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Current Account Dynamics: On Income and Trade Balance*

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Abstract

We investigate the dynamics of Japan's income and trade balance between 1996:Q1 and 2019:Q4 via a structural VAR model. The two most important constituents of the current account (trade balance and income balance) and seven other macroeconomic variables are entered in our VAR model. We implement a shadow rate for the measure of monetary policy under the unconventional monetary policy regime, including a zero lower bound interest rate. By using a standard SVAR model from the literature, we find that world shocks dominate and rule the dynamics of Japan's current account. Through additional short-run zero restrictions, we also find that exogenous exchange rate shocks affect the current account.

Keywords: Current account dynamics; Income balance; Structural VAR; Trade balance.
JEL Classification Codes: F14; F32; F41; E52.

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1. Introduction

The current account has been and remains one of the most important policy issues of international economics over the centuries (Obstfeld, 2012). Current account imbalances can trigger political conflict between two countries. In the 1980s, the large current account deficit of the US pushed US politicians to lobby against Japanese imports such as fabrics, automobiles, and semiconductors, termed the US-Japan trade conflict. In the 21st century, a large deficit of the US current account with China led to the US-China trade war, in which both countries raised tariffs bilaterally. More importantly, a large current account deficit is considered an early indication of a consequent currency crisis (e.g., Catao and Milesi-Ferretti 2014 and Kaminsky and Reinhart 1999).

Japan's trade balance was in surplus for almost thirty years since 1981. However, after a few extreme negative shocks, including the sudden contraction of world trade, called the 'great trade collapse' following the global financial crisis in 2008, and the great earthquake and tsunami that shut down the domestic production network in 2011, the trade balance of Japan showed a deficit for several quarters (see Figure 1). Despite the recent deficit in the trade balance, over three decades of trade surpluses have made Japan accumulate a net international investments position that is at the highest level in the world. In tandem with the growing net investment position, primary income receipts continued to increase and surpassed the level of trade surplus in approximately 2005.

The two major constituents of the current account are trade balance, i.e., export minus import, and income balance, i.e., income receipt minus income payment, as also emphasized in Herkenhoff and Sauré (2021). Gourinchas and Rey (2007) note that there are two important channels to the current account: trade channels and valuation channels. The valuation channel or valuation effect is the difference between a change in the net international investment position and the current account. Forbes et al. (2017) investigate the interrelationship between valuation change and income balance to examine the current account dynamics of the UK. However, Forbes et al. (2017) intentionally leave the trade channel aside in their research: "… ignores any effects through the trade balance. …but trade relationships have been well studied elsewhere and are generally much slower than the financial channels on which this article focuses" (p. 601). In this study, we bring back the trade channel and combine these two studies to simultaneously investigate the trade balance and income balance in one framework.

Figure 2 depicts these flows from the first quarter of 1996 to the fourth quarter of 2019. What are the driving forces of these trade and income flows? The role of the exchange rate on the current account was documented as early as the turn of the 20th century. An exchange rate depreciation adjusts relative prices to induce more demand for exports and less demand for imports. However, sluggish price adjustments in response to exchange rate fluctuations, documented as incomplete exchange rate pass-throughs in the literature, may slow or even nullify this adjustment mechanism. Income balance is also affected by exchange rate movements. A change in the exchange rate induces the revaluation of foreign assets and their dividends and returns in terms of domestic currency, also known as a possible cause of the valuation effect (Gourinchas and Rey, 2007).

The effect of monetary policy on current accounts is less clear. The effect of monetary policy on the home economy has been one of the central issues in the macroeconomics literature. Applying a sign-restriction agnostic identification approach to the US economy, Uhlig (2005) shows that the identified monetary expansionary shock boosted economic growth. If economic growth is coupled with an increase in overall investment return, income payment to foreign countries should increase, leading to a decrease in income balance.

