-3, Appendix Fig.1-4).

Table 2-3: Impulse Response of China/ HK

2008m9-2013m3									
	CNMB	CNM2	CNShare	CNProd		HKMB	HKM2	HKInt	HKShare
HKMB	**+**	**+**	**▲**		CNMB	+	**+**	▲	
HKM2	▲	**+**	▲	+	CNM2		**+**		
HKInt					CNShare	▲	▲	+	+
HKShare			**+**		CNProd				
2013m4-2016m1									
	CNMB	CNM2	CNShare	CNProd		HKMB	HKM2	HKInt	HKShare
HKMB		**+**		+	CNMB	▲	+		+
HKM2	+	**+**	**+**		CNM2	**+**	**+**		
HKInt					CNShare			+	**+**
HKShare	+	+	**+**		CNProd				
2016m2-2019m12									
	CNMB	CNM2	CNShare	CNProd		HKMB	HKM2	HKInt	HKShare
HKMB	+		**+**	+	CNMB	**+**	**+**		+
HKM2	+	+	+		CNM2	+	**+**	**+**	
HKInt					CNShare	**+**	+		+
HKShare	+		+		CNProd				
2014m11-2019m12									
	CNMB	CNM2	CNShare	CNProd		HKMB	HKM2	HKInt	HKShare
HKMB					CNMB		**+**	**▲**	**+**
HKM2	**+**	+	+		CNM2		**+**	**+**	▲
HKInt					CNShare	+	+	▲	+
HKShare	**+**		**+**	+	CNProd				

Notes: + denotes positive responses, and ▲ negative responses. Bold letters show significance at 10% error or less.
Sources: Author's calculation based on the database of IFS (IMF), Bank of Japan, BIS, METI Statistic of China, HK monetary Authority, World Federation of Exchanges, FRED.

CNMB and **CNM2**, on the other hand, had a positive and significant impact on **HKM2**, although that on **HKMB** was not statistically significant. Both **CNMB** and **CNM2** had no effect on HK interest rates and stock prices (Table 2-3, Appendix Fig.1-4). While stock prices in China (**CNShare**) had a significant positive impact on HK stock prices (**HKShare**), **HKMB** and **HKM2** reacted negatively to **CNShare**, which may indicate that HK's investment might be directed to the stock market in China during the period. This can be confirmed by the fact that Hong Kong stocks have reacted positively to Chinese stock prices over the period.

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**) (September 2008 and September 2013) . It may also indicate that the monetary easing introduced in Japan during this period resulted in the transfer of funds to the Chinese market and Hong Kong bank accounts. Thus, the monetary easing during September 2008 and March 2013 had already had a significant impact on the markets in both China and Japan through HK market.

3.3.2 Quantitative and Qualitative Monetary Easing (QQE)① (before negative interest rate policy [April 2013 – January 2016]

During the QQE period from April 2013 to January 2016 under the "zero interest rate" policy prior to the negative interest rate policy, the impact of the mutual liberalization of stock trading between the Shanghai and Hong Kong markets from November 2014 and the Hong Kong and Shenzhen markets from December 2016 has had a significant impact on trading between Japan, Hong Kong and China. In particular, the Bank of Japan's monetary base (JPMB) and money stock (JPM2) as well as China's monetary base (CNMB) and money stock (CNM2) had a significant impact on the Hong Kong and Japanese markets during this period.

(a) Impacts from Japan to China and Hong Kong, and from China and Hong Kong to Japan

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**). During this period, Japan's monetary easing had a significant effect on China's real economy, as Japan's MB (**JPMB**), **BOJAC** and **JPM2** all had a positive and significant impact on China's industrial production (**CNProd**).

Call rate and government bonds (**JGB10Y**) had a negative impact on China's stock prices (**CNShare**) and stock prices in Japan (**JPShare**) also had a significant positive impact on China's stock prices (**CNShare**) (Table 2-1, Appendix Fig.2-1). This may suggest that that Japanese short-term and investment funds were closely linked to Chinese stock prices).

On the other hand, China's money stock (**CNM2**) mainly had put positive effects on Japan's monetary base (**JPMB**), Bank of Japan Current Account (**BOJAC**) and money stock (**JPM2**) (Table 2-2-2) (Appendix Figure 2-3). Stock prices in China (**CNShare**) also had a significant impact on the money stock (**JPM2**) and stock prices in Japan (**JPShare**).

(b) Impact on HK from Japan and HK to Japan

The Japan's monetary base (**JPMB**), Bank of Japan Current Account (**BOJAC**) and money stock (**JPM2**) had a positive and significant impact on the monetary base (**HKMB**) and money stock (**HKM**2) in Hong Kong. While the **call rate** and the yield of government bonds (**JGB 10Y**) had a negative impact on **HKM2**, and the former had negative impact on HK stock prices (**HKShare**). Stock prices in Japan (**JPShare**) also had a significant positive impact on Hong Kong stock prices (**HKShare**) (Table2-1, Appendix Fig. 2-2),

On the other hand, Hong Kong money stock (**HKM2**) had a positive response of BOJ's current account (**BOJAC**), while it had negative response to HK monetary base (**HKMB**). Moreover, Hong Kong stock prices (**HKShare**) had a positive and significant effect on Japan's stock prices (**JPShare**) while the increase in Hong Kong Money Stock (**HKM2**) lowered the **call rate** (Table 2-2 Appendix Fig. 2-3). This indicates that there was a significant flow of money for investment between the Japanese and Hong Kong markets during this period.

(c) Interdependence between Hong Kong and China Market

Both Hong Kong monetary base (**HKMB**) and money stock (**HKM2**) had a significantly positive impact on China's money stock (**CNM2**). The HK stock prices (**HKShare**) also had a significant positive impact on the Chinese stock price (**CNShare**). (Table 2-3, Appendix Fig.2-4).

Although China's money stock (CNM2) also had positive impact on the HK monetary base (**HKMB**) and money stock (**HKM**2), China's monetary base (**CNMB**) had little impact on both **HKMB** and **CNMB.** This may indicate that resources of commercial banks were the main source of investment in both the Chinese and Hong Kong markets during this period.

It is also noted that both of HK and China's share price (**HKShare, CNShare**) had a positive impact on each of the stock markets. Thus, both capital flows from Hong Kong and China had a positive impact on the stock prices in HK and China, due to the stock market integration between Hong Kong and Shanghai since November 2014. These results show that the integration of the Hong Kong and Chinese stock markets increased capital flows between Japan, Hong Kong and China.

3.3.3 Quantitative and Qualitative Easing (QQE) Ⅱ (negative interest rates) [February 2016 – December 2019]

This period (February 2016-December 2019) is mostly post-November 2016, when China tightened capital controls, so the impact of financial investment from China to Japan has declined compared to earlier periods.

(a) Impact from Japan to China and from China to Japan

The money stock in Japan (**JPM2**) had a positive impact on the Chinese market and economy in China during the period, mainly on the money stock (**CNM2**) and industrial production (**CNProd**), while the BOJ's current account (**BOJAC**) had a significant impact on China's stock prices (**CNShare**) during the period (Table 2-1, Appendix Fig.3-3).

JGB10Y yields (**JGB10Y**) had a positive and significant impact on China's monetary base (**CNMB**), while **call rate** put no significant effect on China's monetary base (**CNMB**) and money stock (**CNM2**) as well as stock prices (**CNShare**) .

Compared to the early period of QQE (before the introduction of negative interest rates), the direct effects of Japanese financial markets on the Chinese market decreased during this period. While Japan's stock prices (**JPShare**) have had a positive effect on the China's market, their direct impact from the market in Japan on the money stock (**CNM2**) in China has been limited than before.

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**) (Table 2-2, Appendix Fig.3-3). China's stock prices (**CNShare**) also had a positive effect on stock prices (**JPShare**) in Japan.

(b) Impact on HK from Japan and HK to Japan

The Japan's monetary base (**JPMB**), BOJ current account (**BOJAC**) and money stock (**JPM2**) had a significant positive effect on the Hong Kong money stock (**HKM2**), whereas **JPM2** put some impact on the interbank interest rate in Hong Kong (**HK interbank**),

Hong Kong's monetary base (**HKMB**) had positive effects on Japan's monetary base (**JPMB**) as well as stock prices 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**) (Table 2-2, Appendix Fig.3-3).

(c) Interdependence between Hong Kong and China Market

While the HK monetary base (**HKMB**) and money stock (**HKM2**) had limited effects on monetary base (**CNMB**) and money stock (**CNM2**) in China, **CNMB** had significantly positive towards **HKMB** and **HKM2**. **CNM2** also put significantly positive response of **HKM2** and HK interbank rate (**HKInterbank**) during the period (Table2-3, Appendix Fig.3-4). Thus, both monetary base and money stock in HK and China have significantly affected each other in both of the markets.

It is also noted that **CNShare** had significant response of HK monetary base (**HKMB**), while HK stock prices (**HKShare**) had a certain positive response of China's stock prices (**CNShare**).

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 during the period. It also shows the real effects of integration of the HK and Chinese markets have emerged during this period (February 2016-December 2019).

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 (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.

3.3.4 QQE Ⅱ [November 2014 – December 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, followed by HK and Shenzhen in December 2016, These have facilitated further capital and financial liberalization between the mainland China and Hong Kong.

(a) Impacts from Japan to China and Hong Kong, and from China and Hong Kong to Japan

Since November 2014, there has been a significant change in the impact of Japan's financial and capital markets on the Chinese market. While the Japan's monetary base (**JPMB**) no longer necessarily has a positive and significant impact on the China's monetary base (**CNMB**) in compared to previous years, the Japan's money stock (**JPM2**) and the China's money stock (**CNM2**) have had a very significant positive impact on each other (Tables 2-1 &2-2, Appendix Fig.4-1, 4-3) . Moreover, the **JPM2** had a significant effect on China's industrial production (**CNProd**) during the period.

The impact of Japan's relevant financial indicators on the market in China has been even more diversified compared to the previous QQE period (April 2013-March 2016). For example, the **call rate**, along with the Japanese government bond yield

(**JGB10Y**), has had a certain impact on China's monetary base (**CNMB**), China's money stock (**CNM2**), and China's stock prices (**CNShare**). Furthermore, Japan's stock prices (**JPShare**) also have a certain impact on China's MB/M2 and stock prices (**CNShare**).

On the other hand, China's money stock (**CNM2**) has positive response of Japan's money stock (**JPM2**), while China's monetary base (**CNMB**) affects Japanese government bond yields (**JGB10Y**) and stock prices (**JPShare**). Stock prices in China (**CNShare**) also have a significant effect on stock prices in Japan (JPShare) (Table 2-2, Appendix Fig.4-3).

(b) Impact on HK from Japan and HK to Japan

In the Hong Kong market, the Japan's monetary base (**JPMB**) and BOJ current account (**BOJAC**) had a significant positive impact on the Hong Kong money stock (**HKMB**), while the expansion of Japan's money stock (**JPM2**) had an impact on the Hong Kong money stock (**HKM2**) and interbank interest rate (**HKInterbank**) and stock price (**HKShare**) (Table 2-1, Appendix Fig.4-2). The Japan's money stock (**JPM2**) also had a significant positive impact on HKM2 and **HKShare**, which also influenced the rise in the Hong Kong interbank rate (**HKInterbank**).

The **call rate** had a slightly non-significant but negative impact on the Hong Kong money stock (**HKM2**). In addition, Japanese stock prices (JPShare) had a positive but limited effect on the Hong Kong money stock (**HKM2**).

Hong Kong monetary base (**HKMB**) had a positive and significant impact on Japan's monetary base (**JPMB**)**, while HK** money stock (**HKM2**) put positive effect on the money stock in Japan (**JPM2**). (Table 2-2, Appendix Fig.4-3).

The Hong Kong money stock (**HKM2**) and stock price (**HKShare**) also positively affected on the stock price in Japan (**JPShare**). It is noteworthy here that the response function of **JGB10Y** to **HKMB** is negative, whereas the response function of **JGB10Y** to **HKShare** is significantly positive. This may indicate that JGBs have been used as an alternative financial investment to Japanese stocks for Hong Kong investors.

As in the case of China, Hong Kong stocks (**HKShare**) have had a positive and significant impact on stock prices in Japan (**JPShare**). This indicates that both Chinese and Hong Kong investments are having a significant impact on the Japanese market. These results suggest that Japanese private capital has a significant impact on the Hong Kong financial market and also on the Chinese market.

(c) Interdependence between Hong Kong and China Market

The China's monetary base (**CNMB**) and money stock (**CNM2**) had a positive and significant effect on the Hong Kong money stock (**HKM2**) and stock prices in HK (**HKShare**) , while the Hong Kong money stock (**HKM2**) had also significant effect on the Chinese monetary base (**CNMB**) over the period (Table 2-3, Appendix Fig.4-4). China's money stock (CNM2) also put positive effect on stock prices in HK (**HKShare**) and interbank rate (**HKInterbank**).

On the other hand, Hong Kong stock prices (**HKShare**) put strong effect on China's monetary base (**CMMB**) as well as Stock prices in China (**CNShare**). 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.

3.3.5 Summary on Impulse Response Functions

The analysis of the spillover effects of Bank of Japan's monetary easing policy on Chinese and Hong Kong markets using impulse response functions based on the BVAR model can be summarized as follows.

During the period from the Global Financial Crisis (2008) until just before the QQE, including the Comprehensive Monetary Easing (CME), the financial market had a significant positive impact on the Hong Kong and Chinese markets in terms of the monetary base and money stock, and vice versa.

However, the introduction of QQE by the Bank of Japan from April 2013 has enabled a large amount of money to flow into the Hong Kong-China market as a spillover effect of the Bank of Japan's extraordinary monetary expansion. This has had a significant direct impact on China's money stock (M2), rather than the monetary base.

Moreover, the integration of the capital markets of the Hong Kong and mainland (Shanghai and Shenzhen) markets since November 2014 has significantly facilitated and changed the flow of funds between China, Hong Kong and Japan. In other words, financial investment has now been made directly from China to Japan, rather than through Hong Kong.

As a result, financial investment from China into Hong Kong and Japan has increased substantially, and the impact of capital inflows from China into Hong Kong and Japan has tended to be greater than that of capital inflows from Japan into Hong Kong and China. This has had a significant impact on Japanese financial and capital markets, including stock prices.

