Effect of Japan's Interest Rate and QQE on Emerging Market Economies

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Abstract

This paper examines the impact of Japan's conventional monetary policy and Quantitative and Qualitative Easing (QQE) on neighboring emerging markets by analyzing exchange rates, net exports, and economic output. The neighboring economies considered in this study include Korea, Hong Kong, mainland China, the Philippines, Singapore, and Thailand. Employing a sign-restricted Structural Vector Autoregression (SVAR) model with Bayesian estimation, the analysis reveals that the Japanese yen depreciates against both the U.S. dollar and the average value of neighboring currencies. Furthermore, the findings indicate that Japan's monetary policies have an insignificant effect on China's net exports, the average net exports of neighboring economies, China's output, and the composite GDP of the region. Additionally, the study validates the use of total assets as a reliable proxy for QQE.

Key words: Zero interest rate policy, QQE, Emerging market, Structural VAR, Sign-restriction

Contents

Introduction

Compared with the short quantitative easing programs of the Fed and the European Central Bank, the Bank of Japan (BOJ) has the longest history of implementing expansionary monetary policies. BOJ decided to implement a zero interest rate policy in 1999. Since then, short-term policy rates have been extremely low, whether it was zero, near-zero or slightly negative. In order to overcome the deflation that has lasted for 15 years and to achieve the 2% inflation target, BOJ has conducted a large-scale monetary easing from 2013 to now. This program is quantitative and qualitative monetary easing (QQE). A line of literature is the international spillover effect on emerging market economies of monetary policies implemented by these advanced economies. Long-standing debate exists on whether the international spillover effect of Japan's policies is a beggar-thy-neighbor effect or not (e.g. Coenen and Wieland (2003); Maćkowiak (2006); Spiegel and Tai (2018); Ryou, Baak, and Kim (2019); Fukuda (2019)). For zero interest rate policy, researchers tend to analyze this problem through trade, but for QQE they usually analyze through stock price. In other words, QQE's international effect on emerging market neighbors through trade has not been studied.

We investigate the effects of Japan's conventional monetary policy and QQE on emerging market neighbors in last 24 years by analyzing exchange rate, net exports, and output. We focus on neighbors because in the breakdown as shown in the Table. 1[1], Asia is the main area where Japan's trades happen. This fact is consistent with the influential, classic gravity model as introduced by Isard (1954) in the academic field of international trade due to low transport cost. Neighbors included in our paper are Korea, Hong Kong, China (mainland), Philippines, Singapore, and Thailand. We find the two types of monetary policies of Japan, conventional monetary policy and QQE, lead to depreciation of yen both against U.S. dollar and against neighbors' average. We also find that these policies have an insignificant impact

[1] For further details, please refer to Japan External Trade Organization's "Gaikyo 2023cy_e" document. To enhance clarity, the unit has been converted from thousands to billions.

on net export of China and average net export of neighbors, real output of China and composite nominal GDP of neighbors. The section of results is divided into two policy parts, respectively.

	2023 (Revised)			Share	
Country/Area	Exports	Imports	Balance	Exports	Imports
Total	719.09	787.50	−68.40	100.0	100.0
Asia	374.48	371.21	3.27	52.1	47.1
P.R. China	126.47	174.22	−47.75	17.6	22.1
Hong Kong	32.60	1.53	31.08	4.5	0.2
Taiwan	43.01	35.70	7.31	6.0	4.5
Republic of Korea	47.03	31.06	15.97	6.5	3.9
Singapore	18.86	8.62	10.24	2.6	1.1
Thailand	29.41	25.77	3.64	4.1	3.3
Malaysia	13.98	20.23	−6.25	1.9	2.6
Indonesia	14.46	24.47	−10.01	2.0	3.1
Philippines	10.15	10.40	−0.25	1.4	1.3
Viet Nam	17.19	25.85	−8.7	2.4	3.3
India	15.96	5.65	10.31	2.2	0.7

Table 1: Value of Exports and Imports by Area and Country (Billions of USD, %)

The model we use is sign-restriction structural VAR (SVAR) with Bayesian estimation. SVAR is a broadly adopted model in analyzing macroeconomic time-series problems because it allows interactions among various macroeconomic indicators as in reality. To obtain its result, sign-restriction is a extensively-used identification method for parameter matrix because traditional methods suffer from the price puzzle problem as Estrella (2015) states. We focus on the sign-restriction result in the main body and provide other results in the Appendix 1. In conventional monetary policy part, we use the overnight uncollaterised call money rate as policy instrument variable, following previous papers. But in QQE part, we show two types of results for monetary base and for total assets as proxies for QQE, respectively. Usually, researchers use monetary base as the proxy because it is the policy instrument of BOJ, but using total assets matches the definition of QQE, which is expanding central bank's balance sheet. We use total assets as a robustness test. Results show that total assets successfully capture the effect as monetary base does. Total assets is a valid proxy for QQE.

This paper contributes to the field of international economics and monetary policy by addressing the unexplored area of how Japan's long conventional monetary policies and QQE influence emerging market economies through the lens of trade in recent years. The insignificant result informs policymakers about the nuanced effects of unconventional monetary measures, emphasizing the need for careful consideration of regional spillovers. In addition, the validation of total assets as a robust proxy for QQE provides a new approach for future research, broadening the analytical tools available for studying unconventional monetary policies.

The rest of the paper is organized as follows. Section 2 reviews the relevant literature. Section 3 explains the SVAR model's setup and the data. Section 4 presents the impulse response analysis and interpretations of the results. Section 5 concludes the paper. Appendix.1 shows the results of 3 traditional methods. Appendix.2 describes the detail and specific symbol to obtain data from the data source Datastream.

Literature Review

Spillover Effect of QQE

In April 2013 the BOJ launched an unprecedented quantitative and qualitative monetary easing policy. With this, BOJ decided to change the main operating target for money market operations from the uncollateralized overnight call rate to the monetary base to substantially increase the monetary base and the amounts outstanding of Japanese government bonds (JGBs) as well as exchange-traded funds (ETFs). This large-scale monetary easing has gone through three stages and is still ongoing: QQE from April 2013 to January 2016; QQE with a negative interest rate from January to September 2016; QQE with yield curve control from September 2016 to the present.

In recent years, researchers broadly study the spillover effect of Japan's QQE policy through stock price channel. Fukuda (2019) find that the East Asian stock markets first reacted to the yen's depreciation negatively and came to respond positively as QQE progressed and imply that Japan's QQE had much smaller beggar-thy-neighbor effects than what was originally feared. They also assert that this happened because the positive spillover effect of Japan's stock market recovery dominated the beggar-thy-neighbor effect as QQE progressed. Non-time-series models is used in his paper, but more researchers use VAR-type model. Ryou, Baak, and Kim (2019) find negative effect of the Japanese easing policy on Korea's GDP by using a qualitative vector autoregressive (Qual VAR) model. Sugimoto and Matsuki (2019) advocate that the US-to-Asia spillover is the largest among global-to-Asia spillovers from 2005 to 2018 and the degree of the Asia-to-Japan spillback is comparable to that of the Japan-to-Asia spillover. Papers mentioned above find negative effect, but on the contrary, Ganelli and Tawk (2019) state that positive shock to Japanese equity prices causes an increase in equity prices across emerging Asian countries using global VAR (GVAR).

The implementation of expansionary monetary policy by a country is expected to cause a depreciation of its own currency by previous papers. This change can empirically affect exchange rate and then international trade. Instead of stock price, Ree and Choi (2014) analyze the effect through trade linkage and find that the exchange rate spillover from QQE to Korea has been limited both on trade and capital flow fronts. But they merely used a chart to observe the changes in trade flow over the same period, meaning no interaction of other factors are included. We can say there is a lack of VAR-type models to analyze QQE through trade channel.

Spillover Effect of Conventional Monetary Policy

Besides the QQE of Japan, prior conventional monetary policy also induces researchers' interest in exploration of the effect on emerging market. In 1999, the BOJ adopted the zero interest rate policy to "flexibly provide ample funds and encourage the uncollateralized overnight call rate to move as low as possible" to avoid possible deflationary pressure and to ensure that the economic downturn would end (Fujiki, Okina, and Shiratsuka (2001)). Subsequently, the effects of Japan's monetary policy on Japan and on neighbors are remarkably controversial academically.

Researchers on the one side argue that expansionary monetary policy in Japan is a beggar-thy-neighbor policy. Coenen and Wieland (2003) assert that essentially the trading partners need to expect a beggar-thy-neighbor-type effect from this depreciation of yen. McKinnon and Schnabl (2003) argue that the beggar-thy-neighbor effect prevails in East Asia and that the effect can destabilize the region, which will have adverse consequences for Japan itself. In these papers, researchers typically analyze this topic through trade channel but using non-time-series model. Spiegel and Tai (2018) use a factor-augmented vector autoregressive (FAVAR) to suggest that shocks to 2-year Japanese government bond rates put statistically-significant downward pressure on economic activity and inflation. This paper analyzes the effect using time-series model but through stock price channel.

On the other side, Maćkowiak (2006) exploits SVAR to investigate the spillover effect of expansionary Japanese monetary policy on emerging market neighbors from the lens of trade and show that interest rate decrease in Japan boosts net exports in neighboring economies. Almost twenty years later, we can update the data and analyze the spillover effect of conventional monetary policy and QQE policies of Japan on emerging market neighbors through trade channel with SVAR model.

Proxy of QQE

The "quantitative" dimension refers to the expansion of the monetary base at an annual pace of 60 - 70 trillion yen monetary base targeting (or monetary base control) (Shirai (2019)). Therefore, most of the literature use monetary base as the proxy of QQE (e.g. Lau and Yip (2020); Greenwood (2017); Kimura et al. (2003)). Ganelli and Tawk (2019) use equity prices as a proxy for spillovers from QQE with global vector autoregression (GVAR) method and they find that a positive shock to Japanese equity prices identified by sign restrictions caused an increase in equity prices across emerging Asian countries, as well as an appreciation of their currencies. They assert that using equity prices has the advantage of matching stylized facts (equity prices increased significantly during both first and second QQE periods in Japan) and of capturing the expectation channel of QQE. By the definition of monetary easing, purchasing new financial assets is to expand the balance sheet of central bank. Therefore, in our paper we conduct SVARs with monetary base but simultaneously use total assets as a robustness test.

Data and Model

Data

We use updated data running from 2000:Q1 to 2024:Q2 to revise the effects of Japan's low interest rate and QQE on emerging market neighbors by exchange rate, net exports, and output, while Maćkowiak (2006) takes the data from 1963 to 2002. The data source is Datastream. Every variable has a specific symbol to be used to extract data that is fully introduced in Appendix.2.