The monetary policy of Japan has been peculiar in the last three decades. Faced with ever-accumulating nonperforming loans in the banking sector and the nonbank financial sector in the late 1990s, the monetary authority of Japan needed to lower the policy rate to its historically lowest level, later termed the zero lower bound interest rate policy. At the turn of the century, specifically in March 2001, quantitative easing, as the second tool of unconventional monetary policy, was introduced. Except for a short period from 2006 to the outbreak of the subprime loan crisis in the US housing market, unconventional monetary policy has been continuously pursued. Because of the zero lower bound (ZLB) or effective lower bound (ELB), the policy rates of any country conducting unconventional monetary policy remain at the ZLB or ELB for a long period of time. Directly applying these policy rates as a measure of monetary policy in empirical analysis is at odds when the magnitude or intensity of unconventional monetary policy, e.g., in terms of asset purchase in quantitative easing, has occasionally increased during the unconventional monetary policy regime. We instead use shadow rates constructed by using the term-structure and option concept. More specifically, we rely on shadow rates provided by Krippner (2015). The shadow rates of Japan and the world along the nominal effective exchange rate of the Japanese yen are depicted in Figure 3. Whether these monetary policies had any significant effect on current account dynamics is important for both policy makers and macroeconomic researchers.

In this study, we apply the structural vector autoregression (SVAR) model of Forbes et al. (2017) to Japan during the unconventional monetary policy regime. We extend the analysis of Forbes et al. (2017) in the following three aspects. First, with the aim of investigating the current account in wider coverage, a trade balance is additionally introduced to the SVAR model of Forbes et al. (2017). Our model simultaneously estimates the trade balance and income balance of the current account. Second, instead of treating the home country and the rest of world in relative form as a single variable, we break down three relative-form variables by home and the rest of world variables. The relative GDP, relative price, and relative interest rates in Forbes et al. (2017) are decomposed into Japan's GDP, world GDP, Japan's consumer price, world consumer price, Japan's interest rate, and world interest rate, respectively. In this way, we capture heterogeneous effects of home and the rest of world shocks. Third, and less importantly, we omit the uncertainty index from the set of variables. This strategy is chosen because our focus in this paper is more on trade and income balance dynamics and we need to keep the number of variables at a manageable level, although the risk issue is an important aspect when analyzing the balance of payments.

In identifying structural shocks from the reduced-form shocks, we provide two specifications: one most closely follows restrictions imposed in Forbes et al. (2017), and the other adds short-run zero restrictions to those of Forbes et al. (2017). The most robust result is that world factors are much more influential than domestic factors on Japan's current account dynamics. First, a world supply shock increases both the income and trade balance. Second, a world demand shock increases the income balance (when short-run zero restrictions are added) and decreases the trade balance. Third, Japan's supply shock has no significant effects on the trade or income balance. Fourth, Japan's demand shock has a negative effect on the income balance only in the specification when short-run zero restrictions are added. Fifth, neither Japan's nor the world monetary policy shock has any effect on trade or income balance. Sixth, an exchange rate shock positively affects the trade balance only in the specification when short-run zero restrictions are added.

The rest of the paper is structured as follows. The next section presents a succinct overview of previous studies on current account dynamics. Section 3 describes the dataset. Section 4 presents the empirical model of the SVAR model with zero and sign restrictions. Section 5 provides the empirical results based on the impulse response functions. Section 6 discusses and checks the robustness of the results. The last section concludes.

2. Empirical literature on the current account

Our work relates to the empirical literature on the determinants of current accounts. Glick and Rogoff (1995), among other studies based on intertemporal optimization, emphasized the role of productivity changes in explaining the movements of current accounts for G7 countries. Our SVAR model captures this mechanism by including supply shocks, possibly generated by productivity shocks, among structural shocks. On the other hand, Chinn and Prasad (2003) expanded the set of candidates for possible determinants of current accounts. In this paper, we are not able to include all possible variables in our SVAR model because of the practical limit on the number of variables allowed due to identification restrictions. However, we allow seven variables in addition to two constituents of the current account in our SVAR model. Our approach differs from previous studies with a large panel of datasets to find the statistically significant explanatory variables. Our emphasis is on determining the dynamics of the current account with respect to the selected macroeconomic structural shocks.

Our study is also related to Morita (2014) and Schenkelberg and Watzka (2013), who applied SVAR models to the Japanese economy. Morita (2014) investigates the sources of Japanese business fluctuations, considering external shocks, domestic supply and demand shocks. They use the sign-restricted VAR model based on the theoretical model to identify these shocks and find that approximately 30–50% of the forecast error variances in output can be explained by external shocks. Supply shock is the main influencing factor in Japanese business fluctuations throughout the sample period. Using post-1995 data from Japan, Schenkelberg and Watzka (2013) propose that a quantitative easing shock leads to a significant decrease in long-term interest rates and significantly increases output and the price level. However, the effects are only transitory. This suggests that while the Japanese quantitative easing experiment was successful in temporarily stimulating real activity, it did not lead to a persistent increase in inflation. Sasaki and Yoshida (2018) do not apply the SVAR model but scrutinize the trade balance dynamics of Japan between 1988 and 2014 by decomposing exports and imports by partner country and industries. They show that the trade structure in terms of the responsiveness of trade to both income and price shocks underwent a drastic change between the pre- and postglobal financial crises. All shocks moved in the direction to induce the trade balance to deteriorate despite the favorable movement of the exchange rate and the recovery of the world economy in the postcrisis period.