3.4 Variance Decomposition

The variance decomposition is basically based on BVAR models which are used for the analyses on impulse response functions 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, At the same time, how the monetary base and money stock as well as stock prices in HK and China have put impact on the Market in Japan is also examined.

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

The share of **Japan's monetary base (JPMB)** was relatively limited with 2.8% in the 10th period of variance decomposition of **China's MB (CNMB)** from September 2008 to March 2013 (Table 3-1-1). While the share of **Japan's money stock (JPM2)** was less than 10 % during the same period, **JPM2**'s share in the variance decomposition of **China's money stock (CNM2)** was significantly larger at 45.0% under the QQE from April 2013 to January 2016 (before the BOJ's negative interest rate period). The share of Japan's money stock (**JPM2**) in the tenth period of variance decomposition kept relatively high share with 22.4% in the late QQE period, February 2016-December 2019 and 24.5% in November 2014-December 2019, respectively.

Japan's monetary base (**JPMB**) and money stock (**JPM2**) accounted for 5.5% and 5.0% respectively in the tenth period of the variance decomposition of **stock prices in China (CNShare)** from September 2008 to March 2013, and the shares increased to 14.1% and 17.6%, respectively, during the first period of QQE period (April 2013 – January 2016).

The share of Japan's money stock (**JPM2**) in the tenth period of the variance decomposition of **China's industrial production (CNProd)** was also high with 32.6% during the April 2013-January 2016 period, but it declined to 10.5% in the period from February 2016 to December 2019 and 11.1% during November 2014 - December 2019.

Table 3-1-1: Variance Decomposition (Effects from Japan to China)

	China MB							China M2						
Sept..2008-Mar.2013	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd
	1	0.01	0.86	99.14	0.00	0.00	0.00	1	0.01	1.09	1.50	97.42	0.00	0.00
	10	0.02	2.77	72.04	21.48	3.42	0.29	10	0.01	17.17	0.35	73.93	6.50	2.05
	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd
	1	0.01	1.30	98.70	0.00	0.00	0.00	1	0.01	3.97	1.02	95.01	0.00	0.00
	10	0.02	4.87	69.18	21.90	3.70	0.35	10	0.01	21.81	0.25	68.09	7.74	2.12
Apr.2013-Jan.2016	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd
	1	0.01	0.11	99.89	0.00	0.00	0.00	1	0.00	0.99	0.64	98.37	0.00	0.00
	10	0.01	1.13	95.43	0.91	2.12	0.41	10	0.01	16.72	1.43	65.52	9.62	6.71
	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd
	1	0.00	0.99	0.64	98.37	0.00	0.00	1	0.00	8.14	2.77	89.10	0.00	0.00
	10	0.01	16.72	1.43	65.52	9.62	6.71	10	0.01	45.02	1.19	31.88	4.75	17.17
Feb.2016-Dec.2019	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd
	1	0.01	4.96	95.04	0.00	0.00	0.00	1	0.005	4.59	0.12	95.29	0.00	0.00
	10	0.01	8.01	90.12	0.13	1.70	0.05	10	0.009	1.94	0.08	94.65	1.50	1.82
	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd
	1	0.01	0.10	99.90	0.00	0.00	0.00	1	0.01	0.24	0.04	99.72	0.00	0.00
	10	0.01	1.63	94.51	1.21	2.62	0.02	10	0.01	22.39	0.07	76.39	0.24	0.91
Nov..2014-Dec.2019	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd
	1	0.01	5.10	94.90	0.00	0.00	0.00	1	0.00	2.39	0.38	97.23	0.00	0.00
	10	0.01	5.37	93.69	0.39	0.14	0.41	10	0.01	2.22	0.77	93.13	0.62	3.25
	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd
	1	0.01	0.66	99.34	0.00	0.00	0.00	1	0.00	0.25	0.02	99.73	0.00	0.00
	10	0.01	4.68	94.61	0.54	0.10	0.07	10	0.01	24.50	0.23	73.64	0.37	1.27
Sept..2008-Mar.2013	China Share							China Industrial Production						
	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd
	1	5.82	2.31	0.35	0.03	97.31	0.00	1	5.83	1.26	1.68	0.57	1.12	95.37
	10	6.30	5.54	0.74	1.63	91.95	0.13	10	6.40	9.70	3.09	4.09	2.90	80.22
	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd
	1	5.86	4.33	1.01	0.03	94.63	0.00	1	5.91	0.72	0.87	0.48	0.11	97.82
	10	6.28	5.02	1.60	1.47	91.79	0.12	10	6.41	6.83	2.63	3.16	2.81	84.57
Apr.2013-Jan.2016	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd
	1	13.10	12.76	5.57	0.65	81.02	0.00	1	0.94	0.76	0.21	1.69	3.67	93.67
	10	15.77	14.12	10.84	0.91	73.63	0.50	10	1.20	15.38	0.50	14.81	5.86	63.45
	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd
	1	13.17	13.59	3.66	5.75	77.00	0.00	1	1.00	1.77	0.75	0.73	4.25	92.49
	10	16.03	17.57	7.92	5.47	67.33	1.71	10	1.54	32.63	0.51	7.15	3.54	56.16
Feb.2016-Dec.2019	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd
	1	5.70	0.99	3.74	2.34	92.94	0.00	1	3.29	5.22	0.03	4.52	2.17	88.06
	10	6.59	1.29	3.56	3.14	91.94	0.08	10	3.87	4.23	1.79	26.72	3.12	64.14
	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd
	1	5.67	0.20	1.20	3.33	95.26	0.00	1	3.22	0.64	0.00	5.34	3.69	90.32
	10	6.59	0.22	0.91	3.64	95.22	0.01	10	3.78	10.48	2.00	18.62	3.34	65.56
Nov..2014-Dec.2019	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPMB	CNMB	CNM2	CNShare	CNProd
	1	9.08	0.88	0.02	0.56	98.54	0.00	1	3.01	6.52	0.04	4.37	0.14	88.92
	10	10.56	1.49	3.17	0.51	94.76	0.06	10	3.99	7.71	3.32	36.09	0.15	52.73
	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd	Period	S.E.	JPM2	CNMB	CNM2	CNShare	CNProd
	1	9.19	4.16	0.12	0.72	95.00	0.00	1.00	3.08	0.01	0.20	5.13	0.67	93.99
	10	10.62	4.24	2.08	1.48	92.17	0.03	10.00	3.53	11.07	1.56	14.70	0.76	71.91

Sources: Author’s calculation based on database of Bank of Japan, People’s Bank of China, FRED

Meanwhile, for the ratios of Japan’s monetary base (**JPMB**) and money stock (**JPM2**) in the tenth period of variance decomposition of **Hong Kong’s money stock (HKM2)** remained high at 27.0% and 35.0% from September 2008 to March 2013 (Table 3-1-2). This could be also explained by the fact that substantial flows of investment from Japan. The shares of JPMB and JPM2 reached at 36.3% and 21.9% in the later period of QQE(February 2016-December 2019). This indicates that the HK money stock (**HKM2**) increased as a result of large inflows of capital from private financial institutions, which have been accelerated since the stock market integration between HK and China. However, the share of **JPM2** in the variance decomposition of Stock prices in China (**CNShare**) declined since later period of QQE (February 2016-December 2019). This could be due to the liberalization of stock markets between HK and Shanghai in November 2014, followed by Shenzhen in December 2016, as well as the tightening capital controls introduced by Chinese government since late 2016.

The shares of Japan's monetary base (**JPMB**) and money stock (JPM2) in the tenth period of the variance decomposition of **the Hong Kong Interbank Rate (HKInterbank)** were 0.19% and 0.93%, respectively before QQE, but after the introduction of QQE, the shares of Japan's monetary base (JPMB) and money stock (JPM2) increased to 15.9% and 10.8%, respectively, in the April 2013-January 2016 period (Table 3-1-2). Furthermore, the share of **JPM2** increased to 21.3% in the late QQE period (February 2016 - December 2019).

Table 3-1-2: Variance Decomposition (Effects from Japan to HK)

	HK MB (JPMB/ M2)							HK M2 (JPMB/ M2)						
Sept..2008-Mar.2013	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare
	1	0.02	0.15	99.85	0.00	0.00	0.00	1	0.01	3.11	0.02	96.87	0.00	0.00
	10	0.03	0.44	82.99	3.56	12.91	0.09	10	0.01	26.99	0.10	72.38	0.39	0.14
	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare
	1	0.02	0.46	99.54	0.00	0.00	0.00	1	0.01	3.12	0.21	96.66	0.00	0.00
	10	0.03	0.78	82.40	3.60	13.10	0.12	10	0.01	35.03	0.25	63.47	0.43	0.83
Apr.2013-Jan.2016	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare
	1	0.01	0.00	100.00	0.00	0.00	0.00	1	0.00	0.14	4.69	95.18	0.00	0.00
	10	0.01	5.48	93.02	1.02	0.02	0.46	10	0.01	18.34	6.10	74.76	0.12	0.68
	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare
	1	0.01	0.27	99.73	0.00	0.00	0.00	1	0.00	1.08	2.22	96.70	0.00	0.00
	10	0.01	8.86	86.93	3.68	0.06	0.46	10	0.01	7.21	2.46	89.84	0.31	0.18
Feb.2016-Dec.2019	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare
	1	0.00	0.57	99.43	0.00	0.00	0.00	1	0.00	2.15	13.18	84.68	0.00	0.00
	10	0.01	0.65	96.62	0.06	0.83	1.83	10	0.01	36.30	12.13	51.26	0.06	0.24
	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare
	1	0.00	1.64	98.36	0.00	0.00	0.00	1	0.00	2.06	21.57	76.36	0.00	0.00
	10	0.01	4.76	90.05	2.83	0.37	1.98	10	0.01	21.98	30.07	47.26	0.05	0.64
Nov..2014-Dec.2019	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare
	1	0.01	1.21	98.79	0.00	0.00	0.00	1	0.00	0.74	0.30	98.96	0.00	0.00
	10	0.01	7.22	76.85	13.79	1.02	1.11	10	0.01	13.99	0.42	82.64	0.06	2.88
	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare
	1	0.01	1.63	98.37	0.00	0.00	0.00	1	0.00	3.57	1.46	94.97	0.00	0.00
	10	0.01	1.34	94.99	0.84	0.45	2.38	10	0.01	24.49	7.90	65.42	0.57	1.61
	HK Interbank Rate (JPMB/ M2)							HK Share (JPMB/ M2)						
Sept..2008-Mar.2013	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare
	1	0.15	0.00	9.11	0.00	90.88	0.00	1.00	4.70	1.26	0.03	8.83	10.07	79.81
	10	0.18	0.19	14.80	0.05	84.84	0.12	10.00	5.70	1.13	0.56	8.53	18.23	71.54
	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare
	1	0.15	0.21	6.10	0.81	92.88	0.00	1.00	4.63	0.14	0.07	10.36	7.98	81.45
	10	0.17	0.93	12.74	1.50	84.61	0.22	10.00	5.64	1.37	0.41	11.94	14.57	71.70
Apr.2013-Jan.2016	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare
	1	0.01	15.59	5.15	0.22	79.04	0.00	1.00	5.87	6.80	0.18	6.48	1.57	84.98
	10	0.01	15.86	5.21	1.97	76.94	0.02	10.00	6.61	5.76	10.72	10.68	1.67	71.17
	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare
	1	0.01	10.87	5.68	0.63	82.83	0.00	1.00	5.91	12.15	0.63	4.30	0.40	82.51
	10	0.01	10.81	5.55	4.88	78.74	0.02	10.00	6.62	10.32	10.41	8.99	0.63	69.66
Feb.2016-Dec.2019	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare
	1	0.30	0.59	11.15	15.01	73.25	0.00	1.00	5.14	0.39	8.01	10.92	2.54	78.15
	10	0.33	3.57	21.20	15.33	59.46	0.43	10.00	6.70	1.83	38.24	7.60	2.12	50.21
	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare
	1	0.30	14.12	7.97	1.62	76.29	0.00	1.00	5.14	0.22	8.51	9.84	5.40	76.03
	10	0.33	21.29	15.80	1.66	60.78	0.47	10.00	7.34	0.65	43.13	11.97	2.97	41.29
Nov..2014-Dec.2019	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPMB	HKMB	HKM2	HKIntrate	HKShare
	1	0.28	0.63	1.82	1.08	96.47	0.00	1.00	5.95	2.70	2.63	12.44	1.44	80.80
	10	0.32	1.00	9.01	7.51	81.38	1.10	10.00	7.90	1.71	2.38	28.75	7.32	59.85
	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	JPM2	HKMB	HKM2	HKIntrate	HKShare
	1	0.27	15.26	1.09	0.20	83.44	0.00	1.00	5.98	0.95	0.43	14.48	0.19	83.96
	10	0.31	21.72	10.32	1.43	65.98	0.55	10.00	7.98	0.90	0.30	32.87	3.67	62.26

Sources: Author's calculation based on database of Bank of Japan, Monetary Authority of HK, FRED

The shares of Japan's monetary base (**JPMB**) and money stock (**JPM2**) in the tenth period of the variance decomposition of the **Hong Kong Stock Price (HKShare)** were 5.8% and 10.3%, respectively between April 2013 and January 2016, but in the later period of QQE (February 2016 – December 2019), the shares of **JPMB** and JPM2 sharply dropped to 1.8% and 0.7%, respectively. This may indicate that substantial investment from China had already made, which had resulted in increasing capital flows into the Hong Kong market since the integration of the stock market, and the money from Japan had already decreased during the period.

3.4.2 Variance Decomposition of the effects of China/ HK's monetary base (CNMB/ HKMB) and money stock (CNM2/HKM2) on the markets in Japan

[Influence of China on the Japanese market]

Chinese market had put significant effects on Japan's monetary base (JPMB) and M2 (**JPM2**), which had a large share in variance decomposition of the **monetary base (JPMB)** and money stock (JPM2) even before the introduction of QQE (Table3-2-1).

The impact of China's MB (**CNMB**) and M2 (**CNM2**) on Japan's monetary base (**JPMB**) as well as **M2 (JPM2)** has significantly changed, if we examine the results of variance decomposition after the introduction of QQE. In the variance decomposition of **Japanese MB (JPMB)** the shares of China's MB (**CNMB**) and M2 (**CNM2**) in the tenth period had remained at 13.4% and 16.3%, respectively in the period September 2008-March 2013. However, after the introduction of QQE, the shares of **CNMB** and **CNM2** have changed, and in the early years of QQE before introduction of negative interest rate policy (April 2013-January 2016), the shares of **CNMB** and **CNM2** were 0.4% and 33.6 %, respectively, and 2.1% and 1.5% during the late period of QQE (February 2016-December 2019).