In addition, Maćkowiak (2006) could not include China in the paper due to limit access of data. With the growing GDP and the enormous trade volume worldwide of China, it is extremely necessary to include China in this paper. The neighbors in his paper were Korea, Hong Kong, Malaysia, Philippines, Singapore, and Thailand. In our paper, we include China but exclude Malaysia also due to inaccessibility of data. The neighbors in this paper are Korea, Hong Kong, China (mainland), Philippines, Singapore, and Thailand. Besides the difference with respect to data coverage, policies and countries involved, another nontrivial difference is that Maćkowiak (2006) tried 4 different identification methods to find robust results, but we only focus on sign-restriction. The reason behind is that traditional methods suffer from price puzzle problem in this analysis. We will explain the problem in detail in the Identification Section below.

For Japan we use overnight uncollaterised call money rate, real GDP, M1, CPI, export, and import data. For neighbors, we use nominal GDP to calculate the weights in average terms and neighbors' aggregate output and use their exchange rate, export, and import data. In the analysis specifically for Japan's effect on China, we use real GDP to compute the results. We obtain original quarterly data of countries' GDP and monthly data of their imports, exports, CPI, exchange rate, and commodity price. Subsequently, monthly data are converted into quarterly data for computation. For proxy of QQE, we use both monetary base and total assets of BOJ. For commodity price, we use NZ ANZ Commodity Price because it is a world index in US$. In the robustness test part of the baseline models for both two policies, we add real GDP of the U.S. and federal funds rate into the SVAR, specifically. The source of US data is the Federal Reserve Bank of St. Louis.

Model

Following Maćkowiak (2006), the baseline model for Japan includes six variables common in small-size SVARs for monetary policy analysis in open economies: real GDP in Japan, consumer price index in Japan, a world commodity price index, the overnight uncollaterised money market interest rate in Japan, money stock M1 in Japan, and the exchange rate between yen and U.S. dollar. Lag length is 2. All time series are expressed in logarithm, except that the interest rate is in percentage points at an annual rate.

$$\begin{bmatrix} 1 & b_{12} & b_{13} & \cdots & b_{16} \\ b_{21} & 1 & b_{23} & \cdots & b_{26} \\ . & . & . & \cdots & . \\ b_{61} & b_{62} & b_{63} & \cdots & 1 \end{bmatrix} \begin{bmatrix} rgpd_t \\ cpi_t \\ \cdots \\ ex_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \\ \cdots \\ b_{60} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \cdots & \gamma_{16} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \cdots & \gamma_{26} \\ . & . & . & \cdots & . \\ \gamma_{61} & \gamma_{62} & \gamma_{63} & \cdots & \gamma_{66} \end{bmatrix} \begin{bmatrix} rgdp_{t-1} \\ cpi_{t-1} \\ \cdots \\ ex_{t-1} \end{bmatrix} +$$

$$\begin{bmatrix} \rho_{11} & \rho_{12} & \rho_{13} & \cdots & \rho_{16} \\ \rho_{21} & \rho_{22} & \rho_{23} & \cdots & \rho_{26} \\ . & . & . & \cdots & . \\ \rho_{61} & \rho_{62} & \rho_{63} & \cdots & \rho_{66} \end{bmatrix} \begin{bmatrix} rgdp_{t-2} \\ cpi_{t-2} \\ \cdots \\ ex_{t-2} \end{bmatrix} + \begin{bmatrix} v_{1t} \\ v_{2t} \\ \cdots \\ v_{6t} \end{bmatrix}$$

To obtain the results of SVAR that cannot be estimated consistently, we use VAR to recover them. We can estimate the coefficients and obtain the residuals and variance-covariance matrix of VAR by simple OLS, but the number of equations is less than the number of unknowns in SVAR. However, because the error terms of VAR are composites of the underlying shock in SVAR, we can use this relationship to calculate the corresponding SVAR model. Write the matrix of the model into compact form, we have

$$A_0 X_t = A_1 X_{t-1} + A_2 X_{t-2} + v_t$$

$$X_t = A_0^{-1} A_1 X_{t-1} + A_0^{-1} A_2 X_{t-2} + A_0^{-1} v_t$$

$$u_t = A_0^{-1} v_t$$

$$\Sigma = u_t u_t' = A_0^{-1} \operatorname{Var}(v_t) \left(A_0^{-1}\right)'$$

where u_t is the error term of VAR, A_0 is the parameter matrix, v_t is the shock within SVAR model, and Σ is the variance-covariance matrix of VAR. $u_t = A_0^{-1} v_t$ means VAR error term equals parameter matrix times monetary policy shock. The mechanism of estimation is that, by VAR, we have u_t and Σ, then we need to identify A_0 to obtain v_t by, for example, Cholesky decomposition. Since Σ is symmetric, it contains only $(n^2 + n)/2$ distinct elements (known). Given that the diagonal elements of A_0 are all unity, A_0 contains $n^2 - n$ unknown values. v_t contains n unknowns. Total of n^2 unknown values exist. In order to identify the n^2 unknowns from the known $(n^2 + n)/2$ independent elements of Σ, it is necessary to impose an additional $n^2 - [(n^2 + n)/2] = (n^2 - n)/2$ restrictions on the system. Traditional methods add enough number of zero in to the parameter matrix to meet the requirement, but sign-restriction conducts the identification from a brand-new angle, that is, find impulse response functions (IRFs) directly with certain restrictions on specific columns to obtain the results.

Even though the analysis of this paper is divided into two parts, conventional monetary policy and QQE, but they have the same two steps. First, we estimate the baseline model 6-variable-SVAR in order to uncover the effects of Japanese monetary policy shocks on real output in Japan and on the exchange rate between yen and U.S. dollar. After we have the result of exchange rate, in the second step, we add to the baseline model a variable that measures international trade flows or economic conditions in Japan's neighbors and reestimate the SVARs model.

The new variable that we add is yen to neighbors' average exchange rate, Japan's net export, China's net export, neighbors' average net export, China's output, and neighbors' composite GDP, respectively. Alternatively speaking, the second step is repeated for several times, using distinct variables to represent trade flows and economic conditions differently in Japan's neighbors. The goal is to shed light on the effects of Japanese monetary policy shocks on trade flows with neighbors. In this process, we also add one more restriction on the sign of exchange rate between yen and U.S. dollar as the result indicated previously in the baseline model.

Identification

In this section, we introduce 4 identification methods and introduce why we focus on sign-restriction in the main body of this paper. As $u_t = A_0^{-1} v_t$ for all of the methods, first three methods can be shown in matrix form as follows.

1. **CEE method**

$$\begin{bmatrix} urgdp_t \\ ucpi_t \\ ucpriuce_t \\ ur_t \\ um1_t \\ uex_t \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{bmatrix} \begin{bmatrix} vrgdp_t \\ vcpi_t \\ vcprice_t \\ vr_t \\ vm1_t \\ vex_t \end{bmatrix}$$

Christiano, Eichenbaum, and Evans (1999) proposed this method that assumes A_0 to be a lower-triangular to meet the number of restrictions explained above. CEE method orders the variables as follows: real GDP, CPI, commodity prices, interest rate, money supply and exchange rate. The economic meaning behind this order assumption is that exchange rate reacts to every variable contemporaneously but the interest rate set by the central bank can react to fluctuations in the exchange rate only with a lag of at least one period. If the Bank of Japan in fact decreases the interest rate systematically and without delay in reaction to strengthening of the yen, the CEE identification may lead to incorrect inference.

2. **Policy-instrment method**

$$\begin{bmatrix} urgdp_t \\ ucpi_t \\ ucpriuce_t \\ uex_t \\ um1_t \\ ur_t \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{bmatrix} \begin{bmatrix} vrgdp_t \\ vcpi_t \\ vcprice_t \\ vex_t \\ vm1_t \\ vr_t \end{bmatrix}$$

Policy-instrument method retains the assumption that A_0 is lower-triangular. The only difference between this method and CEE method is that policy-instrument method puts interest rate to the last order. It means that interest rate, as a policy instrument, reacts to every variable immediately. All other variables, including the exchange rate, are assumed to react to monetary policy shocks only with delay.

3. LSZ method

$$
\begin{bmatrix} urgdp_t \\ ucpi_t \\ vm1_t \\ ucpriuce_t \\ uex_t \\ vr_t \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} \\ 0 & 0 & 0 & a_{64} & a_{65} & a_{66} \end{bmatrix} \begin{bmatrix} vrgdp_t \\ vcpi_t \\ vm1_t \\ vcprice_t \\ vex_t \\ vr_t \end{bmatrix}
$$

Leeper et al. (1996) considered an identification scheme that lets the central bank react contemporaneously to changes in the exchange rate and lets the exchange rate react contemporaneously to changes in monetary policy simultaneously. We refer to this identification scheme as LSZ identification after them. In the LSZ identification, we drop the assumption that A_0 is triangular and partition the six elements into blocks. But the number of zero in this matrix equals the restriction requirement mentioned above. Real GDP, CPI and M1 are postulated not to react contemporaneously to shocks in other variables. Commodity price and the exchange rate are allowed to react without delay to all disturbances. Interest rate is postulated not to react contemporaneously to changes in real GDP and CPI.

4. Sign-restriction method

Sign-restriction does not have the form of parameter matrix. It directly assign the signs of specific variables in the impulse response function. In our paper, we restrict the sign of the impulse responses of the interest rate to be nonpositive because Japanese government decreases interest rate. Correspondingly, signs of commodity price, CPI, and M1 are restricted to be nonnegative. These restrictions are theoretically supported because interest rate decrease makes households not want to save money but consume goods and services. M1 (cash and liquid deposits) increases. This situation elevates price level as reflected in commodity price and CPI.

From research in the last few years, some possible problems of 3 traditional methods have been discovered. The beginning period in their IRFs may show abnormal result due to the overweighted amount of assumptions (Estrella (2015)). This problem is called price puzzle. Specifically, in SVARs unexpected monetary tightening often leads to the price puzzle, a counterintuitive increase in inflation in the impulse response function. Almost all of the old proposals for dealing with the price puzzle introduce additional variables into VAR to mitigate the empirical magnitude of this counterintuitive effect. It was sign-restriction that solved this problem. It does not require specific order of variables but directly restrict the signs of specific variables in the IRFs. It imposes minimal but theoretically-supportive assumptions in the responses to avoid the problem intelligently. Gradually, researchers turn not to use the conventional methods. Sign-restriction identification method proposed by Uhlig (2005) is the most widely-used one in recent years.

Algorithm

All of the models are estimated in Bayesian framework.