The research most closely connected to our study is that of Forbes et al. (2017), which emphasized the dominant role of income balance in recent UK current account movements. They examined the rolling correlation of the UK and other OECD countries' current accounts with the trade balance and income balance. The correlation of the UK's (and of Switzerland's) current account with the income balance has risen close to 0.9, while for many other OECD countries, the correlation of the current account with the trade balance remains close to one. In terms of correlation, Japan was more aligned with other OECD countries despite the major role of income balance in the current account. They further estimate SVAR for the UK valuation change and income balance along other macroeconomic variables and risk factors. Our SVAR model very closely follows the model of Forbes et al. (2017) but with important modifications and new contributions. The most important is that we simultaneously examine both trade balance and income balance in our SVAR model.

Some studies dig deeper into one aspect of the current account. One strand of the literature examines the return differentials. The income balance surplus in the US despite the large net international investment position directed researchers' attention to the return differentials. One possible explanation for this puzzling phenomenon was the return differentials between the US and the rest of the world. Supposedly, the US enjoys exorbitant privilege as the issuer of international currency. However, by scrutinizing the data revision process in the balance of trade and international capital flows, Curcuru et al. (2008) conclude that they cannot find evidence to support return differentials in portfolio investments. Interestingly, in contrast, Rogoff and Tashiro (2015) find that Japan, as the largest net creditor nation, enjoys a higher return of assets, which exceeds the return of Japan's debt. They claim that Japan's exorbitant privilege is partly supported by the safe haven status of the Japanese yen.

3. Data

The main data sources for this paper are fourfold: (i) Japan's Balance of Payments, Ministry of Finance; (ii) International Financial Statistics (IFS), IMF; (iii) UN Comtrade, UN; and (iv) the shadow rate from Krippner (2015). The gross domestic product, the consumer price index except for Japan, and the exchange rate are from IFS. The Japanese consumer price index adjusted for consumption tax is taken from Japan's Ministry of Internal Affairs and Communications. The seasonally adjusted trade balance and income balance are taken from Japan's Balance of Payment Statistics, Ministry of Finance. Shadow interest rates are from Krippner (2015). For calculations of trade weights, we apply the sum of exports and imports from the UN Comtrade database. For exact definitions of variables in the original data sources, see the variable list in the appendix table.

The following transformation of the original data is performed prior to estimation. The trade balance and income balance are normalized by taking the ratio of the balance to the GDP[1]. The output of Japan is the first-differenced natural log of the seasonally adjusted real gross domestic product. World output is the first-differenced natural log of the trade-weighted average of the real gross domestic product of twenty-one countries of Japan's largest trade partners[2]. The fixed trade weights are used for the entire sample[3]. The world price is constructed similarly to the weighted average of the same twenty-one countries. Both Japan and world prices are based on the CPI index. The

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[1] Alternatively, the growth rates of trade balance and income balance are also used in the following SVAR estimation. The growth rate are used instead of the first-differenced log form because of possible negative values in the balance. For possible nonstationarity remaining in the growth-rate form, we applied standard unit-root tests and confirmed the stationarity of these series. However, the estimation results when the growth rates of balances are used showed stronger cyclicality because of extremely large values of growth rates near the zero trade balance in the 2010s. We only report the results for the ratio of balance to GDP in this paper.

[2] For Brazil, India, Indonesia, Mexico, Thailand, and UK, only seasonally adjusted nominal GDP was available. We constructed the real GDP index for these countries by combining the seasonally adjusted nominal GDP and the quarterly inflation rate. In addition, we deseasonalized China's real GDP, which we constructed by combining the nominal GDP, taken from National Bureau of Statistics of China, and the quarterly inflation rate.