While the shares of **CNMB** and **CNM2** were 33.2% and 40.2% in the 10th period of variance decomposition of Japan's **money stock (JPM2)**, respectively during the pre-QQE period, the shares of monetary base (**CNMB**) and money stock (**CNM2**) significantly changed to 0.3% and 27.2% respectively April 2013-January 2016, and the shares of 1.6% and 19.4%, respectively during the periods of post-negative interest rate policy under the QQE (February 2016-December 2019).

The above results may suggest that Chinese money invested into the Japanese market after the introduction of QQE has shifted significantly from the monetary base (**CNMB**) to the money stock (**CNM2**) in China,

It should be also noted here that such a change has been seen in the stock market in Japan. The share of the **Chinese stock prices (CNShare)** in the tenth period of the variance decomposition of **stock prices in Japan (JPShare)** increased from 1.9% during the pre-QQE period (September 2008-March 2013) to 58.5% after the introduction of QQE (April 2013-January 2016) indicating that the stock market in China has surely put direct impact on that of Japan after the QQEII and stock market integration between HK and Shanghai in November 2014.

Table 3-2-1: Variance Decomposition (Effects from China to Japan)

				Japan MB (CNMB/ M2)					
Sept..2008-Mar.2013	Period	S.E.	**CNMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.01	3.81	96.19	0.00	0.00	0.00	0.00	0.00
	10	0.02	**13.35**	82.87	0.16	2.97	0.14	0.34	0.17
	Period	S.E.	**CNM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.01	6.75	93.25	0.00	0.00	0.00	0.00	0.00
	10	0.02	**16.27**	81.12	1.05	0.39	0.56	0.21	0.38
Apr.2013-Jan.2016	Period	S.E.	**CNMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.01	1.63	98.37	0.00	0.00	0.00	0.00	0.00
	10	0.02	**0.40**	**92.26**	**1.19**	**4.05**	**0.29**	**0.98**	**0.83**
	Period	S.E.	**CNM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.01	2.37	97.63	0.00	0.00	0.00	0.00	0.00
	10	0.01	**33.57**	**60.05**	**1.23**	**3.07**	**0.22**	**0.63**	**1.24**
Feb.2016-Dec.2019	Period	S.E.	**CNMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	3.97	96.03	0.00	0.00	0.00	0.00	0.00
	10	0.01	**2.07**	92.61	0.43	2.84	1.95	0.04	0.06
	Period	S.E.	**CNM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	1.76	98.24	0.00	0.00	0.00	0.00	0.00
	10	0.01	**1.45**	93.81	0.04	1.84	2.62	0.14	0.09
Nov..2014-Dec.2019	Period	S.E.	**CNMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	3.76	96.24	0.00	0.00	0.00	0.00	0.00
	10	0.01	**1.91**	91.01	0.43	0.24	2.61	3.66	0.14
	Period	S.E.	**CNM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	0.63	99.37	0.00	0.00	0.00	0.00	0.00
	10	0.01	**0.21**	91.71	0.87	0.46	2.10	4.49	0.16
				Japan M2 (CNMB/M2)					
Sept..2008-Mar.2013	Period	S.E.	**CNMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	10.21	32.87	10.83	46.09	0.00	0.00	0.00
	10	0.00	**33.24**	45.38	3.01	16.83	0.41	0.64	0.49
	Period	S.E.	**CNM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	8.27	24.92	0.59	66.22	0.00	0.00	0.00
	10	0.00	**40.10**	29.44	0.80	26.71	0.38	0.73	1.83
Apr.2013-Jan.2016	Period	S.E.	**CNMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	**0.49**	46.97	17.50	35.03	0.00	0.00	0.00
	10	0.00	**0.31**	62.65	12.00	22.11	0.52	0.82	1.59
	Period	S.E.	**CNM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	16.91	33.26	20.37	29.46	0.00	0.00	0.00
	10	**0.00**	**27.16**	37.71	13.62	18.77	0.31	0.51	1.91
Feb.2016-Dec.2019	Period	S.E.	**CNMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	0.03	48.45	22.46	29.06	0.00	0.00	0.00
	10	0.00	**1.55**	66.65	11.84	18.05	0.11	1.77	0.03
	Period	S.E.	**CNM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	0.04	49.67	13.12	37.17	0.00	0.00	0.00
	10	0.00	**19.36**	50.67	6.28	21.71	0.34	1.55	0.09
Nov..2014-Dec.2019	Period	S.E.	**CNMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	**0.03**	41.81	20.49	37.66	0.00	0.00	0.00
	10	0.00	**0.26**	47.77	18.19	32.59	0.57	0.22	0.41
	Period	S.E.	**CNM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	0.00	38.44	21.32	40.23	0.00	0.00	0.00
	10	**0.00**	**24.39**	26.98	16.33	29.32	0.77	1.20	1.01
				Japan Share(CNShare)					
Sept..2008-Mar.2013	Period	S.E.	**CNShare**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	5.67	1.94	0.64	15.85	3.89	0.25	3.10	74.33
	10	6.60	**1.90**	1.11	16.77	4.19	0.67	3.46	71.91
Apr.2013-Jan.2016	Period	S.E.	**CNShare**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	6.92	47.89	3.67	2.69	0.55	1.20	4.69	39.31
	10	8.28	**58.48**	6.38	1.89	0.48	0.89	4.04	27.85
Feb.2016-Dec.2019	Period	S.E.	**CNShare**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	7.89	6.87	2.79	0.08	0.83	0.10	29.83	59.50
	10	8.74	**9.90**	12.26	0.18	0.87	0.94	26.07	49.78
Nov..2014-Dec.2019	Period	S.E.	**CNShare**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	8.51	21.13	0.02	1.75	1.47	0.00	23.11	**52.53**
	10	11.08	**29.85**	0.96	3.92	6.61	0.23	24.20	**34.23**

Sources: Author's calculation based on database of Bank of Japan, People's Bank of China, Nikkei Profile, FRED

However, the share of **CNShare** decreased to 9.9% in the late period of QQE (February 2016-December 2019), which may indicate the fact that investment in the financial market in Japan has been diversified from stock trading to other financial investment in Japan, as one of the results of capital controls tightened in China since November 2016.

[Influence from HK to Japanese markets]

As shown in Table 3-2-2, Hong Kong MB (**HKMB**) and M2 (**HKM2**) shares in **Japan's monetary base (JPMB)** in 10th period of variance decomposition were 4.1% and 18.2%, respectively between September 2008 and March 2013, while in the QQE period, HKM2's share was 7.9% in the early period (before negative interest rate) of QQE (April 2013-January 2016) and It increased significantly to 12.8% in the late QQE period (February 2016 to December 2019).

The share of Hong Kong money stock (**HKM2)** in the tenth period of the variance decomposition of **Japan's money stock (JPM2)** was 19.6 percent in the early QQE period but decreased to 2.9% during April.2013-January 2016. However, the share picked up to 16.1% in the late QQE period (February 2016-December 2019) and to 22.6% from November 2014 to December 2019. Thus, the impact of Hong Kong financial investment on **JPM2** has been mainly through money stock (HKM2) during the QQE period.

The share of Hong Kong stock prices (**HKM2**) in the tenth period of the variance decomposition of **stock prices in Japan (JPShare)** was only 0.5% in the pre-QQE period (September 2008-March 2013). However, it increased significantly to 40.5% in early period of QQE (April 2013-Jamuary 2016). though the share of **HKShare** in the variance composition of **JPShare** slightly declined to 17.5% during the period of November 2014 and December 2019.

The results suggest that the Chinese investment in the market in Japan, utilizing money stock in Japan via Hong Kong, has increased due to the introduction of QQE as well as the integration of the stock markets in Hong Kong and mainland China (Shanghai and Shenzhen) during the period.

Table 3-2-2: Variance Decomposition (Effects from HK to Japan)

				Japan MB (HKMB/M2)					
Sept..2008-Mar.2013	Period	S.E.	**HKMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.01	0.79	99.21	0.00	0.00	0.00	0.00	0.00
	10	0.02	**4.11**	85.80	0.39	8.78	0.08	0.46	0.38
	Period	S.E.	**HKM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.01	5.54	94.46	0.00	0.00	0.00	0.00	0.00
	10	0.02	**18.18**	77.21	0.47	3.49	0.12	0.32	0.22
Apr.2013-Jan.2016	Period	S.E.	**HKMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.01	2.29	97.71	0.00	0.00	0.00	0.00	0.00
	10	0.01	**0.76**	**93.88**	**0.13**	**4.09**	**0.02**	**0.16**	**0.96**
	Period	S.E.	**HKM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.01	0.52	99.48	0.00	0.00	0.00	0.00	0.00
	10	0.01	**7.91**	**84.28**	**0.84**	**4.85**	**0.31**	**1.01**	**0.81**
Feb.2016-Dec.2019	Period	S.E.	**HKMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	0.07	99.93	0.00	0.00	0.00	0.00	0.00
	10	0.01	**3.70**	82.65	0.52	9.83	3.02	0.19	0.09
	Period	S.E.	**HKM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	7.10	92.90	0.00	0.00	0.00	0.00	0.00
	10	0.01	**12.84**	81.93	0.16	1.63	3.36	0.07	0.00
Nov..2014-Dec.2019	Period	S.E.	**HKMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.01	0.22	99.78	0.00	0.00	0.00	0.00	0.00
	10	0.01	**6.61**	88.69	0.06	1.75	0.89	1.92	0.09
	Period	S.E.	**HKM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	2.02	97.98	0.00	0.00	0.00	0.00	0.00
	10	0.01	**1.18**	92.01	0.23	0.25	2.25	3.93	0.15
				Japan M2 (HKMB/M2)					
Sept..2008-Mar.2013	Period	S.E.	**HKMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	5.03	37.93		0.10	56.95	0.00	0.00
	10	0.00	**14.23**	56.27		0.34	27.13	0.26	0.92
	Period	S.E.	**HKM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	0.83	29.87	0.90	68.40	0.00	0.00	0.00
	10	0.00	**19.61**	45.08	0.36	31.73	1.56	0.70	0.96
Apr.2013-Jan.2016	Period	S.E.	**HKMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	**0.88**	34.83	14.45	49.84	0.00	0.00	0.00
	10	0.00	**2.71**	58.39	7.44	29.19	0.02	0.24	2.02
	Period	S.E.	**HKM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	0.49	45.55	14.36101	39.59712	0.00	0.00	0.00
	10	**0.00**	**2.93**	54.92	10.71	28.15	0.51	0.83	1.95
Feb.2016-Dec.2019	Period	S.E.	**HKMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	0.44	25.75	1.22	72.59	0.00	0.00	0.00
	10	0.00	**1.31**	35.70	3.02	58.28	0.03	1.55	0.12
	Period	S.E.	**HKM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	2.46	38.29	22.68	36.57	0.00	0.00	0.00
	10	0.00	**16.06**	45.10	11.86	23.71	0.07	3.16	0.04
Nov..2014-Dec.2019	Period	S.E.	**HKMB**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	**0.03**	16.06	3.48	80.44	0.00	0.00	0.00
	10	0.00	**1.38**	18.98	3.88	74.32	0.65	0.13	0.67
	Period	S.E.	**HKM2**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	0.00	2.51	35.22	16.53	45.74623	0.00	0.00	0.00
	10	0.00	**22.57**	**32.10**	**13.25**	**28.89**	**1.10**	**2.01**	**0.08**
				Japan Share(HKShare)					
Sept..2008-Mar.2013	Period	S.E.	**HKShare**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	5.79	0.05	0.49	14.25	3.91	0.75	1.64	78.92
	10	6.82	**0.51**	0.91	15.07	3.80	1.06	2.02	76.63
Apr.2013-Jan.2016	Period	S.E.	**HKShare**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	7.68	36.66	0.03	14.97	0.15	3.08	4.06	41.04
	10	8.62	**40.46**	6.14	12.74	0.68	2.51	3.91	33.56
Feb.2016-Dec.2019	Period	S.E.	**HKShare**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	7.84	14.69	1.81	0.98	1.41	2.86	29.96	48.29
	10	8.72	**17.49**	10.23	1.25	1.51	3.95	25.59	39.98
Nov..2014-Dec.2019	Period	S.E.	**HKShare**	**JPMB**	**BOJAC**	**JPM2**	**CallRate**	**JGB10Y**	**JPShare**
	1	8.21	26.20	0.16	0.43	5.05	3.25	19.73	**45.18**
	10	10.72	**40.70**	0.62	1.74	7.21	3.56	17.85	**28.33**

Sources: Author's calculation based on database of Bank of Japan, Monetary Authority of HK, Nikkei Profile, FRED

3.4.3 Variance Decomposition of the effects of CNMB/HKMB and CNM2/HKM2 on the CN/ HK markets

While the shares of HK monetary base (HKMB) and money stock of HK (HKM2) in the variance decompositions of **monetary base in China (CNMB)** were limited, the influence of money stock in China (**CNM2**) in the variance decompositions of **money stock in HK (HKM2)** has become larger during the QQE period (Table 3-3-1).

The share of HK money stock (**HKM2**) in the variance decomposition of China's money stock (**CNM2**) increased to 21.2% after the introduction of QQE (April 2013-January 2016) from that of 19.5% before the introduction of QQE, which decreased substantially to 2.2% respectively in the late QQE (February 2016-December 2019) and 2.2% in QQE II (November 2014-December 2019) (Table3-3-1). This suggest that money flows from Japan had a direct impact on the Chinese market rather than from Hong Kong in the late QQE period

The share of **HK stock prices (HKShare)** in the variance decomposition of **China's stock prices (CNShare)** has been high since the Pre-QQE period (September 2008-March 2013) with 34.8%, and it increased to 43.5% during the early period of QQE (April 2013-January 2016). On the other hand, the impact of monetary base in HK (MBHK) on **China's industrial Production (CNProd)** has been limited, as shown in the share of **HK monetary base (HKMB)** in the variance decomposition of **CNProd**.

On the other hand, the shares of China's money stock (**CNM2**) in the tenth period of variance decomposition of **HK money stock (HKM2)** have been relatively high with 27.8% during the Pre-QQE period. Although it decreased substantially to 10.6% during the early QQE period (March 2013-January 2016), the share recovered to 23.3% during late period of QQE (February 2016 – December 2019) (Table 3-3-2).