For CEE, policy-instrument, and LSZ methods:

1. Run an unrestricted VAR in order to get estimator of parameter $\hat{A}$ and estimator of variance-covariance $\hat{\Sigma}$.

2. Randomly draw the mean $\bar{A}$ and S_T from the posterior distributions.

$\bar{A}$ follows normal distribution and S_T follows the inverse-Wishart distribution. They are conjugate distributions, which means that generated prior and drawn posterior distributions are the same. In this process, the concept of Sims and Zha (1998) is put in the prior, where every variable has a unit root: the mean of the 1-period lag is 1, and the mean of the other lags is 0. This way incorporates a statistical sense that nearer data have higher weights.

3. Extract the parameters from the model using a Cholesky decomposition. Only in this step, LSZ method is different because its parameter matrix has an idiosyncratic form.

We need to compute parameters separately, though we also use Cholesky sense. CEE and policy-instrument methods contain same steps because the only difference between them is the switched orders of exchange rate and interest rate.

4. Calculate the resulting impulse responses from Step 3.

For sign-restriction method:

After the same four steps above, additional three steps are required.

5. Randomly draw an orthogonal impulse vector α from unit sphere.

6. Multiply the responses from Step 4 by α and check if they match the imposed signs.

7. If yes, keep the response. If not, drop the draw.

Sign-restriction method identifies specific columns of parameter matrix with the impulse vector. After random drawing for parameters, Cholesky decomposition also can be applied. Numerically, this can be and will be accomplished in a straightforward manner by generating many impulse vectors randomly, calculating their implied impulse response functions, and checking whether or not the sign restrictions are satisfied. It is wise to calculate the responses once and then calculate the response for some given impulse vector by calculating a weighted sum.

For each of the 1000 draws from the joint posterior density of parameter matrix A_0 and variance-covariance Σ, we take 100 draws of α from the standard normal distribution, normalizing each α to have unit length. We then compute 100,000 a's and the same number of candidate impulse responses to an expansionary monetary policy shock. We define a monetary policy impulse vector to be an impulse vector a such that the impulse response generated with a of money supply is positive, of interest rate is nonpositive, and of price level is nonnegative at all horizons $K = 1, \cdots, K$, for K that we choose a priori. $K = 4$ in our results plotted, meaning the effect analysis lasts 16 quarters. We retain those of the 100,000 draws that satisfy the sign restrictions. We use the retained draws to compute median impulse responses and probability bands, and discard the draws that failed to satisfy the restrictions.

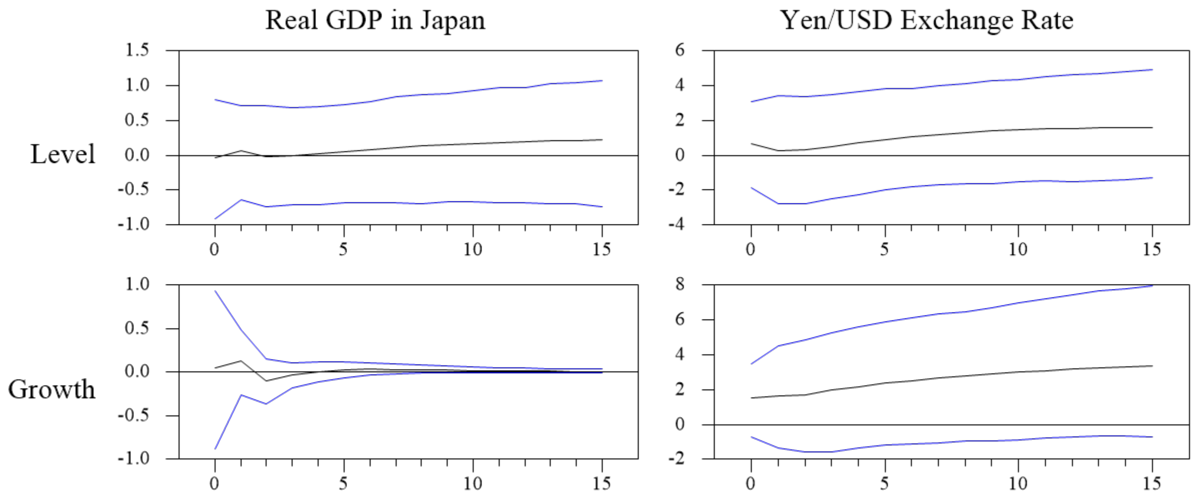


Figure 1: Baseline Model for Conventional Monetary Policy

Results

Conventional Monetary Policy

The structure of the analysis follows Maćkowiak (2006) starting from a baseline model to various 7-variable-SVARs. But in this part, we use not only level data but also growth data to illustrate the effect and timing, which is the difference. All the figures in this paper consist of the average line in black line and 90% probability band in blue lines. All time series are expressed in logarithm, except interest rate. We plot the impulse responses to 1% expansionary shock in interest rate. Results obtained with K = 4 with horizontal axes ending in 16 (quarters), meaning the effect analysis lasts 4 years.

Baseline Model

We start from estimating the basic six-variable SVAR models for Japan's domestic macro performance. The variables chosen are real GDP, CPI, commodity price, interest rate, M1, and exchange rate, following previous papers. Sign-restriction assigns the signs of interest rate to be nonpositive, commodity price to be nonnegative, CPI to be nonnegative, and M1

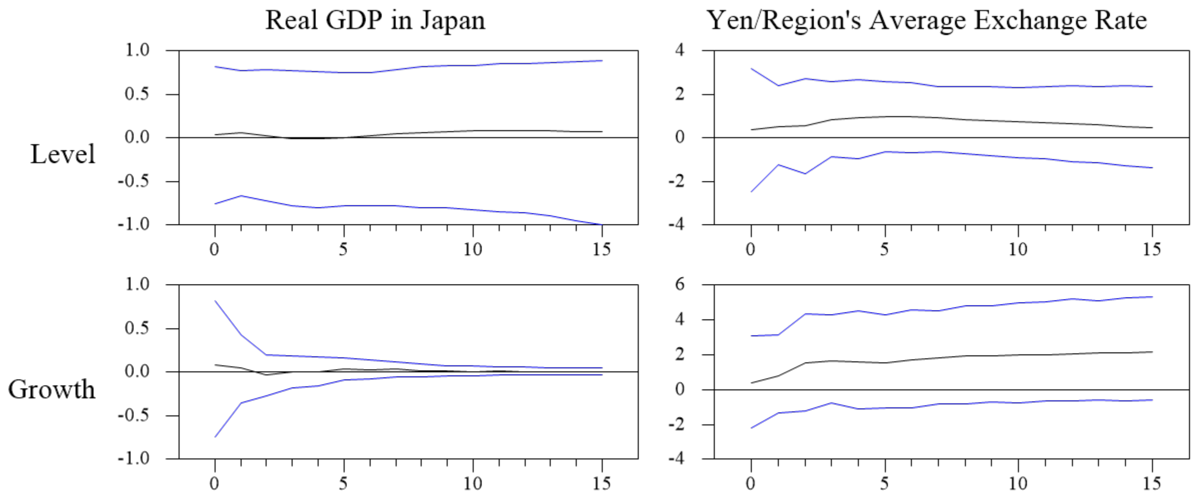


Figure 2: Exchange Rate Analysis for Conventional Monetary Policy

to be nonnegative. No restrictions are imposed on the response of real GDP and exchange rate to show the effect. As in the top row of the first column of Fig. 1, a decrease in the interest rate has no impact on Japan's real GD, and the bottom row of that reveals that the effect quickly converges to zero. Second column demonstrates yen depreciates against U.S. dollar. This result is consistent with Maćkowiak (2006).

Seven-variable SVARs of Japan's Effects on Emerging Market

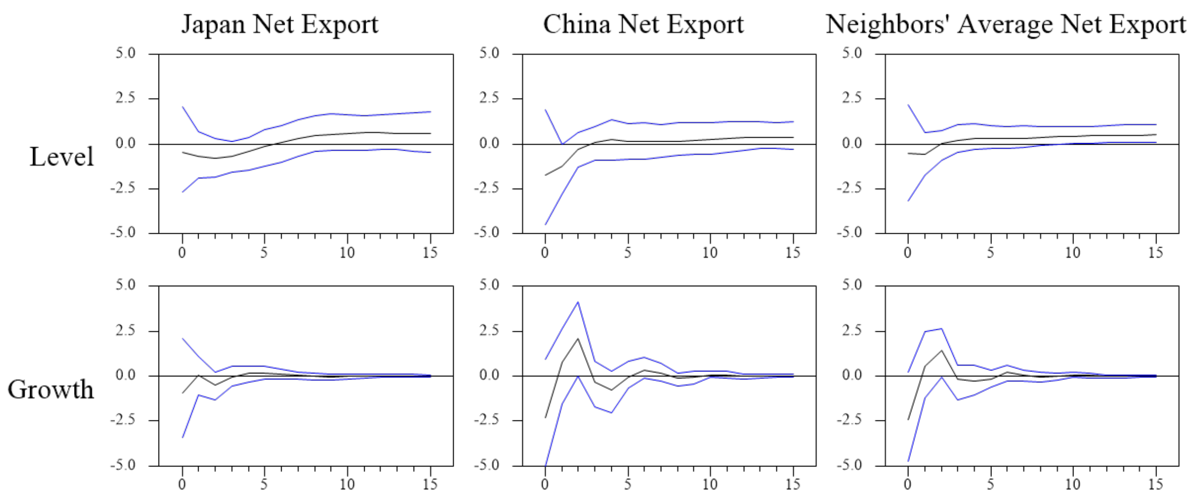
In this section, we add to the six-element baseline model a variable that measures exchange rate, net exports, or neighbor's output and reestimate the SVARs. With the result obtained in the baseline model, we further restrict the sign of the impulse responses of the exchange rate between the yen and the U.S. dollar to be nonnegative while other signs being unchanged. In the Fig. 2, added variable is the exchange rate between the yen and the average of the currencies of China (mainland), Hong Kong, Korea, Philippines, Singapore and Thailand. The weight is calculated by nominal GDP. In the first column, we show the robust results on real GDP of Japan. Interest rate decrease causes no significant influence. In the second column, yen also depreciates against the neighbor's average exchange rate. Depreciation is consistent with Maćkowiak (2006), but they find yen depreciates with respect to the currencies of Japan's neighbors by the same amount as it depreciates with respect to the U.S. dollar. This situation does not exist in our result. This may because currencies of the neighbors we choose do not follow the U.S. dollar after a Japanese interest rate shock.