[3] We also used time-varying weights that are recalculated every year. However, a large shift in the trade weight of 2011 creates a jump in the world GDP index without large movements in the GDP of any countries in that year. We only report the results for fixed trade weight in this paper.

exchange rate is the first-difference natural log of the nominal effective exchange rate[4]. We use Krippner's (2015) shadow rates as interest rates in Japan and the world. We first construct quarterly series by averaging the monthly average shadow rates of Australia, Canada, the Euro zone, Japan, Switzerland, the UK, and the US from Krippner's website. The world shadow rate is constructed by taking the weighted average of Australia, Canada, the Euro zone, Switzerland, the UK, and the US with Japan's trade weight.

The data series are quarterly data from the first quarter of 1996 to the fourth quarter of 2019. Gross domestic products, trade flows, and income flows are seasonally adjusted.

[4] We should note that the weights used in constructing the nominal effective exchange rate by the BIS do not necessarily match our weights used in constructing world GDP growth or world inflation.

4. SVAR model

Consider the SVAR in the following form:

$$y_t' A_0 = \sum_{s=1}^{p} y_{t-s}' A_s + \varepsilon_t' \text{ for } 1 \le t \le T, \tag{1}$$

where y_t is an $n \times 1$ vector of endogenous variables, ε_t is an $n \times 1$ vector of exogenous structural shocks, and A_s is an $n \times n$ matrix of parameters for $1 \le s \le p$. A_0 is an $n \times n$ matrix of parameters and is invertible. The vector ε_t is Gaussian with mean zero and covariance matrix that is the $n \times n$ identity matrix. The reduced-form representation is

$$y_t' = x_t' B + u_t' \text{ for } 1 \le t \le T, \tag{2}$$

where $x_t' = [y_{t-1}' \dots y_{t-p}']$, $B' = [A_1' A_0^{-1} \cdots A_P' A_0^{-1}]$, and $u_t' = \varepsilon_t' A_0^{-1}$.

To recover structural shocks in equation (1) from estimates of the reduced-form representation in equation (2), a number of restrictions, i.e., n(n-1)/2, need to be imposed. Rubio-Ramirez et al. (2010) show that their algorithm for exactly identified models with short- and long-run restrictions can also include sign restrictions. Binning (2013) extends the procedures to underidentified SVAR models. Furthermore, for an SVAR model with zero and sign restrictions, Arias et al. (2018) develop an algorithm that draws a posterior over orthogonal reduced form parameters and transforms it to obtain a posterior over the structural parameters.

In this study, the sample period is between the first quarter of 1996 and the fourth quarter of 2019. The lag order *p* is set to four quarters[5]. The number of variables *n* is equal to 9. The nine endogenous variables are trade balance, income balance, Japan's output, world output, Japan's price, world price, nominal effective exchange rate of the Japanese yen, Japan's shadow interest rate, and world shadow interest rate.

After estimating the reduced form in equation (2), structural orthogonal shocks in SVAR form (1) are recovered in the algorithm proposed in Rubio-Ramirez et al. (2010)

[5] The lag order *p* is checked by several lag order selection criteria. With the restriction of a maximum number of four, The Hannan and Quinn information criterion (HQIC) and Schwarz Bayesian information criterion (SBIC) both indicate 1, whereas Akaike's information criterion (AIC) indicates 2. With the restriction of a maximum number of six, equivalent to one and half years, the AIC indicates 6, whereas the HQIC and SBIC indicate one. We set the lag order equal to 4 because of the quarterly frequency. It should be noted that the value of AIC for four lags is only marginally different from those of the optimal lag in either case of a maximum number of four or six lags. For a robustness check, we also estimate SVAR with the lag order of one, two, three, and six.

and Arias et al. (2018)[6]. Zero and sign restrictions imposed in the base model are described in the following[7].

4–1. Identification of structural orthogonal shocks

We fundamentally follow the identification strategy, i.e., setting short-run signs and zero restrictions and long-run zero restrictions, of Forbes et al. (2017) and directly apply it to the current account data series of Japan in this paper. However, we also consider it fair to add more short-run zero restrictions to the original identification strategy, especially when we use quarterly frequency series. Macroeconomic variables often do not respond to shocks in the same quarter period. For convenience, we call the original identification Forbes-Hjortsoe-Nenova (FHN) and the specification with additional short-run zero restrictions Yoshida-Zhai (YZ). These zero and sign restrictions of the FHN and YZ specifications are summarized in Tables 1 and 2, respectively. We maintain our agnostic views about the two remaining structural shocks. The lengths of sign restrictions are assumed only on impact.