The **HK interbank interest rate (HKInterbank)** was hardly affected by the China's monetary stock (**CNM2**) during the Pre-QQE period (September 2008 – March 2013) and early period of QQR (April 2013-January 2016), as shown in the variance decomposition with the shares of 0,2 and 0.8%, respectively. However, the share of CNM2 increased to 12.3% during the late period of QQE (February 2016 – December 2019), and 11.9%during QQEⅡ (November 2014-December 2019). The result suggests that the investment from China in the HK market increased during the period of liberalization of stock trading in the HK and Shanghai markets.

The share of China's stock prices (**CNShare** in tenth period of the variance

Table 3-3-1: Variance Decomposition (Effects from HK to China)

	China MB							China M2						
Sept..2008-Mar.2013	Period	S.E.	HKMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	HKMB	CNMB	CNM2	CNShare	CNProd
	1	0.01	1.16	98.85	0.00	0.00	0.00	1	0.01	1.62	1.64	96.74	0.00	0.00
	10	0.02	9.77	65.69	20.04	3.90	0.60	10	0.01	2.40	0.72	87.41	7.17	2.30
	Period	S.E.	HKM2	CNMB	CNM2	CNShare	CNProd	Period	S.E.	HKM2	CNMB	CNM2	CNShare	CNProd
	1	0.01	0.11	99.89	0.00	0.00	0.00	1	0.01	0.01	0.01	99.99	0.00	0.00
	10	0.02	2.78	69.51	23.72	3.73	0.26	10	0.01	19.47	4.26	73.38	2.33	0.56
Apr.2013-Jan.2016	Period	S.E.	HKMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	HKMB	CNMB	CNM2	CNShare	CNProd
	1	0.01	5.15	94.85	0.00	0.00	0.00	1	0.00	1.79	1.90	96.31	0.00	0.00
	10	**0.01**	**4.84**	**90.74**	**0.70**	**2.58**	**1.14**	10	**0.01**	9.25	1.10	53.43	8.52	27.69
	Period	S.E.	HKM2	CNMB	CNM2	CNShare	CNProd	Period	S.E.	HKM2	CNMB	CNM2	CNShare	CNProd
	1	0.01	5.22	94.78	0.00	0.00	0.00	1	0.00	3.45	0.05	96.50	0.00	0.00
	10	**0.01**	**9.40**	**86.93**	**1.26**	**2.41**	**0.00**	10	**0.01**	**21.21**	1.50	66.94	10.35	0.00
Feb.2016-Dec.2019	Period	S.E.	HKMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	HKMB	CNMB	CNM2	CNShare	CNProd
	1	0.01	4.74	95.26	0.00	0.00	0.00	1	0.00	0.05	0.81	99.15	0.00	0.00
	10	**0.01**	**7.51**	87.38	3.71	1.32	0.08	10	0.01	**0.33**	1.43	95.48	0.40	2.35
	Period	S.E.	HKM2	CNMB	CNM2	CNShare	CNProd	Period	S.E.	HKM2	CNMB	CNM2	CNShare	CNProd
	1	0.01	1.17	98.83	0.00	0.00	0.00	1	0.01	0.73	0.49	98.78	0.00	0.00
	10	**0.01**	**6.54**	90.66	0.88	1.82	0.09	10	0.01	**2.17**	0.71	95.35	1.23	0.54
Nov..2014-Dec.2019	Period	S.E.	HKMB	CNMB	CNM2	CNShare	CNProd	Period	S.E.	HKMB	CNMB	CNM2	CNShare	CNProd
	1	0.01	1.82	98.18	0.00	0.00	0.00	1	0.00	0.46	1.78	97.76	0.00	0.00
	10	**0.01**	**1.88**	**95.83**	**1.72**	**0.13**	**0.44**	10	0.01	**2.21**	1.46	95.32	0.58	0.43
	Period	S.E.	HKM2	CNMB	CNM2	CNShare	CNProd	Period	S.E.	HKM2	CNMB	CNM2	CNShare	CNProd
	1	0.01	3.35	96.65	0.00	0.00	0.00	1	0.00	0.46	1.78	97.76	0.00	0.00
	10	**0.01**	**11.40**	**88.01**	**0.43**	**0.06**	**0.09**	10	0.01	**2.21**	1.46	95.32	0.58	0.43

	China Share							China Industrial Production						
Sept..2008-Mar.2013	Period	S.E.	HKShare	CNMB	CNM2	CNShare	CNProd	Period	S.E.	HKMB	CNMB	CNM2	CNShare	CNProd
	1	5.50	28.03	2.57	0.28	69.13	0.00	1	5.54	3.01	0.05	0.03	0.76	96.16
	10	**6.17**	**34.83**	**3.65**	**2.24**	**59.16**	**0.12**	10	5.96	**4.18**	0.09	8.23	3.63	83.87
Apr.2013-Feb.2016	Period	S.E.	HKShare	CNMB	CNM2	CNShare	CNProd	Period	S.E.	HKMB	CNMB	CNM2	CNShare	CNProd
	1	12.70	38.27	2.19	0.00	59.54	0.00	1	1.00	0.02	0.13	0.00	1.32	98.53
	10	**16.83**	**43.50**	7.49	3.43	45.36	0.23	10	1.51	**7.66**	0.19	19.21	3.48	69.46
Feb.2016-Dec.2019	Period	S.E.	HKShare	CNMB	CNM2	CNShare	CNProd	Period	S.E.	HKMB	CNMB	CNM2	CNShare	CNProd
	1	5.63	28.04	2.16	1.71	68.09	0.00	1	3.23	9.74	0.03	5.44	0.61	84.18
	10	6.63	**31.55**	1.74	1.65	64.99	0.08	10	4.22	**5.98**	3.54	39.27	0.90	50.31
Nov..2014-Dec.2019	Period	S.E.	HKShare	CNMB	CNM2	CNShare	CNProd	Period	S.E.	HKMB	CNMB	CNM2	CNShare	CNProd
	1	9.06	33.18	1.75	0.87	64.20	0.00	1	2.95	1.75	0.91	5.45	0.10	91.78
	10	**10.77**	**39.72**	**2.27**	**1.66**	**56.20**	**0.15**	10	3.91	**3.20**	4.76	37.62	0.24	54.18

Sources: Author's calculation based on database of People's Bank of China, Monetary Authority of HK, FRED

Table 3-3-2: Variance Decomposition (Effects from China to HK)

	HK MB							HK M2						
Sept..2008-Mar.2013	Period	S.E.	CNMB	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	CNMB	HKMB	HKM2	HKIntrate	HKShare
	1	0.02	1.05	98.95	0.00	0.00	0.00	1	0.01	1.95	0.14	97.91	0.00	0.00
	10	0.03	2.22	84.25	1.12	12.31	0.10	10	0.01	28.56	1.88	68.79	0.75	0.02
	Period	S.E.	CNM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	CNM2	HKMB	HKM2	HKIntrate	HKShare
	1	0.02	0.11	99.89	0.00	0.00	0.00	1	0.01	0.00	0.23	99.77	0.00	0.00
	10	0.03	0.58	83.72	0.66	14.98	0.06	10	0.01	27.78	5.57	64.45	0.75	1.45
Apr.2013-Jan.2016	Period	S.E.	CNMB	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	CNMB	HKMB	HKM2	HKIntrate	HKShare
	1	0.01	7.47	92.53	0.00	0.00	0.00	1	0.00	0.17	1.59	98.24	0.00	0.00
	10	0.01	10.19	75.67	13.43	0.11	0.61	10	0.01	0.21	2.74	96.64	0.35	0.06
	Period	S.E.	CNM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	CNM2	HKMB	HKM2	HKIntrate	HKShare
	1	0.01	0.73	99.27	0.00	0.00	0.00	1	0.00	3.89	3.76	92.36	0.00	0.00
	10	0.01	11.98	85.79	2.08	0.02	0.13	10	0.01	10.56	3.89	84.59	0.13	0.84
Feb.2016-Dec.2019	Period	S.E.	CNMB	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	CNMB	HKMB	HKM2	HKIntrate	HKShare
	1	0.00	5.14	94.86	0.00	0.00	0.00	1	0.00	0.04	8.76	91.20	0.00	0.00
	10	0.01	12.65	84.24	0.22	0.92	1.98	10	0.01	4.38	12.22	82.50	0.09	0.82
	Period	S.E.	CNM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	CNM2	HKMB	HKM2	HKIntrate	HKShare
	1	0.00	0.12	99.88	0.00	0.00	0.00	1	0.00	0.20	18.65	81.15	0.00	0.00
	10	0.01	1.50	91.82	4.56	0.25	1.87	10	0.01	23.34	25.94	49.84	0.11	0.76
Nov..2014-Dec.2019	Period	S.E.	CNMB	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	CNMB	HKMB	HKM2	HKIntrate	HKShare
	1	0.01	1.83	98.17	0.00	0.00	0.00	1	0.00	**0.64**	0.91	98.46	0.00	0.00
	10	0.01	2.38	94.62	0.13	0.31	2.55	10	0.01	4.77	13.22	81.86	0.04	0.11
	Period	S.E.	CNM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	CNM2	HKMB	HKM2	HKIntrate	HKShare
	1	0.01	0.20	99.80	0.00	0.00	0.00	1	0.00	0.03	0.82	99.15	0.00	0.00
	10	0.01	1.17	93.96	2.16	0.96	1.76	10	0.01	19.41	3.72	73.76	0.58	2.53

	HK Interbank Rate							HK Share						
Sept..2008-Mar.2013	Period	S.E.	CNM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	CNShare	HKMB	HKM2	HKIntrate	HKShare
	1	0.15	0.07	7.85	1.06	91.01	0.00	1	4.73	29.44	0.67	2.61	5.49	61.79
	10	0.18	0.22	15.77	1.61	82.20	0.21	10	5.75	31.89	0.52	2.36	10.53	54.69
Apr.2013-Jan.2016	Period	S.E.	CNM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	CNShare	HKMB	HKM2	HKIntrate	HKShare
	1	0.01	0.19	3.52	0.44	95.85	0.00	1	5.30	50.82	3.93	5.80	1.81	37.64
	10	0.01	0.77	3.55	3.38	92.27	0.04	10	6.42	45.61	19.00	7.33	1.26	26.81
Feb.2016-Dec.2019	Period	S.E.	CNM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	CNShare	HKMB	HKM2	HKIntrate	HKShare
	1	0.28	1.43	10.49	0.57	87.51	0.00	1	5.15	19.52	5.55	2.86	1.95	70.12
	10	0.32	12.30	18.96	0.59	67.58	0.58	10	7.54	24.12	29.44	9.56	1.45	35.42
Nov..2014-Dec.2019	Period	S.E.	CNM2	HKMB	HKM2	HKIntrate	HKShare	Period	S.E.	CNShare	HKMB	HKM2	HKIntrate	HKShare
	1	0.26	2.77	3.77	0.04	93.42	0.00	1	6.06	33.25	0.45	3.05	1.22	62.03
	10	0.30	11.93	18.47	0.99	68.50	0.10	10	8.02	33.04	1.25	12.12	7.32	46.27

Sources: Author's calculation based on database of People's Bank of China, Monetary Authority of HK, FRED decomposition of **HK stock prices** (**HKShare)** increased from 31.9% during September 2008- March 2013 to 45.6% in the early period of QQE (April 2013 to January 2016), though the share of China's stock price (CNShare) slightly declined to 24.1% during the late period of QQE (February 2016 – December 2019).

The above results may indicate the fact that the liberalization of stock trading between the Shanghai and HK market since November 2014 has facilitated massive flows of capital as financial investment between the HK and Chinese markets

3.4.4 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 was already active and Japanese funds were being used in the China and Hong Kong markets. However, while China's money stock (**CNM2**) had consistently maintained a high share in the Japan's 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 were 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 on the markets in China and Hong Kong after the Global Financial Crisis (2008), through the analysis of impulse response functions and variance decomposition based on BVAR model. The period of analysis was set from the first introduction of monetary easing policy after the Crisis from September 2008 to December 2019. The period of the Bank of Japan's Quantitative and Qualitative Monetary Easing (QEE) is divided into two periods: before the introduction of negative interest rates (April 2013-January 2016) and after the negative interest rates (February 2016-December 2019). The period is further divided into the period from November 2014, when further expansion of QQE (Phase II) was launched and the liberalization of stock trading in the Shanghai and Hong Kong markets.

The analysis confirms that the integration of Hong Kong with the Shanghai and Shenzhen markets significantly increased financial transactions not only between China and Hong Kong, but also between China and Japan, with a significant impact on the monetary base (M2), interest rates, stock prices and other variables in both countries. Notably, since the Post-Global Financial Crisis, the monetary easing under QQE has also had a positive and significant impact on the monetary base and commercial banks' money stock in China. On the other hand, the capital investment from China has had a considerable impact on the Hong Kong market during the QQE period.

Since the introduction of QQE, China's impact on Japan's financial markets has been very significant, especially the expansion of the money stock of Chinese commercial banks, which has had a significant impact on Japan's monetary base (JPMB) and money stock (M2). Moreover, the direct impact of the transmission from China to the Japan's monetary base (JPMB), BOJ current account, and money stock (JPM2) had been steadily growing since 2008, even before the QQE. In addition to Hong Kong stock prices, the Hong Kong Money Stock (HKM2) also has a significant impact on the level of interest rates (call rates and JGB yields) in Japan.

In recent years, especially China's money stock has had strong impact on the level of interest rates (call rates and government bond yields) as well as the stock market in Japan. This indicates the substitutability of equities for other financial instruments and may reflect investment activity from China and Hong Kong.

Recent Chinese financial statistics show an increase in financial transactions that do not appear in official statistics, which may have led to an influx of money into informal financial markets, including the crypto asset market, particularly from Chinese investors. This trend has become even more pronounced since November 2016, when the Chinese authorities tightened capital controls. Thus, an increase in the size of the crypto asset market could further undermine the effectiveness of traditional financial indicators and lead to a long-term change in the monetary policy of central banks that originally provided financial resources to the real economy, which could fundamentally alter money flows in global markets in the future. Therefore, it is necessary to analyse the capital flows between Japan, HK and China from this perspective in the future.