We analyze global net export and output simultaneously with 2 panels of Fig. 3, respectively. In Fig. 3a, we show the results obtained in a seven-variable SVAR where the added variable is the ratio of exports to imports in Japan, China, and neighbor's average, respectively. Upper row shows that decrease in interest rate has insignificant impact on net exports. Even though yen depreciates both against U.S. dollar and against neighbors' average exchange rate, no significant positive impact or beggar-thy-neighbor effect occurs on net exports in Asia. Bottom row tells the effect converges to zero quickly. We observe that the effect on neighbors is similar to that on China. We think this is because China in last 20 years has the largest weight by nominal GDP.

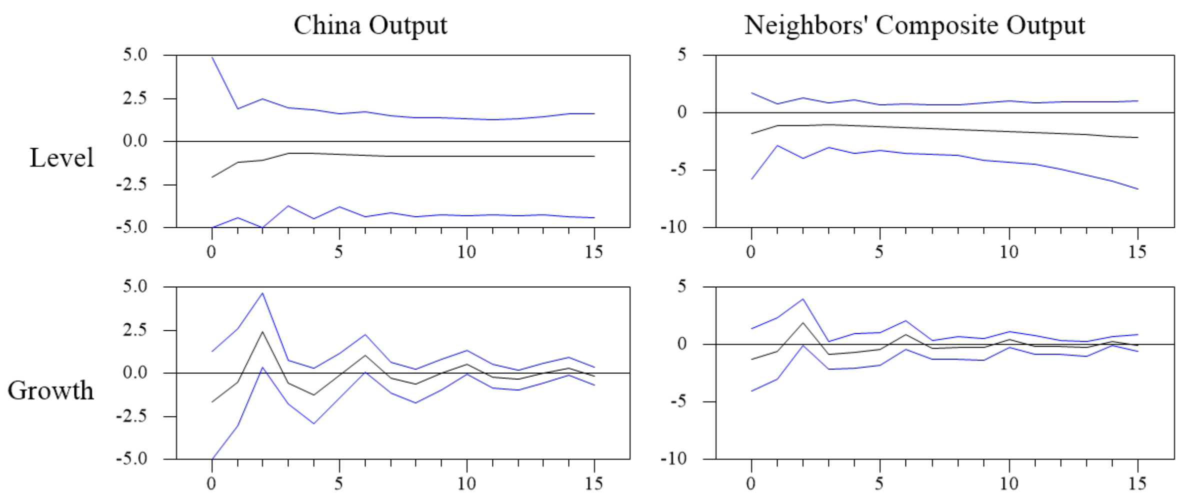
In Fig. 3b, we show the results obtained in a seven-variable SVAR where the added variable is the real GDP of China and neighbors' composite nominal GDP, respectively. Upper row shows that a decrease in interest rate has insignificant impact on their outputs. Bottom row tells the effect is always near zero. For the regular fluctuation around zero, we think this is seasonality. In this figure, the effect on neighbors is not so similar to that on China. We guess that is because China's output in last 20 years relies on other factors, rather than Japan's interest rate change.

Robustness test

We add variables measuring economic conditions in the United States (U.S. real GDP and the Federal Funds rate) into the SVAR model. This does not affect the estimated effects of Japanese monetary policy shocks as in the figures above. The restrictions of signs are kept the same as the baseline model in the above. Exchange rate shows a similar pattern with yen depreciation. Real GDP trends are both near zero robustly. These results suggest that



(a) Net Export



(b) Output

Figure 3: Nex Export and Output Analysis for Conventional Monetary Policy

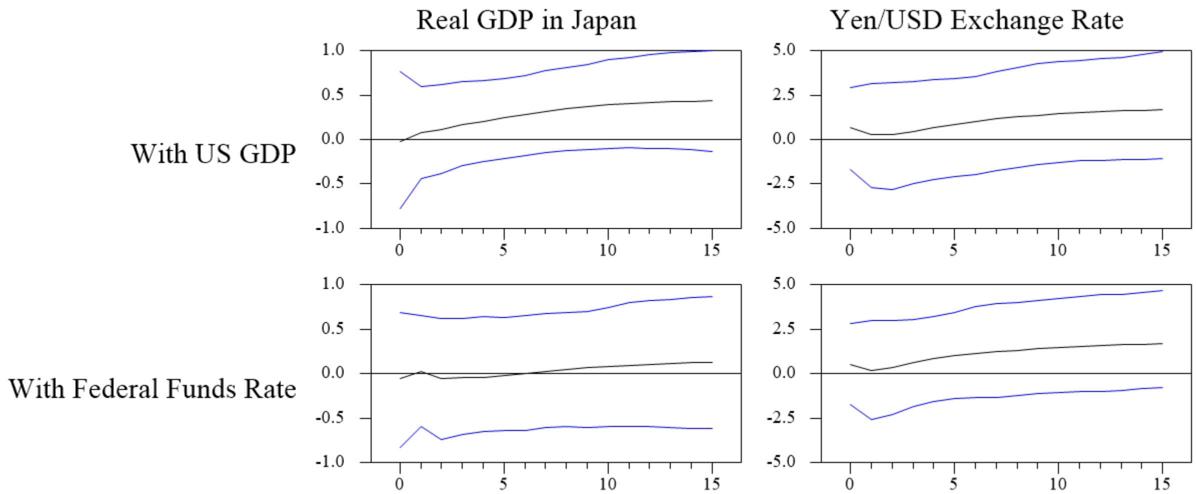


Figure 4: Robustness Test for Conventional Monetary Policy Baseline Model

the Bank of Japan does not adjust its interest rate systematically in response to events in the U.S. economy. The other way to interpret this this is that the events in the US economy relevant for the BOJ's decisions are already reflected in world commodity prices and the exchange rate between the yen and the U.S. dollar.

QQE

This section covers the effect of the new regime of Japan, unconventional monetary policy QQE, on emerging markets with the same process of basic model, added exchange rate version, net export version and output version as above. We only use log difference in this part, following previous researches (e.g. Ryou, Baak, and Kim (2019)). We substitute M1 in previous analysis by monetary base as proxy of QQE and by total assets as a new, broad proxy to show the robust results.

Baseline Model

Replacing M1 and keeping other things unchanged, variables chosen in this baseline model are real GDP, CPI, commodity price, interest rate, monetary base (total assets),

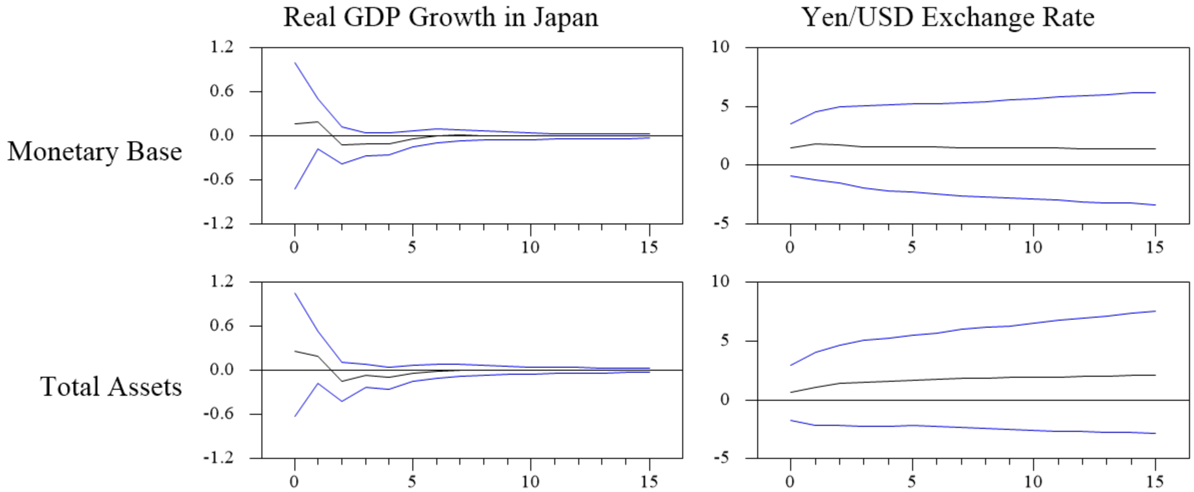
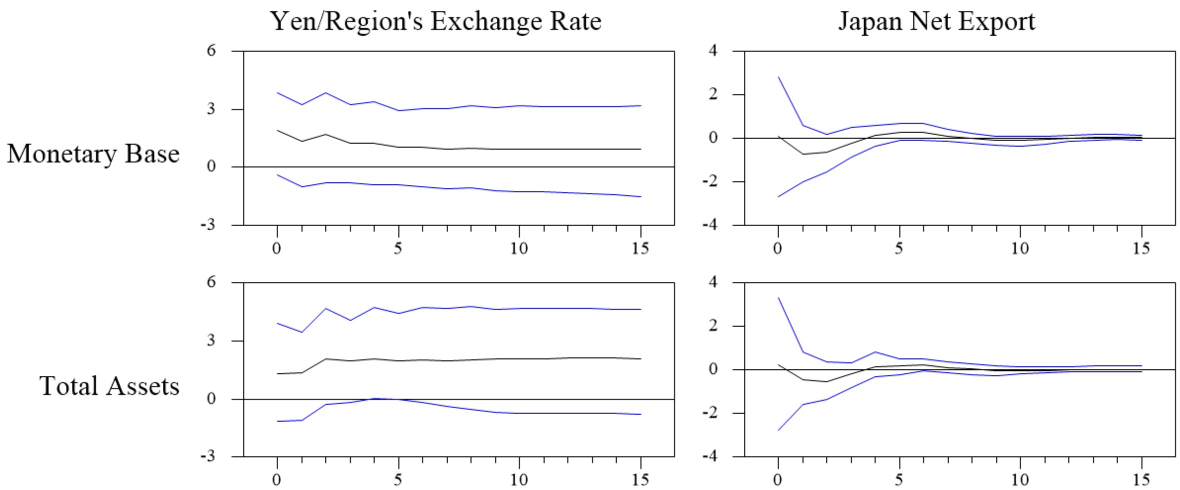


Figure 5: Baseline Model for QQE

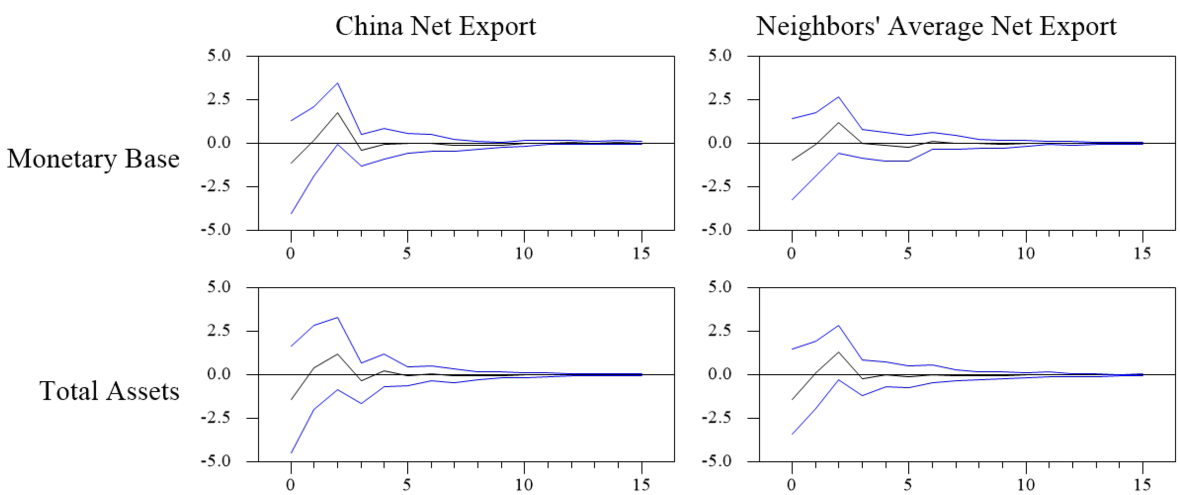
and exchange rate. Sign of monetary base (total assets) is restricted to be nonnegative, commodity price to be nonnegative and CPI to be nonnegative. No restrictions are imposed on the response of interest rate. We still use real GDP and exchange rate to show the effect. As in the top row of Fig. 5, effects of increasing monetary base or total assets on Japan's real GDP converge to zero swiftly. Bottom row also shows yen depreciates against U.S. dollar, a result that is on the same direction as conventional monetary policy. Total assets' result is the same as monetary policy's result.

Seven-variable SVARs

Similarly as the conventional monetary policy part in the above, we add to the six-element baseline model a variable that measures exchange rate, net exports, or neighbor's output and reestimate the SVARs in this section. As in the conventional monetary policy in the above, we further restrict the sign of the impulse responses of the exchange rate between the yen and the U.S. dollar to be nonnegative while other signs being unchanged. In the first column of Fig. 6a, added variable is the exchange rate between the yen and the average of the currencies of all neighbors, which are China (mainland), Hong Kong, Korea, Philippines,



(a) Exchange Rate and Japan Net Export



(b) China and Neighbors' Average Net Export

Figure 6: Exchange Rate and Net Export Analysis for QQE

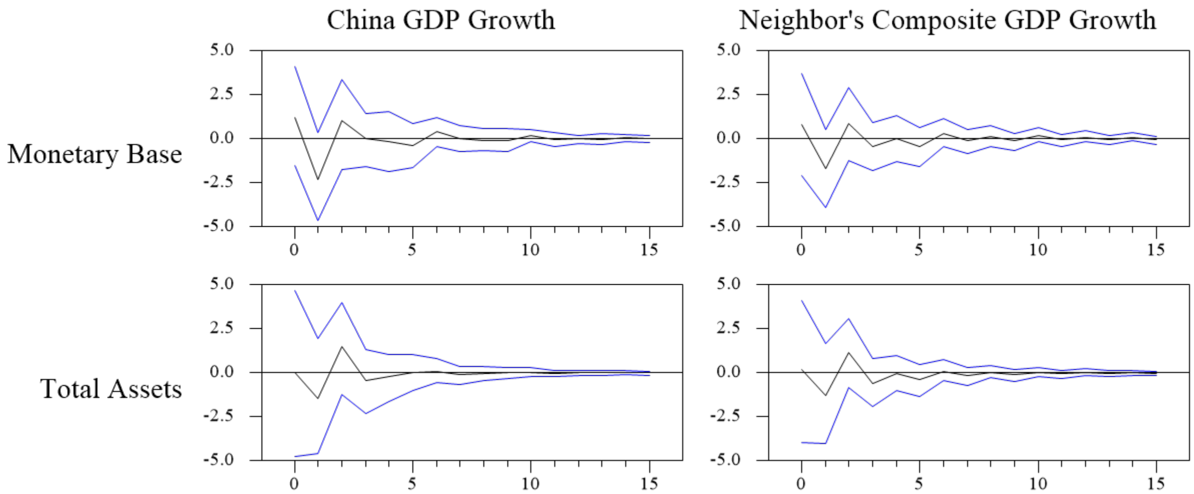


Figure 7: Output Analysis for QQE

Singapore and Thailand. The weight is calculated by nominal GDP. With separate but similar results of monetary base and total assets, expansion in monetary base or in total assets causes yen to depreciate against the neighbor's average exchange rate. Total assets can capture this robust effect.

In the second column of Fig. 6a, the added variable is the ratio of exports to imports in Japan. Effects on net exports quickly converge to zero. Both monetary base and total assets can tell that no evidence can show significant effect of QQE on the net export of Japan. In Fig. 6b, the added variable is the ratio of exports to imports in China and neighbor's average, respectively. No evidence can show significant effect of QQE on neighbors' net exports. As in the corresponding figure in the conventional monetary policy in the above, neighbors' net export pattern is the same as China's. The reason for this is believed to be that China in last 20 years has the largest weight by nominal GDP. In summary, no significant positive impact or beggar-thy-neighbor effect occurs on net exports in Asia even though yen depreciates both against U.S. dollar and against neighbors' average exchange rate.

In Fig. 7, we show the results obtained in a seven-variable SVAR where the added variable is the real GDP of China and neighbor's composite nominal GDP, respectively. Effect rapidly converges to zero as illustrated by both monetary base and total assets. For the regular fluctuation around zero, we also treat this as seasonality. Not as in the corresponding figure in the conventional monetary policy in the above, the effect on neighbors in this figure is very similar to that on China. This indicates the QQE's spillover effect on Asia is influenced by countries' nominal GDP themselves.

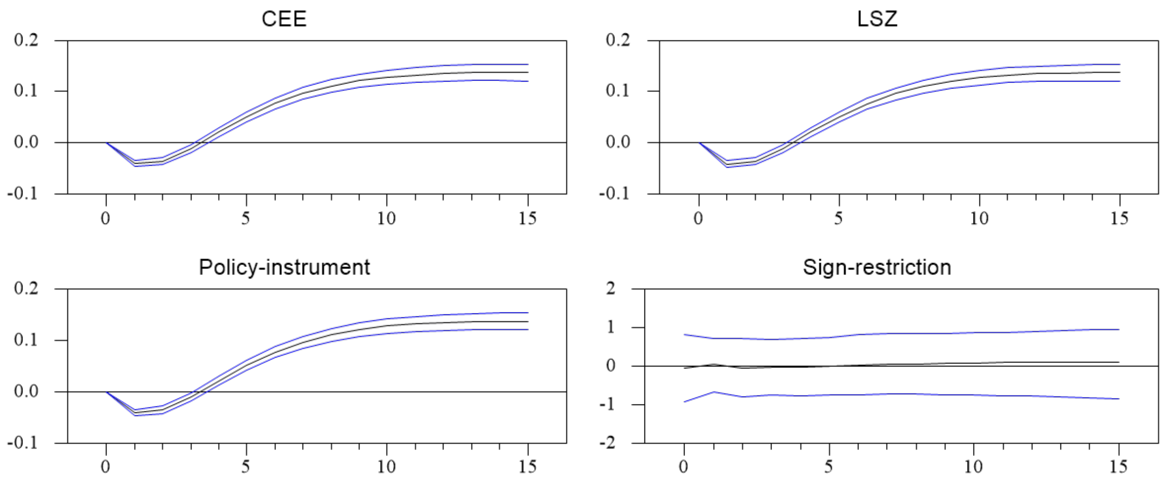
Conclusion

Using data from 2000:Q1 to 2024:Q2, we investigate the effects of Japan's conventional monetary policy and QQE on the 6 countries as Asian emerging market neighbors. We include Korea, Hong Kong, China (mainland), Philippines, Singapore, Thailand in the model. We analyze the effect through the lens of exchange rate, net exports, and output. We find Japan's conventional monetary policy and QQE lead to depreciation of yen both against U.S. dollar and against neighbors' average. However, these policies have an insignificant impact on net export of China and average net export of neighbors, real output of China and composite nominal GDP of neighbors. For the proxy of QQE, not only can the widely-used monetary base show the insignificant effect, but also total assets can successfully capture the effect. Total assets is a valid proxy for QQE to capture the effect.

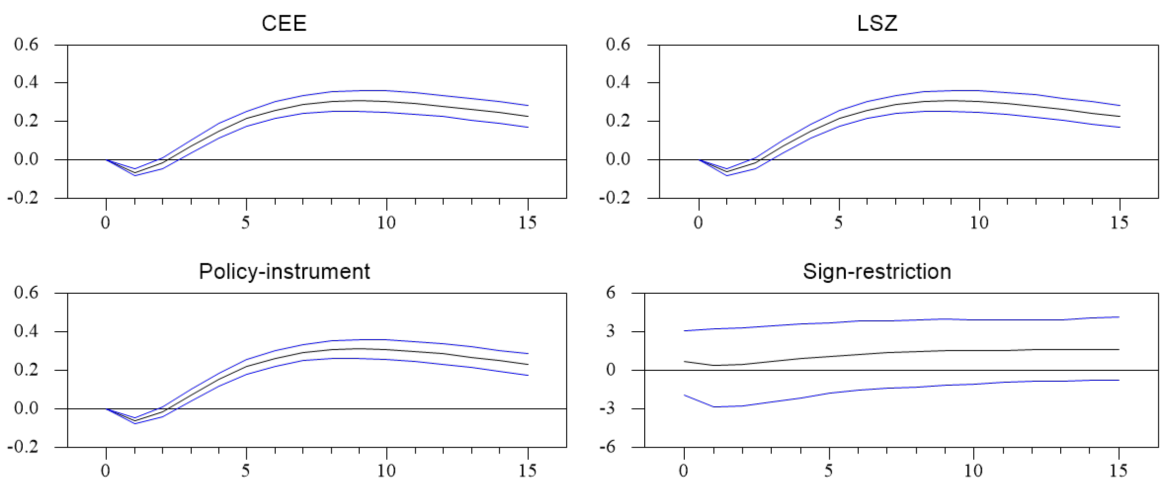
Appendix

Appendix.1 Results of Traditional Identification Methods

Fig. 8 shows the results of 4 methods for baseline model of conventional monetary policy with level data. Fig. 8a shows that a 1% decrease in interest rate causes Japan's real GDP to increase under first 3 methods but causes no impact under sign-restriction. Fig. 8b shows that yen depreciates under all of 4 methods even though the trends of first three methods are different from sign-restriction, but overall effects are positive. Fig. 9 shows the results