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*written in Japanese

[Appendix] Effects of Monetary Policies in Japan/ China/ HK

Fig. 1-1 [September 2008 – March 2013] (1) Japan to China

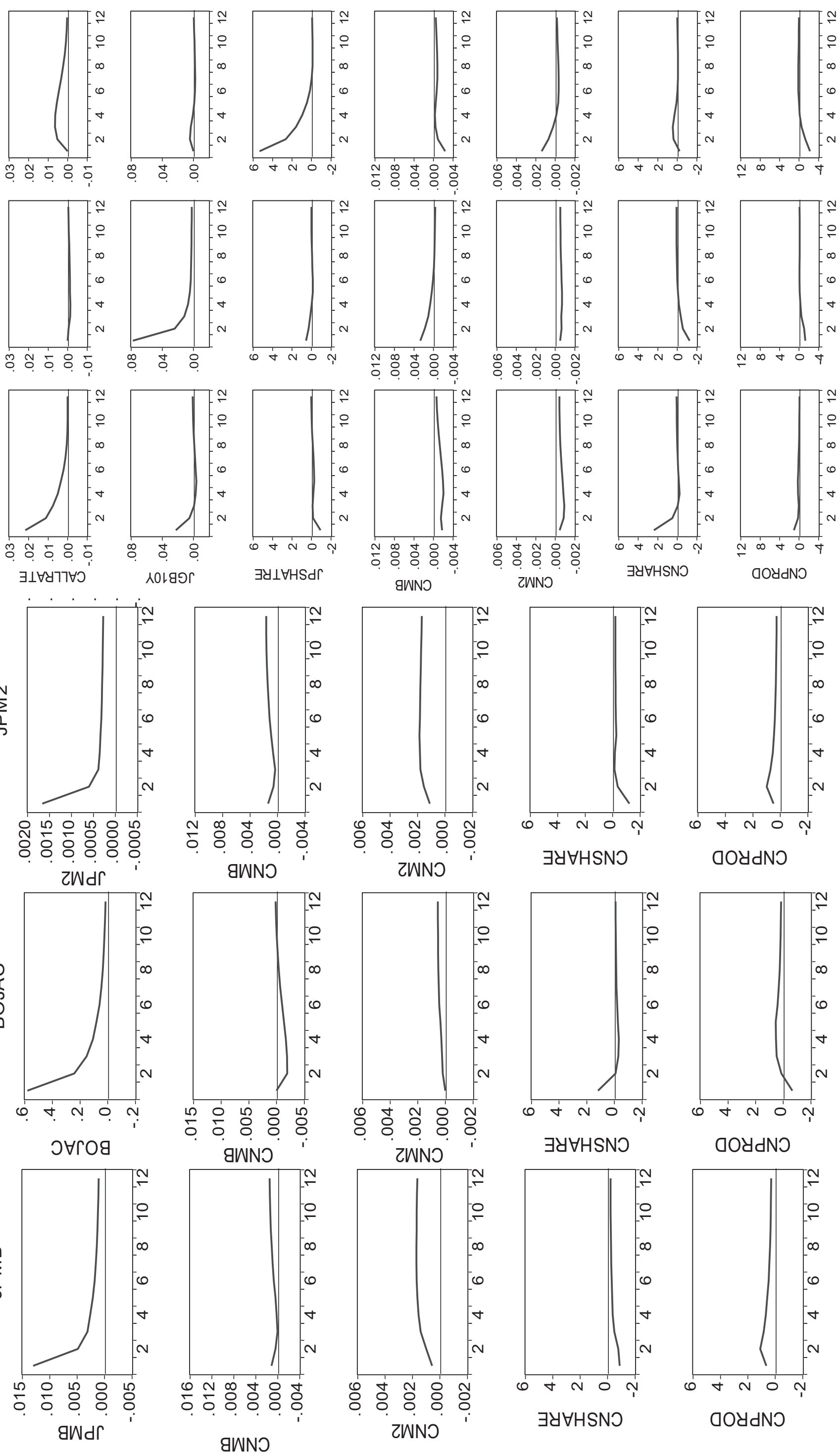


Fig.1-2 [September 2008 – March 2013] (2) Japan to HK

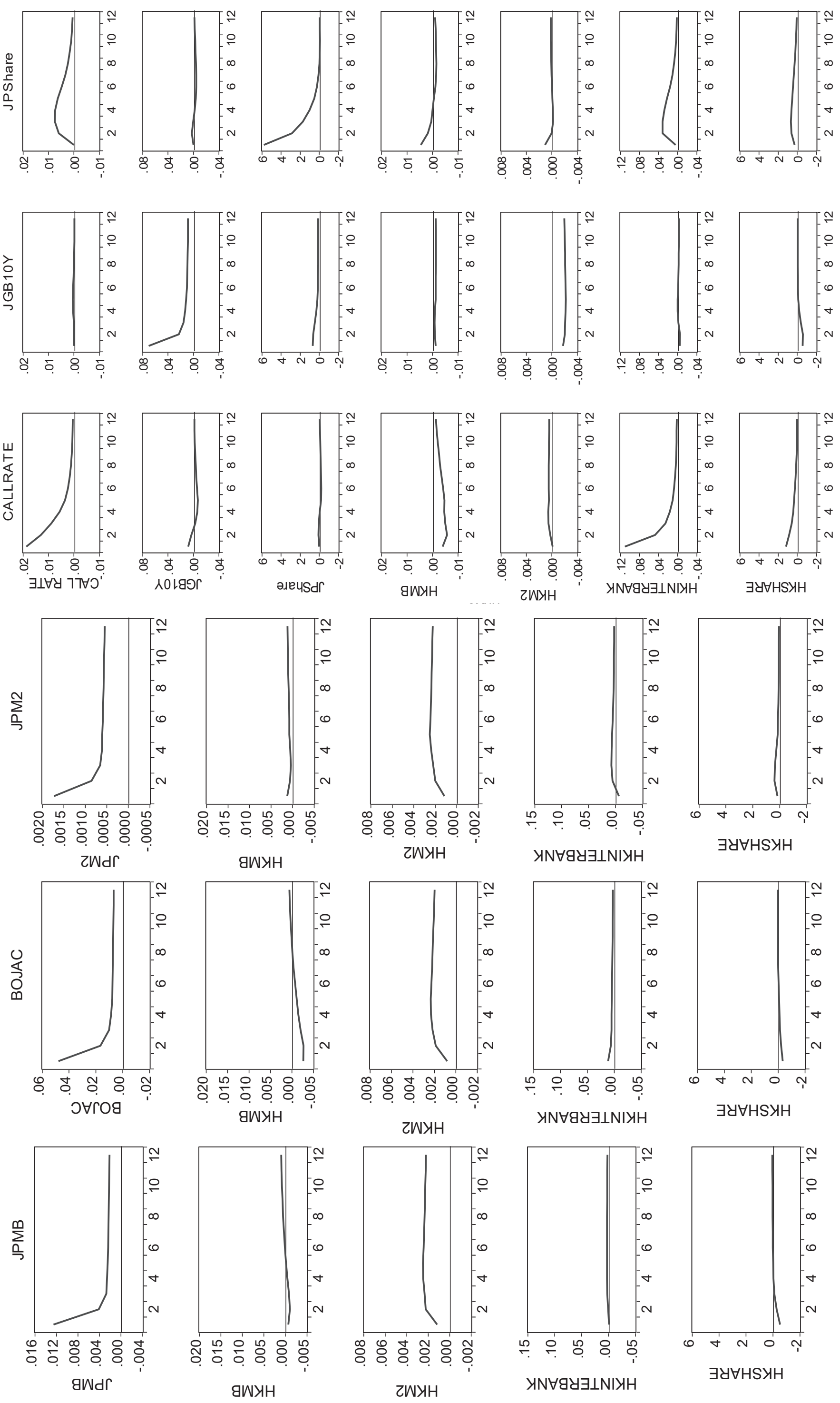
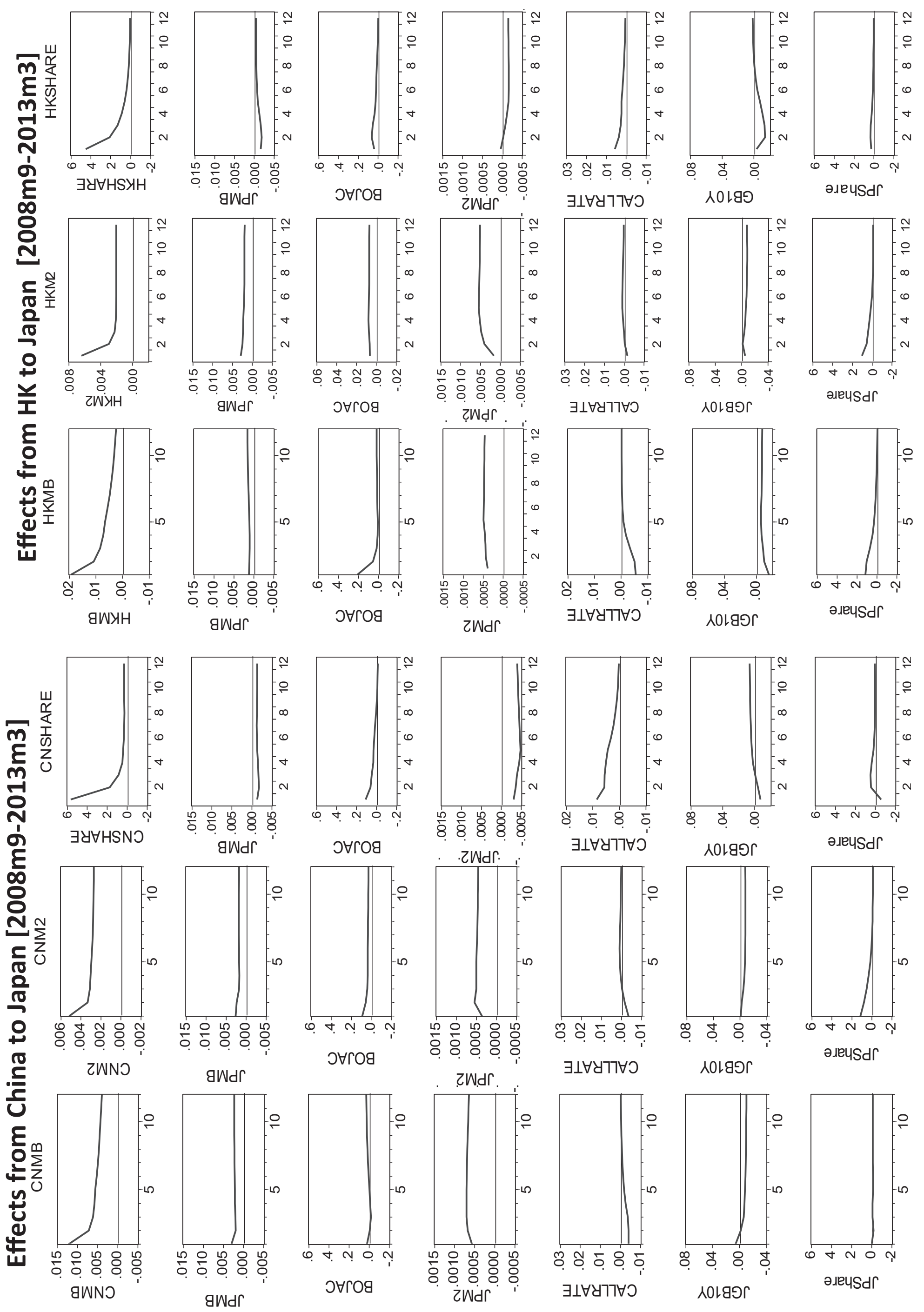