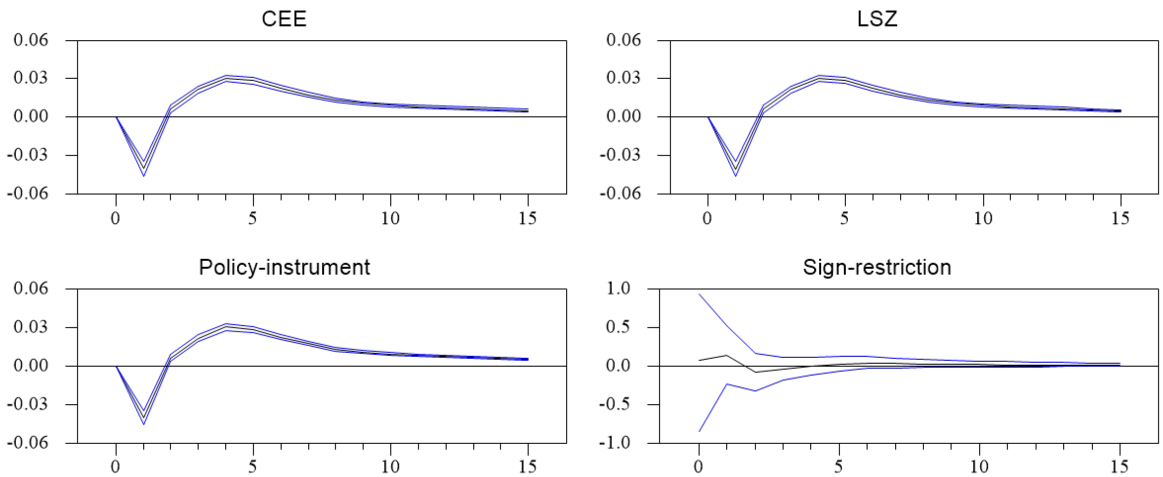


(a) Real GDP in Japan, Level Data

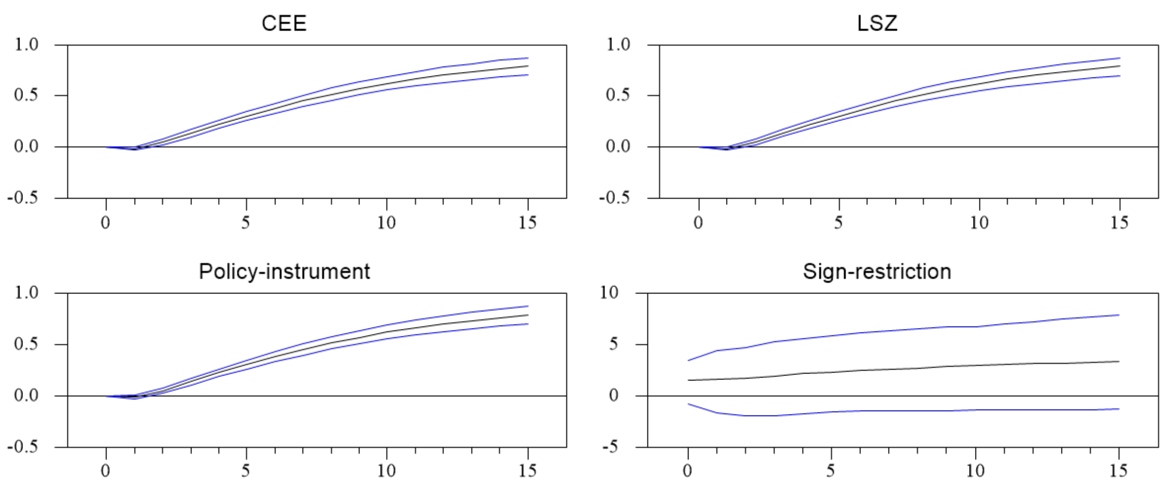


(b) Yen/USD Exchange Rate, Level Data

Figure 8: Baseline Model of Conventional Monetary Policy with 4 Identification Methods, Level Data



(a) Real GDP in Japan, Growth Data



(b) Yen/USD Exchange Rate, Growth Data

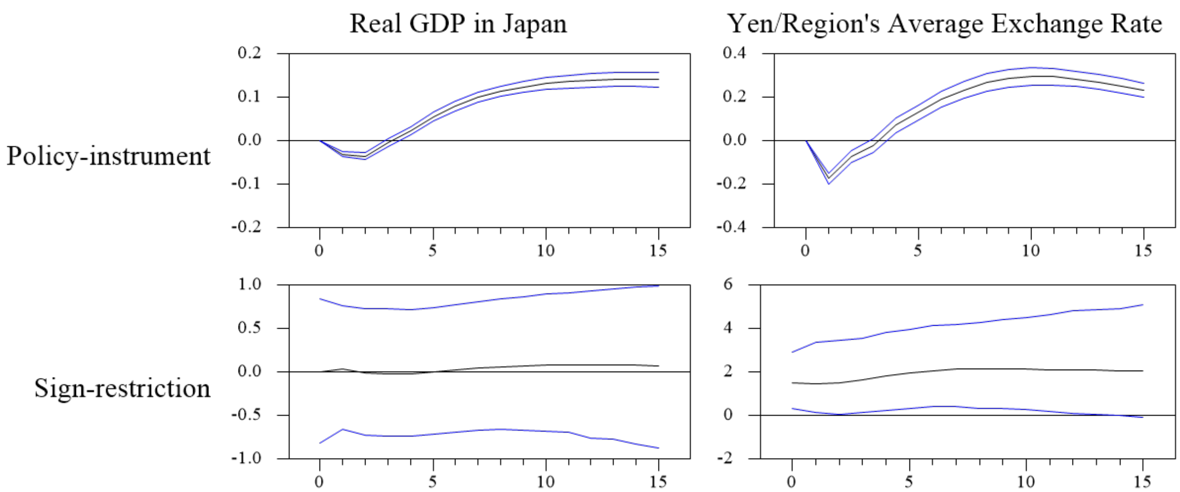
Figure 9: Baseline Model of Conventional Monetary Policy with 4 Identification Methods, Growth Data

of 4 methods for baseline model of conventional monetary policy with growth data. With Fig. 9a, we discover that the effect on real GDP reaches the maximum at period 4 under first three methods. But the effect quickly converges to 0 under sign-restriction. Fig. 9b suggests the depreciation of yen under all 4 methods. But for both Fig. 9a and Fig. 9b, CEE method, policy-instrument method, and LSZ method might suffer price puzzle problems.

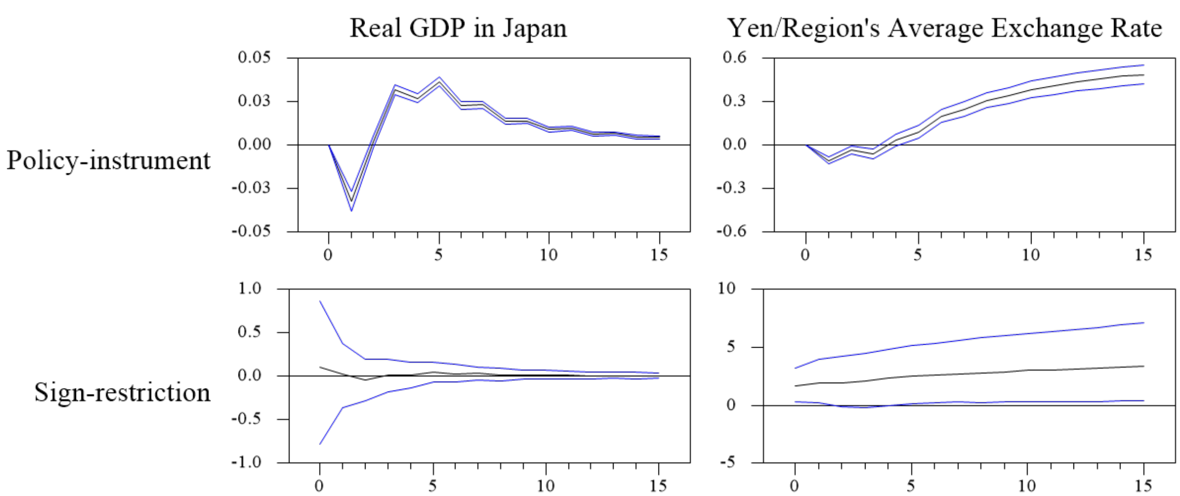
The results of CEE and policy-instrument are the same because the only difference between them is the switched order of exchange rate and interest rate, as mentioned in the model section above. LSZ's result is also similar. The only thing to mention is that the average line and the 90% probability band lines start separately in fact because exchange rate reacts to interest rate contemporaneously in the assumptions. However, due to the tiny movement of Japan's interest rate and corresponding vertical axis, it is hardly to see the separation.

Hereafter, we use policy-instrument result to represent traditional 3 methods due to same results. Fig. 10 shows the results of the 7-variable SVAR including the exchange rate between the yen and the average of neighbors for conventional monetary policy with level data and growth data. The first column of Fig. 10a indicates the similarly inconsistent effect on real GDP in Japan as the figure above. The first column of Fig. 10b suggests that the effect on real GDP reaches maximum at period 5 under policy-instrument. Under sign-restriction, effect quickly converges to zero. Yen depreciates against neighbors' average exchange rate with the results of the second row and last row. Traditional methods may suffer from the price puzzle problem when exchange rate included.

Fig. 11 shows the results of the 7-variable SVAR adding the ratio of exports to imports in Japan, China, and neighbor's average, respectively, for conventional monetary policy with level data and growth data. First row of Fig. 11a indicates that under policy-instrument, net export of Japan increases, but net exports of both China and neighbor's average decrease. If we do not think about the possible problems with the first-period IRF, a possible explanation for this chart may be that the trade volume is determined in advance by the previous contract.