Fig.1-3 [September 2008 – March 2013] (3) China/HK/ to Japan



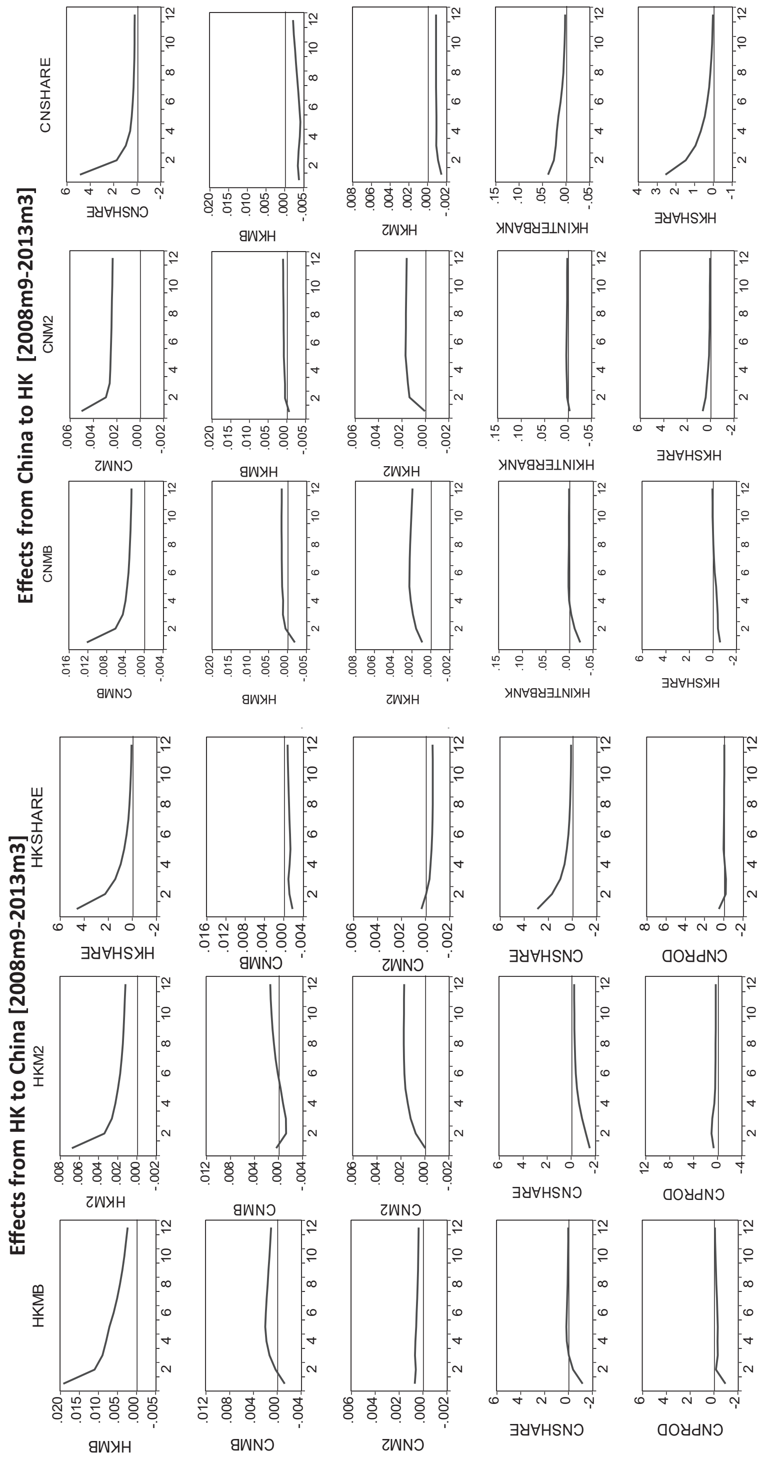
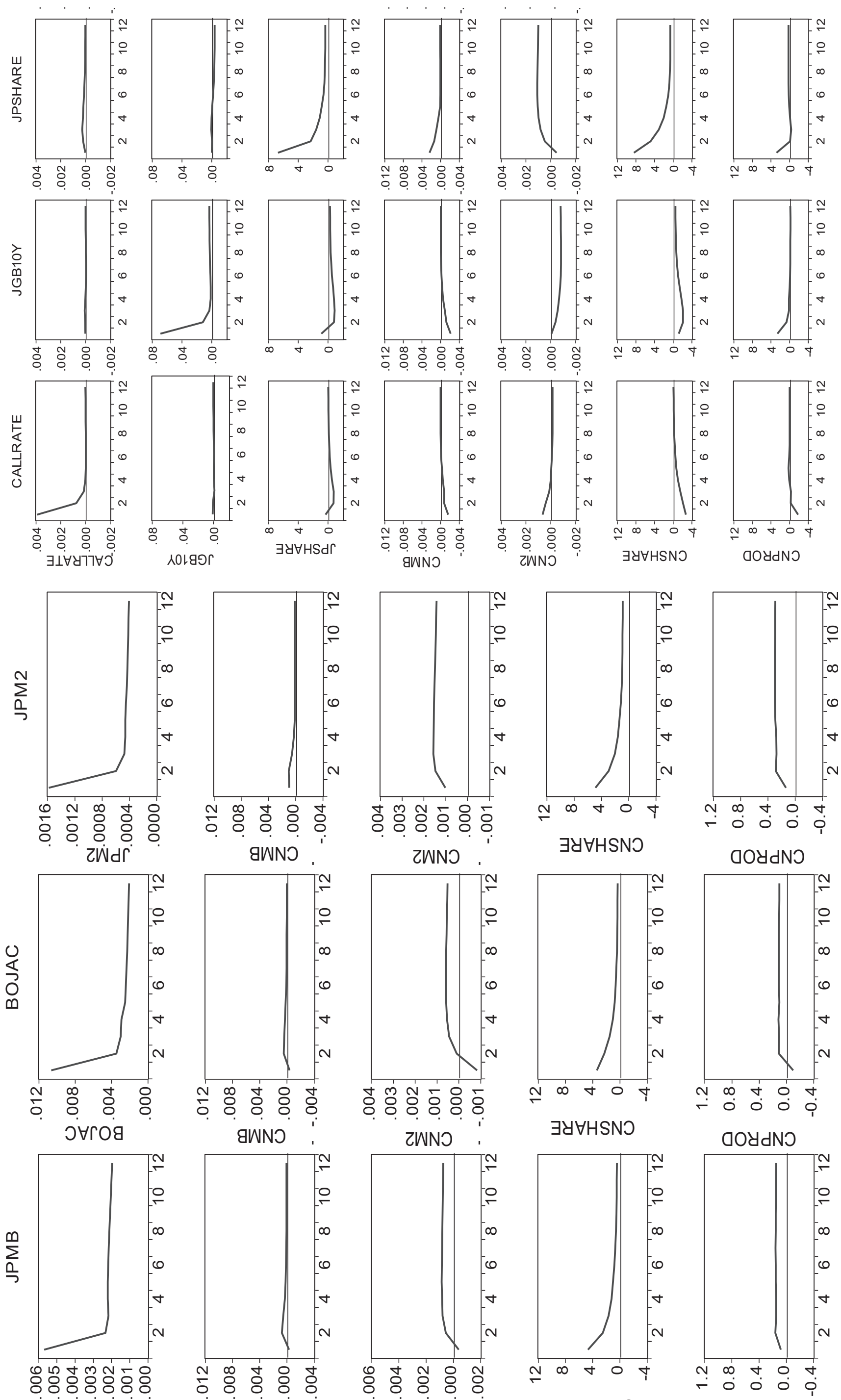


Fig.1-4 [September 2008 – March 2013] (4) HK/China

Fig.2-1 [April 2013 – January 2016] (1) Japan to China



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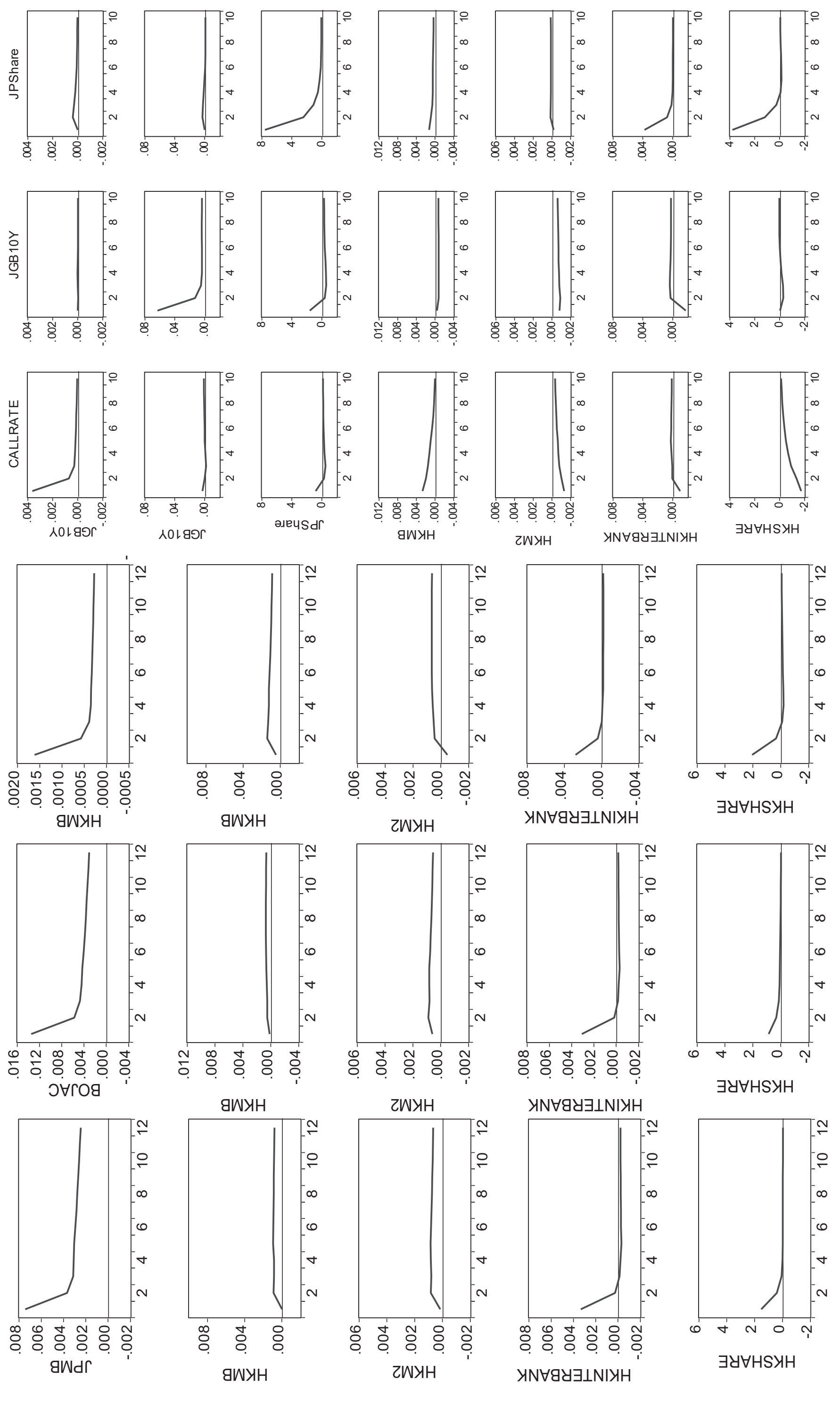

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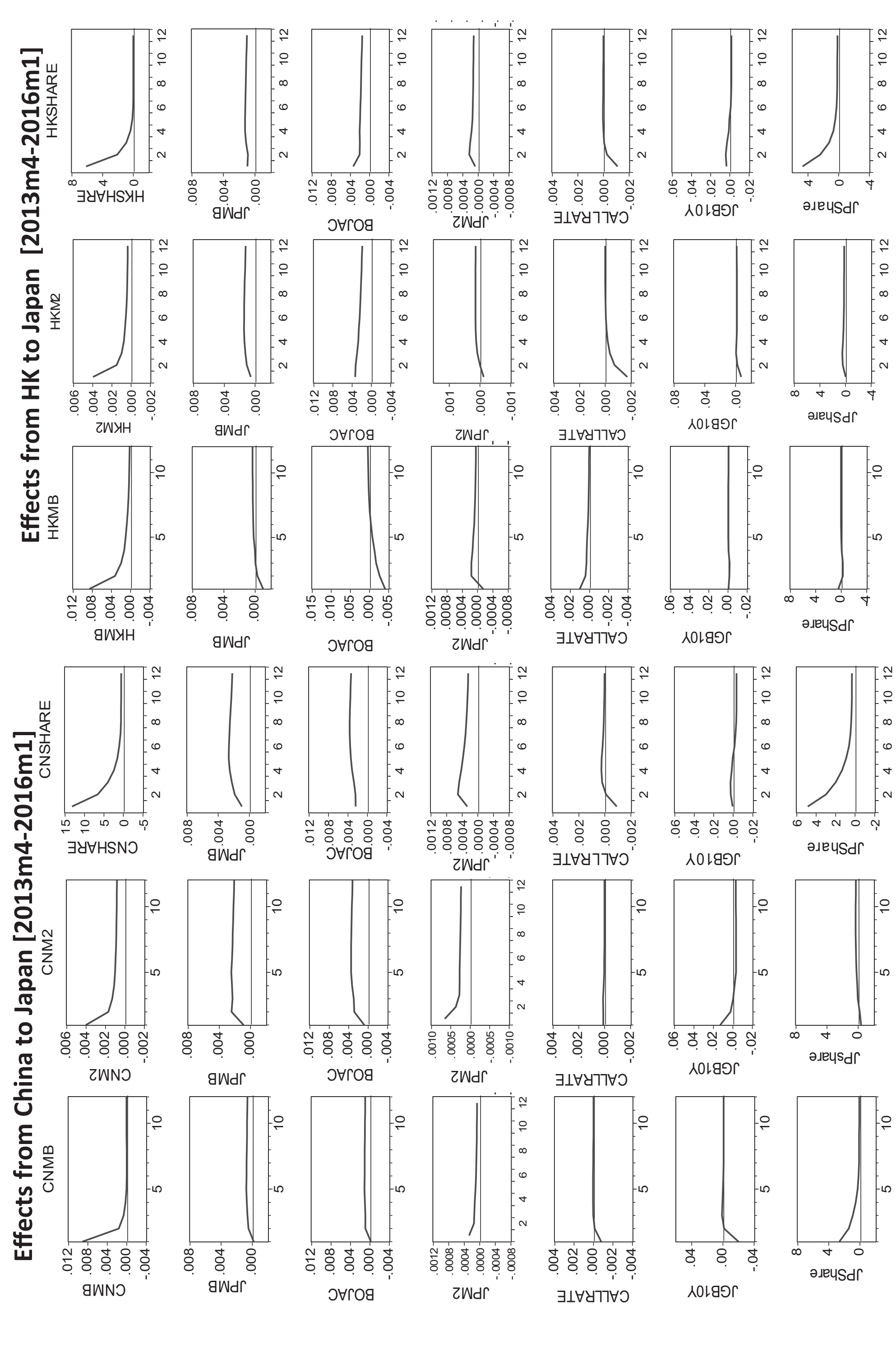

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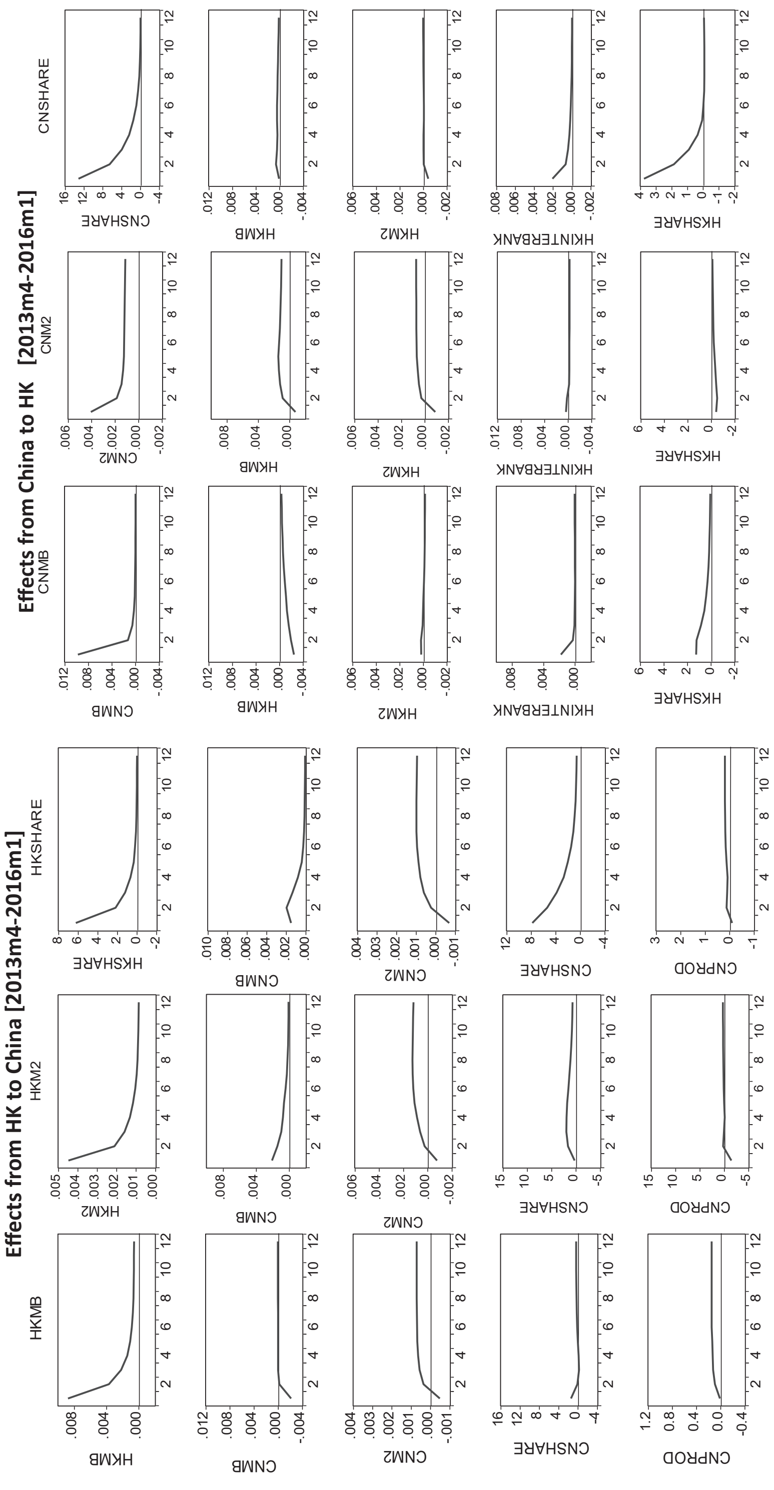
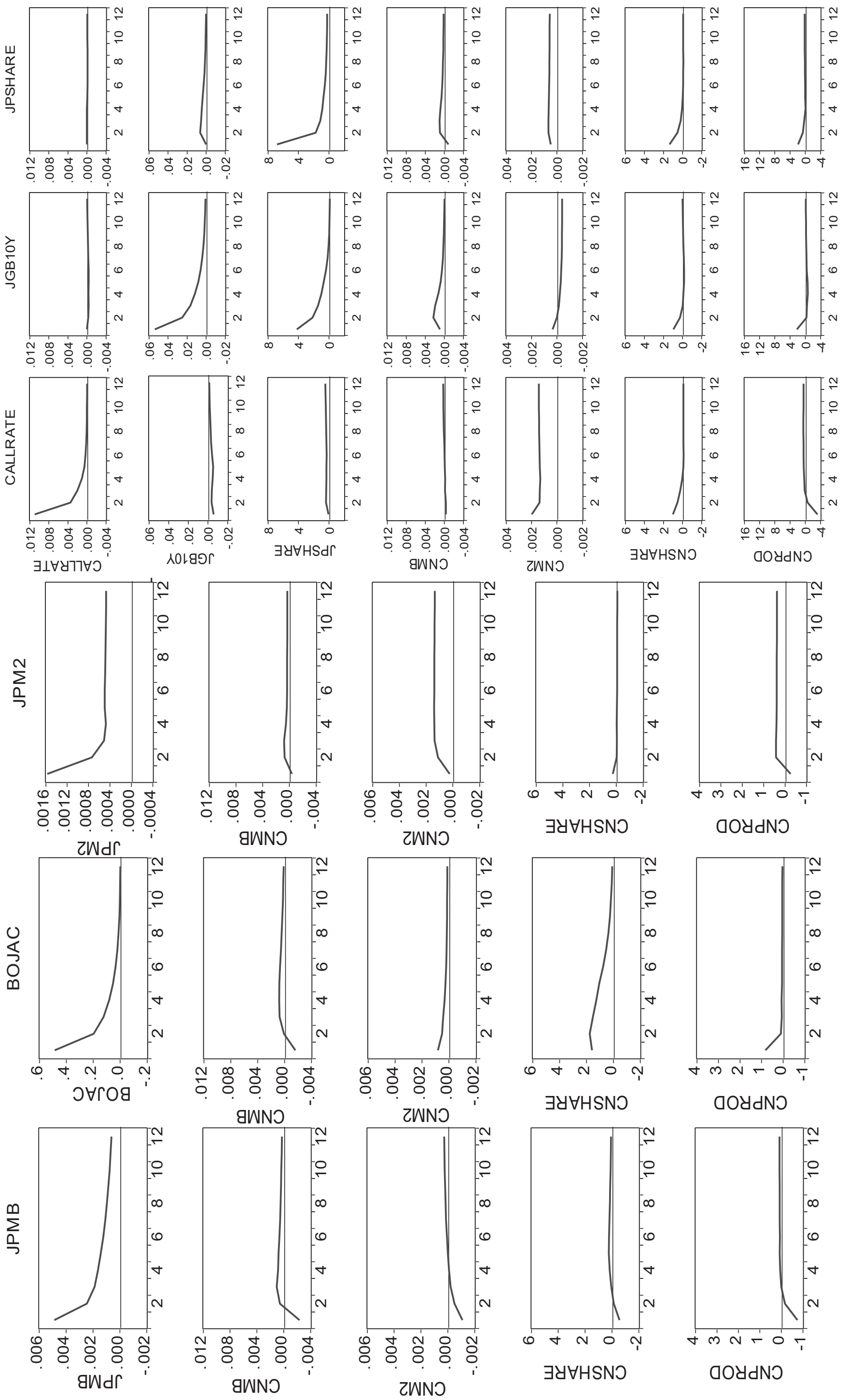


Fig.3-1 [February 2016 – December 2019] (1) Japan to China



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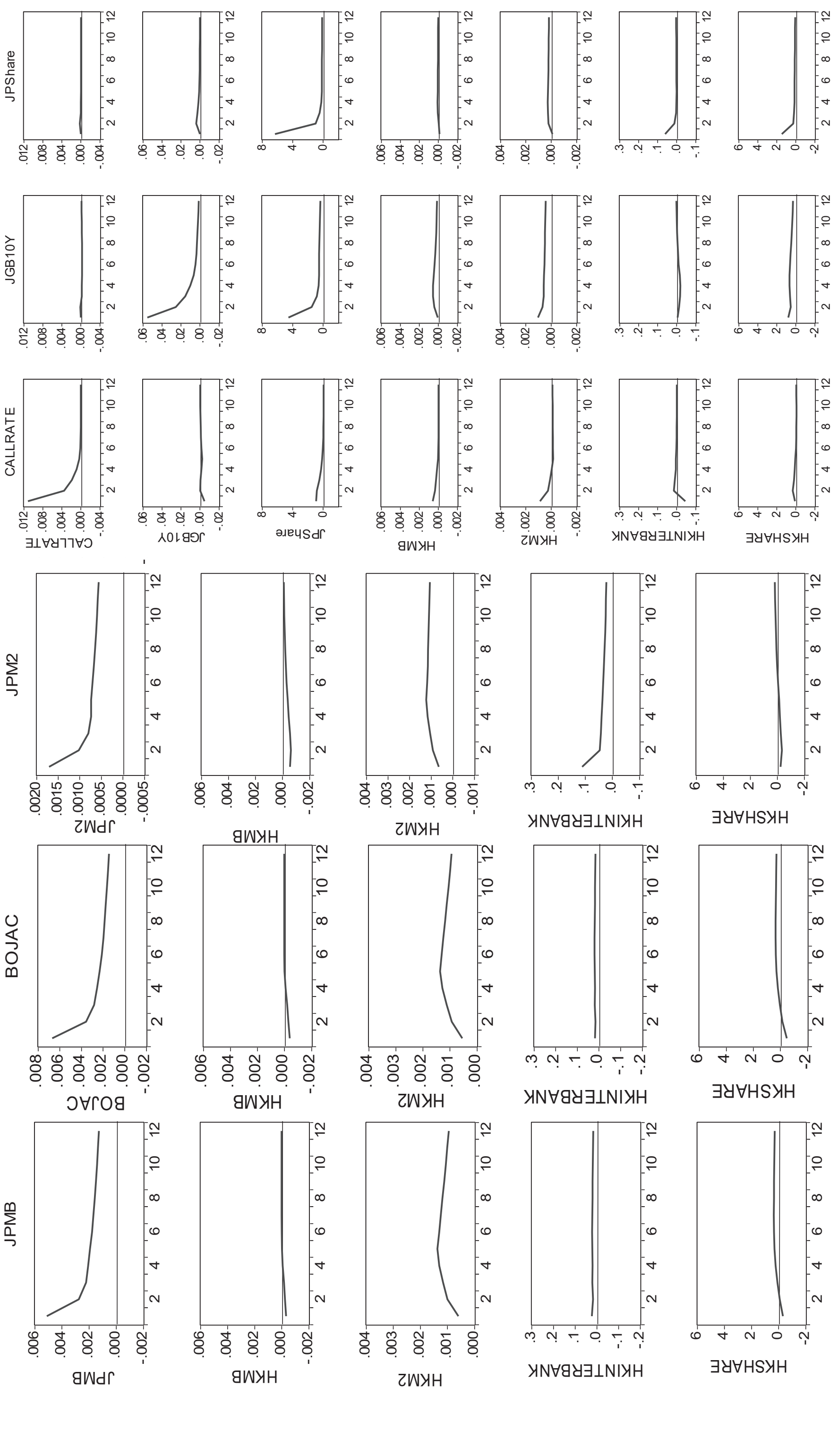
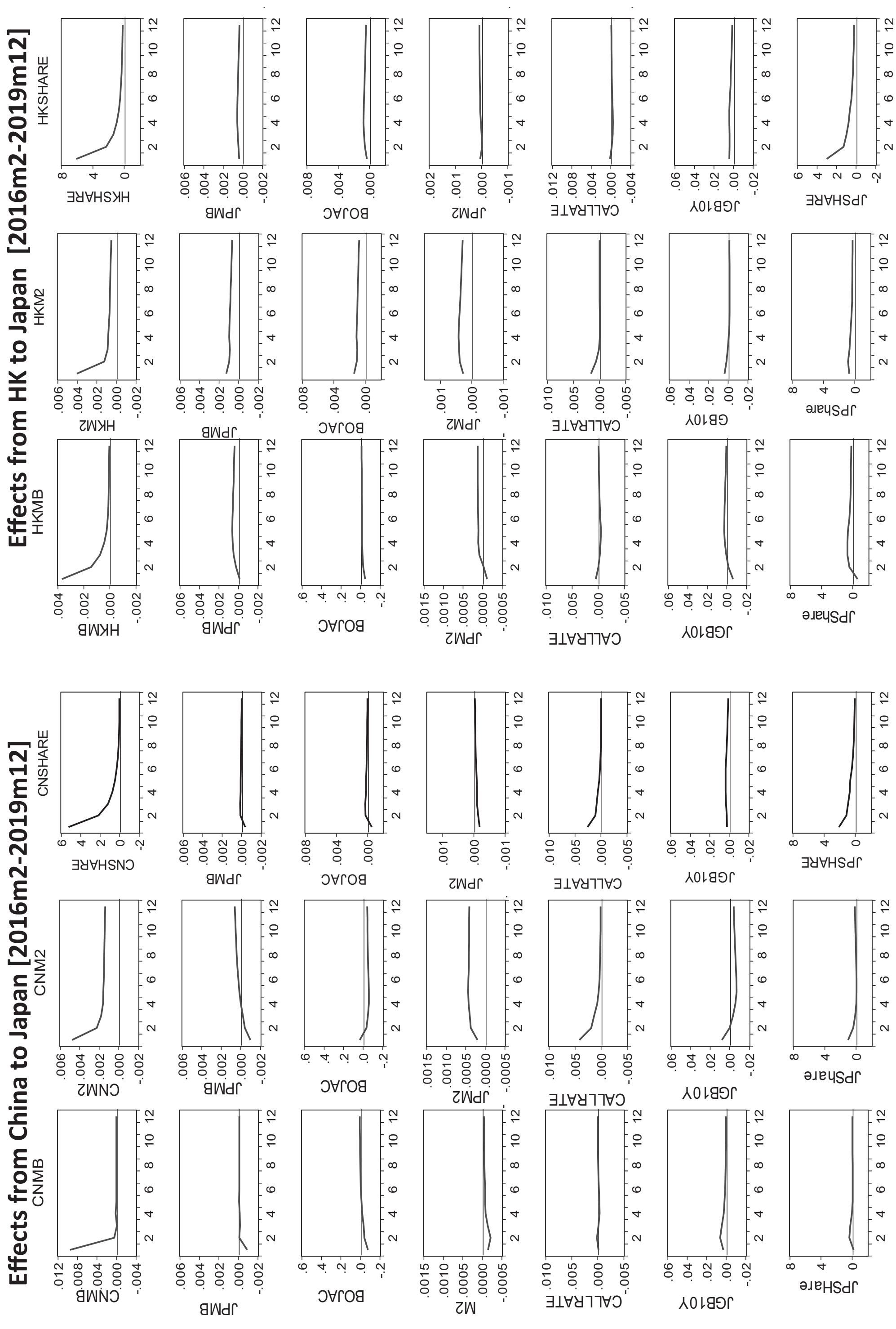