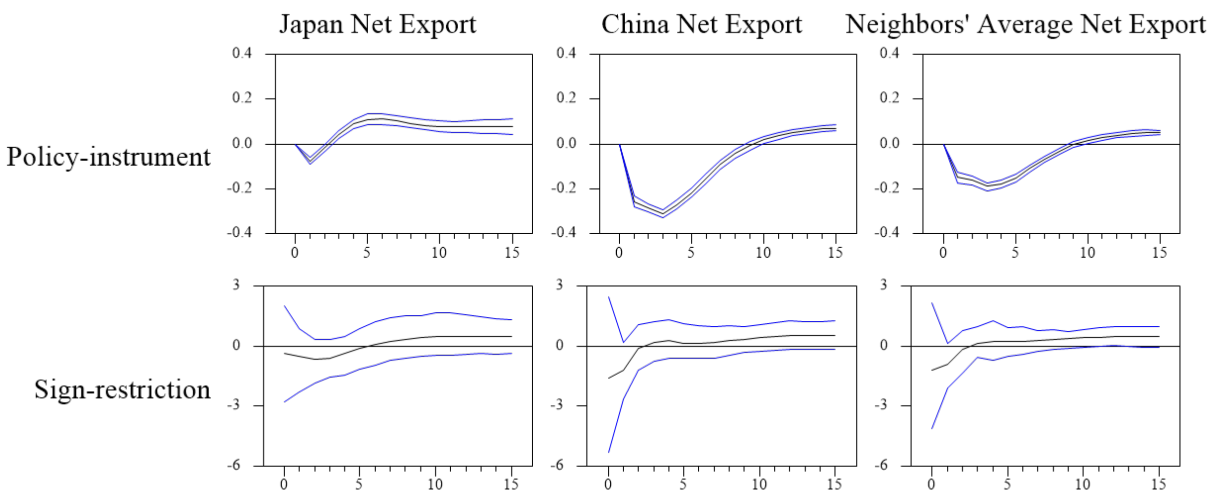


(a) GDP and Exchange Rate, Level Data

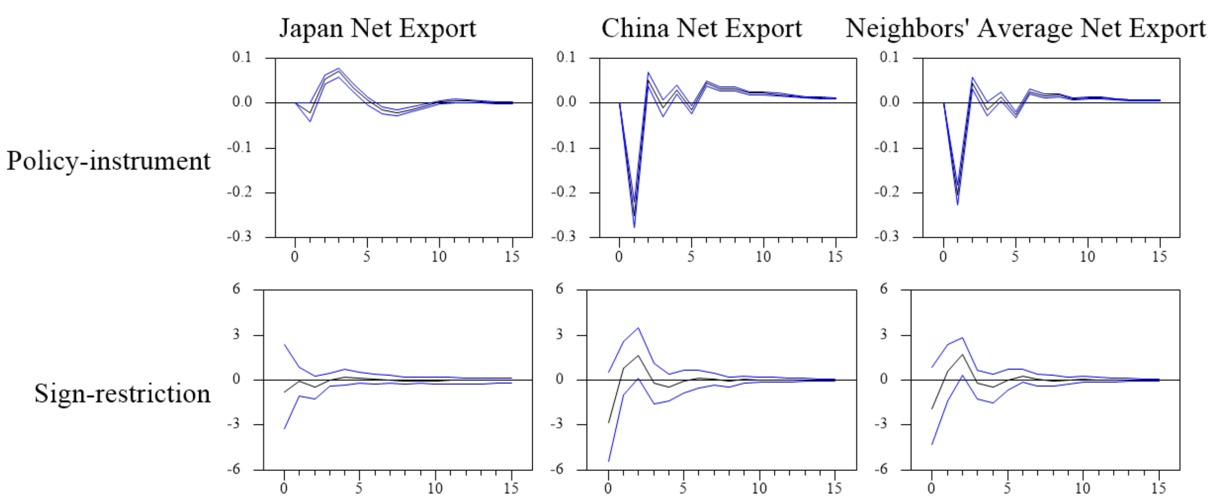


(b) GDP and Exchange Rate, Growth Data

Figure 10: GDP and Exchange Rate Analysis of Conventional Monetary Policy, Level and Growth Data



(a) Net Export, Level Data



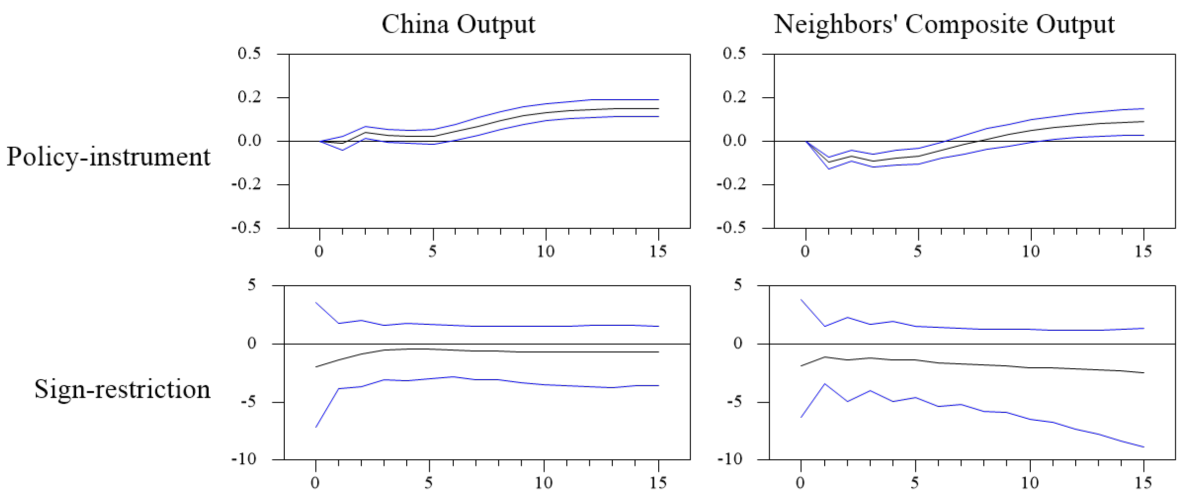
(b) Net Export, Growth Data

Figure 11: Net Export Analysis of Conventional Monetary Policy, Level and Growth Data

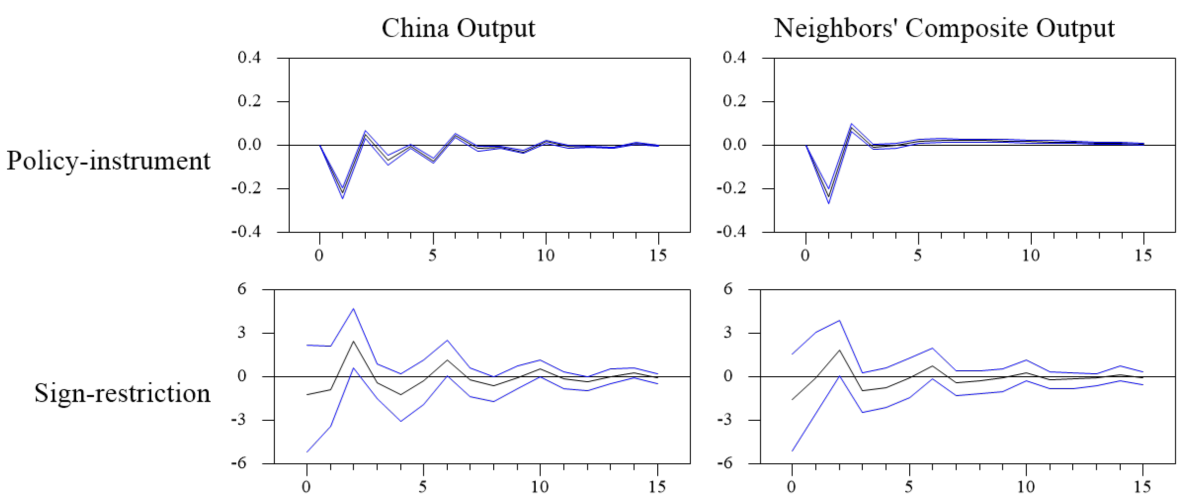
As the yen depreciates, income decreases. At the same time, due to the depreciation of the yen, the subsequent trade volume increases, and profits increase, making the overall impact positive. Simultaneously, yen depreciation damages China's net export. This can be treated as a beggar thy neighbor effect. Effect on neighbors' average is similar to that on China because China has the largest weight in the average. However, sign-restriction, second row of 11a, shows insignificant effect. Results are not robust under traditional method and sign-restriction method. Fig. 11b suggests that under policy-instrument, effect on net export of Japan reaches maximum at period 3. Effect quickly converges to 0 under sign-restriction. Effect on neighbors is still similar to that on China. The result of sign-restriction still tells insignificant pattern.

Fig. 12 shows the results of the 7-variable SVAR where the added variable is the real GDP of China and neighbor's composite nominal GDP, respectively for conventional monetary policy with level data and growth data. Fig. 12a indicates that, under policy-instrument, China's GDP increases with 1% decrease of interest rate, but neighbors' does not. If we do not think about the possible problems with the first-period IRF, a possible explanation for this result may be that the way of Japan's interest rate decrease affecting China's GDP is not net exports. It is possible that capital outflow of Japan goes to China simply because of the difference of interest rate. However, the effect on neighbors' average is not similar to that on China this time. Maybe net exports are very important for other countries. Still, results are not robust under traditional method and sign-restriction method. The first row of 12b suggests that, under the policy instrument method, the effects on China's GDP and the composite GDP of the neighbors reach the maximum in period 6 then soon converge to zero. For the rate of change, the pattern of the neighbors is still similar to that of China. The results of sign-restriction still advocate insignificant pattern.