Fig.3-3 [February 2016 – December 2019 (3) China/ HK to Japan



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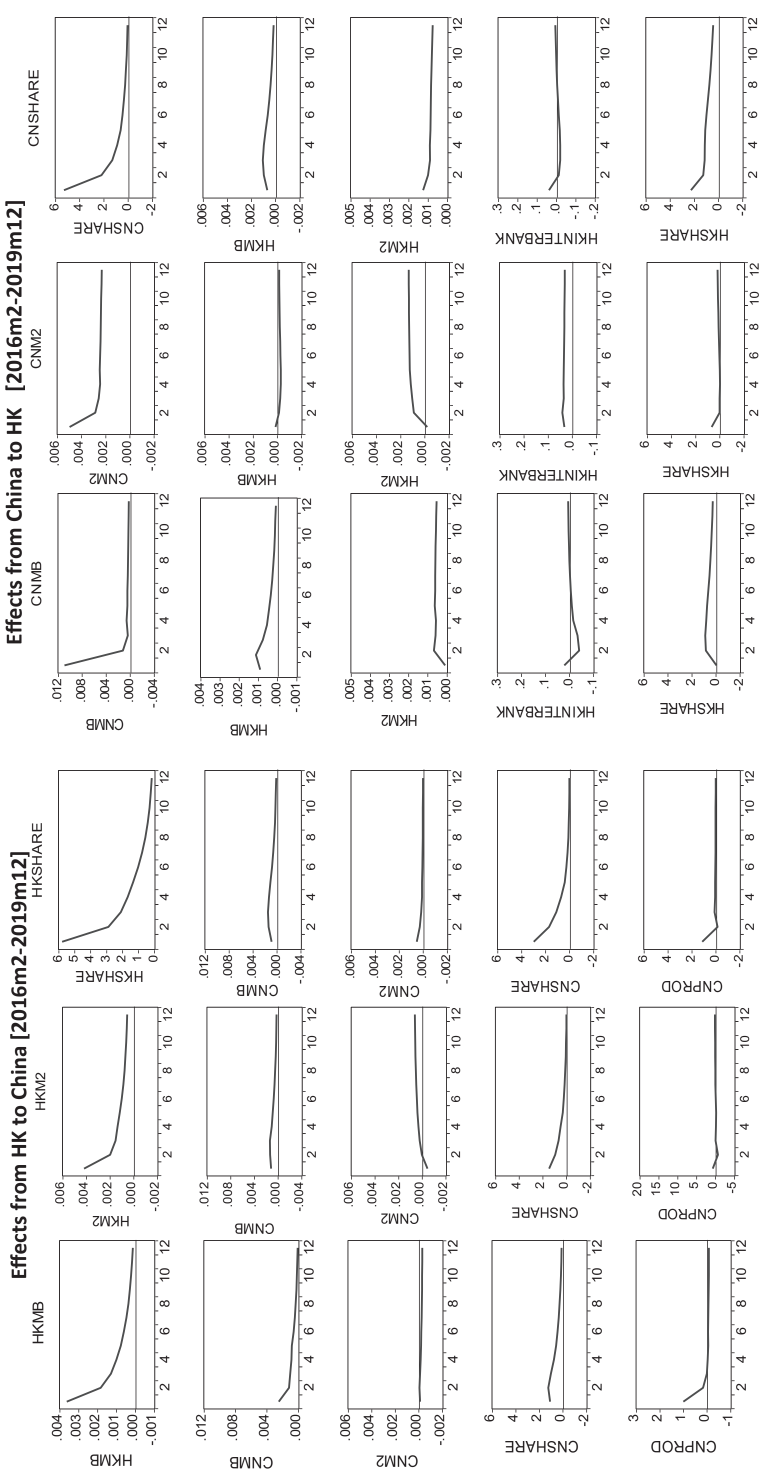

Fig.4-1 [November 2014 – December 2019] (1) Japan to China

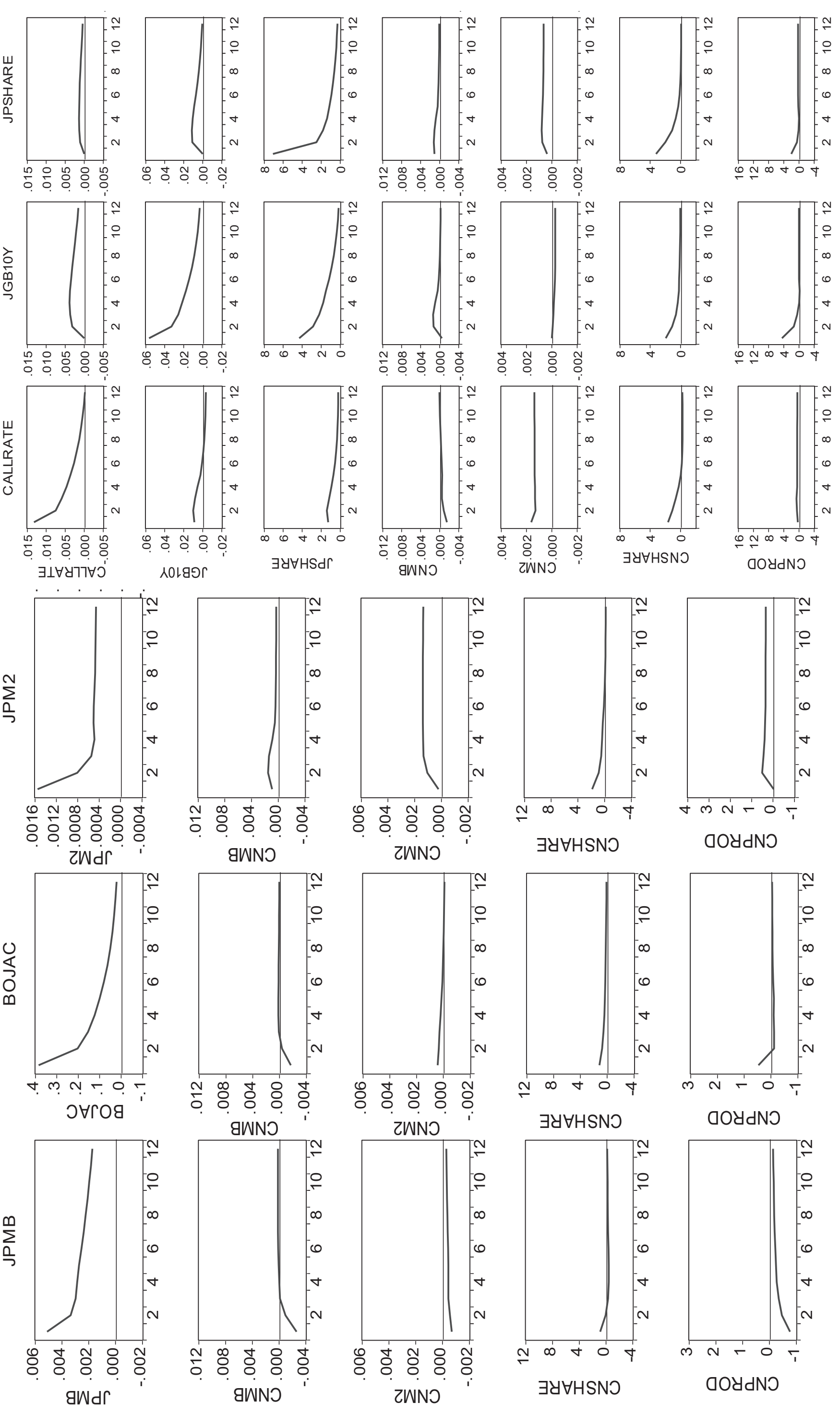

Fig.4-2 [November 2014 – December 2019] (2) Japan to HK

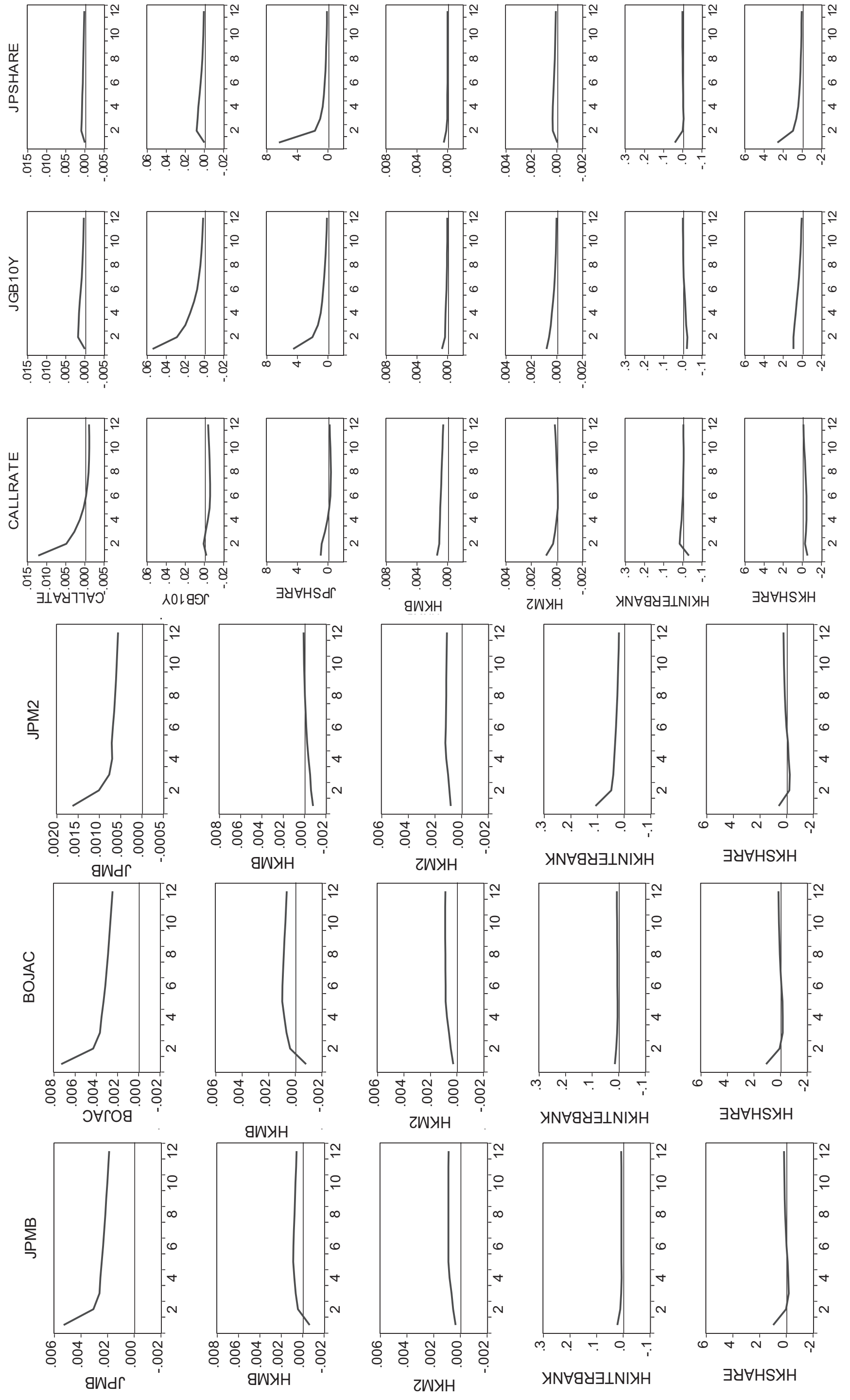

Fig.4-3 [November 2014 – December 2019] (3) China/ HK to Japan

Effects from China to Japan [2014m11-2019m12]

Effects from HK to Japan [2014m11-2019m12]

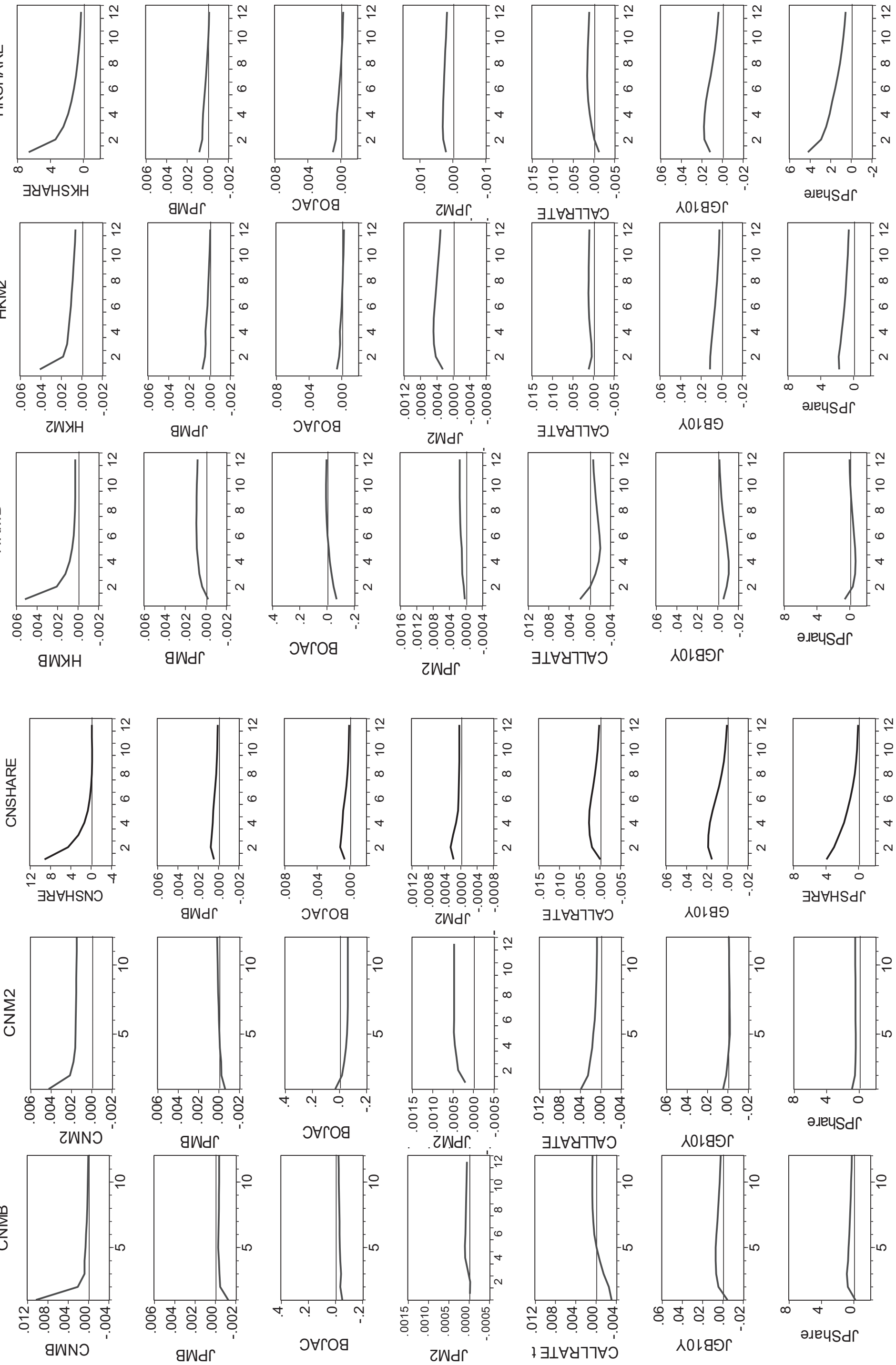

Fig.4-4 [November 2014 – December 2019] (4) HK/China