Similarly as the robustness test in the conventional monetary policy part in the main body of this paper, we add variables measuring economic conditions in the United States (U.S. real GDP and the Federal Funds rate) into the SVAR model in Fig. 13. The restrictions on signs

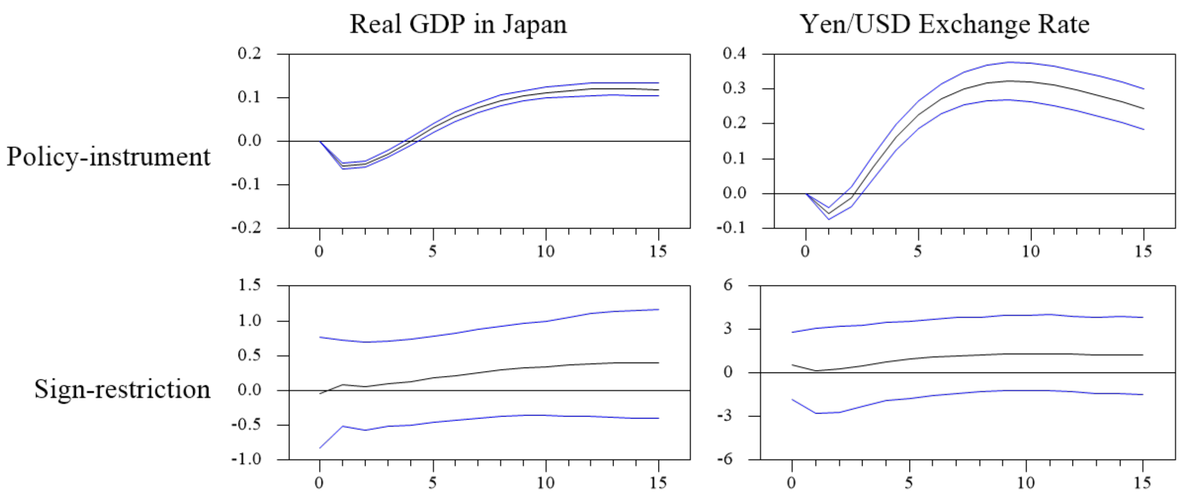


(a) China and Neighbors' Composite Output, Level Data

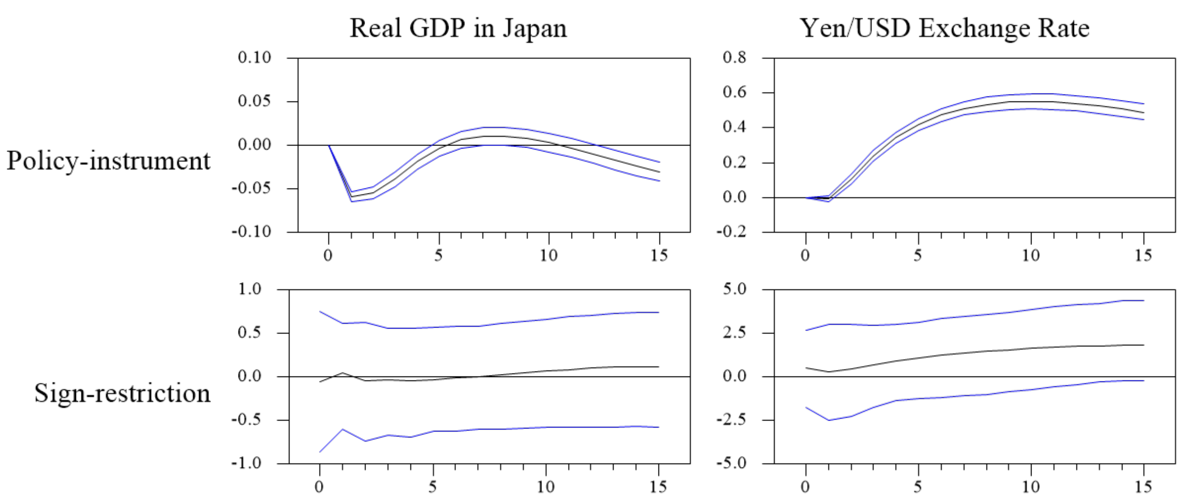


(b) China and Neighbors' Composite Output, Growth Data

Figure 12: Output Analysis of Conventional Monetary Policy, Level and Growth Data



(a) Robustness Test with US GDP



(b) Robustness Test with Federal Funds Rate

Figure 13: Robustness Test of Conventional Monetary Policy

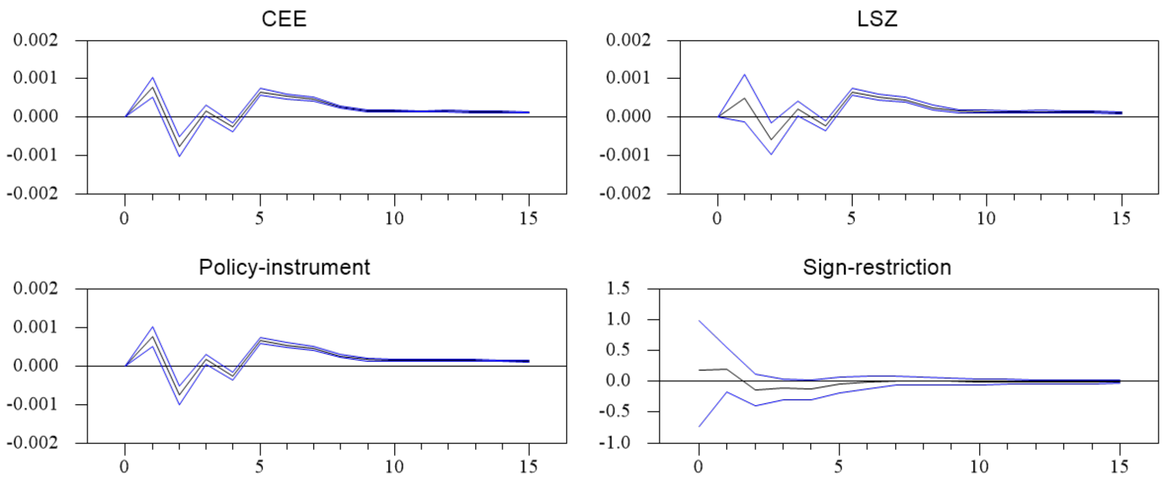
are kept the same. We can obtain the mostly consistent solution aligning with the previous results. Yen depreciates against U.S. dollar no matter what variable is newly added. Real GDP increases under first 3 methods, and there is no impact under sign-restriction with U.S. GDP in the model. Nevertheless, with federal funds rate in the analysis, real GDP of Japan shows non-robust results in policy-instrument method. This may because federal funds rate hugely influences Japan's economy in reality.

In QQE part, we only show the baseline model with monetary base result because total assets result should be the same. From Fig. 14a, real GDP receives volatile but positive overall effect under first 3 methods and receives no significant impact under sign-restriction method. Identification schemes fail to indicate robustly whether a QQE in Japan causes an increase in real GDP or not. Uncertainty is the same as above. Even though the trends are different among four charts in Fig. 14b, yen can be interpreted to depreciate against U.S. dollar. In the results of LSZ, average line and 90% probability bands clearly separate at $t = 0$. This is the result that should always be obtained because exchange rate reacts to monetary base contemporaneously.

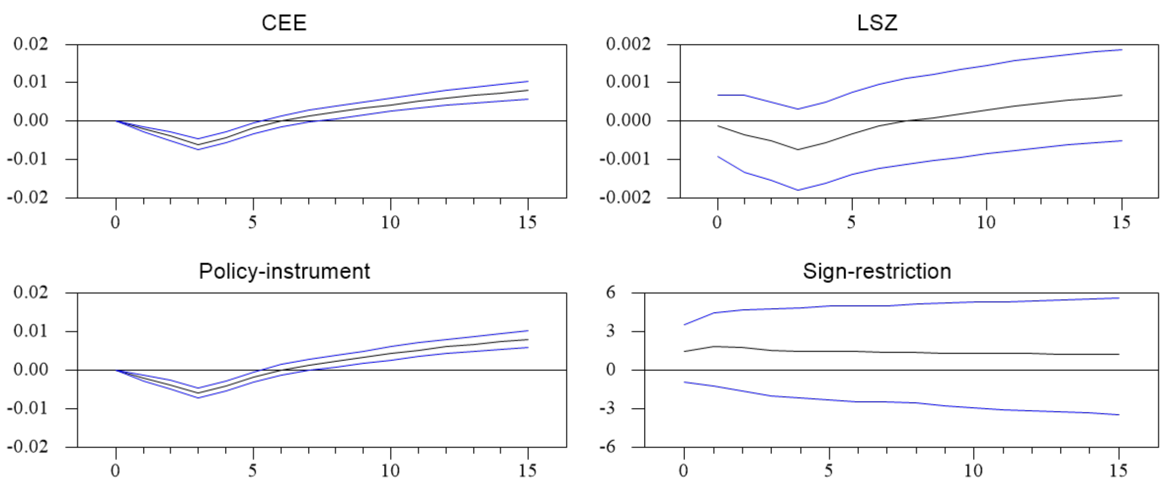
Appendix.2 Data Detail

Datastream is the source for all data from Asia and for data on world commodity prices. The website of the Federal Reserve Bank of St. Louis is the source for all data from the United States. All data were downloaded in October 2024. Below is a list of all time series used in the paper, including their Datastream (or the Federal Reserve Bank of St. Louis) symbols.

Japan: overnight uncollaterised call money rate JPCALLM%, money supply M1 JPM1....A, consumer price index JPI64...F, real GDP JPGDP...D, exchange rate USD per yen JPI..AG. (converted into yen per U.S. dollar before using), exports measured in yen JPEXPGDSA, imports measured in yen JPIMPGDSA. All series except GDP consist of monthly observations running from January 2000 to June 2024; the GDP series consists of quarterly observations



(a) Real GDP in Japan



(b) Yen/USD Exchange Rate

Figure 14: Baseline Model with Monetary Base for QQE

running from I: 2000 to II: 2024.

China mainland: exchange rate domestic currency per U.S. dollar CHUSDSP, real GDP CHGDP...C, exports measured in U.S. dollars CHEXPUDSA , imports measured in U.S. dollars CHIMPUDSA. All series except GDP consist of monthly observations running from January 2000 to June 2024; the GDP series consists of quarterly observations running from I: 2000 to II: 2024.

Other countries, exchange rate domestic currency per U.S. dollar: (1) Hong Kong HKI..AE., (2) Korea KOI..AE., (3) Philippines PHI..AE., (4) Singapore SPI..AE., (5) Thailand THXRUSD. All series consist of monthly observations running from January 2000 to June 2024.

Other Asian countries, international trade measures: (1) Hong Kong, exports measured in domestic currency HKEXPGDSA, imports measured in domestic currency HKIMPGDSA. (2) Korea, exports measured in domestic currency KOEXPGDSA, imports measured in domestic currency KOIMPGDSA. (3) Philippines, exports measured in U.S. dollars PHEXPGDSA, imports measured in U.S. dollars PHIMPGDSA. (4) Singapore, exports measured in domestic currency SPEXPGDSA, imports measured in domestic currency SPIMPGDSA. (5) Thailand, exports measured in U.S. dollars THEXPGDSA, imports measured in domestic currency THIMPGDSA. All series consist of monthly observations running from January 2000 to June 2024.

World commodity prices: NZ ANZ Commodity Price (World Index in US$), monthly, NZCOMPUSF.

Regional average time series were constructed by the author as linear combinations of time series for six neighbors of Japan: China mainland, Hong Kong, Korea, Philippines, Singapore and Thailand. The weight for each country in the regional average was the country's share in the sum of the nominal GDP levels of all six countries (measured in U.S. dollars). The share was defined as the average share over the period 2000 - 2024. Raw nominal GDP series used were annual with the following Datastream symbols: CHGDP...A, HKGDP...A, KOGDP...A, PHGDP...A, SPGDP...A, THGDP...A.

United States: real GDP GDPC1 and federal funds rate FEDFUNDS. Federal funds rate data consist of monthly observations; the GDP series consists of quarterly observations.

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