4–1(a). Long-run zero restrictions

Following Forbes et al. (2017), we impose that demands, exchange rates and monetary policies do not affect the long-term growth of the economy. Specifically, long-run zero restrictions are imposed on the following 10 cases: Japan's demand shock, world demand shock, exogenous exchange rate shock, Japan's monetary policy shock, and world monetary policy shock on the long-run growth of Japan and the long-run growth of the world.

Additionally, partly due to decomposing a single term addressing relative growth into the home country and the rest of the world, we also impose that Japan's (the world's) supply shock does not affect the long-run growth of the world (Japan). In total, there are 12 long-run zero restrictions. With regard to the long-run zero restrictions, FHN and YZ are the same.

4 -1(b) Sign restrictions

This subsection explains our identification strategy regarding sign restrictions.

[6] For implementations of the Rubio-Ramirez et al. (2010) and Arias et al. (2018) algorithm in MATLAB, we used codes provided by Binning (2013) and Breitenlechner et al. (2019). The number of models drawn is set to 1,000.

[7] Numerous identification strategies with restrictions are proposed especially for monetary shocks (Antolin-Diaz and Rubio-Ramirez, 2018; Arias et al., 2019; and Giacomini and Kitagawa, 2018).

In terms of sign restrictions, we strictly follow the identification strategy implemented in Forbes et al. (2017). With regard to the sign restrictions, FHN and YZ are the same.

(i) Japan's supply shocks

As a standard assumption in the monetary macroeconomic model, Japan's supply shock has a positive effect on domestic output and a negative effect on domestic prices. These two sign restrictions are also adopted in relative form in Forbes et al. (2017).

(ii) The world supply shocks

Symmetrically, with assumptions for Japan's supply shock, a world supply shock has a positive effect on the world's output and a negative effect on the world's price.

(iii) Japan's demand shocks

Japan's demand shock has a positive effect on both domestic output and price and increases the value of the Japanese yen (i.e., appreciation of the Japanese yen) and Japanese shadow rate. These sign restrictions for domestic demand shocks closely follow the identifications used for relative demand shocks in Forbes et al. (2017).

(iv) The world demand shocks

A world demand shock has a positive effect on both the world's output and price, relatively increases the value of foreign currencies against the Japanese yen (i.e., depreciation of the Japanese yen), and increases the world shadow rate. These are the sign restrictions assumed in Forbes et al. (2017).

(v) Exchange rate shocks

An exogenous exchange rate shock is identified as a positive shock to the exchange rate (i.e., appreciation of the Japanese yen), and the shock puts downward pressure on both Japan's price and interest rate (see footnote 8).

(vi) Japan's monetary policy shocks

Japan's monetary policy shock is identified such that it increases Japan's shadow rate, has a negative impact on Japan's price and output, and increases the value of Japanese yen (i.e., appreciation of the Japanese yen).

(vii) World monetary policy shocks

Our identification specification states that a world monetary policy shock is identified such that it increases the world shadow rate, has a negative impact on world price and output, and decreases the value of Japanese yen (i.e., depreciation of the Japanese yen).

4‑1(c). Short-run zero restrictions

With regard to short-run zero restrictions, we provide two specifications: no short-run zero specifications as in Forbes et al. (2017) as the FHN and additional short-run zero restrictions as the YZ specifications.

It should be noted that there are some short-run zero restrictions imposed in the original work of Forbes et al. (2017). In their model, short-run zero restrictions are imposed only on the responses of the UK and global uncertainty indices or on those corresponding to risk shocks. These restrictions are not used in this study because we do not include these uncertainty indices in our VAR model. However, we impose some short-run zero restrictions because we think that a simultaneous impact within a quarter can be rationally considered too short to have any impact even if the effect will kick in eventually. For example, world growth or inflation should be sluggish, if there is any effect at all, to respond to Japan's supply shock. We impose nine short-run zero restrictions, as explained in the following.

First, Japanese monetary policy shocks do not affect (at least in the same quarter) the economic growth of the rest of the world. Symmetrically, world monetary policy shocks do not affect the output of Japan. Second, an exogenous exchange rate shock does not have any effect on the economic growth of Japan and the rest of the world or shadow rates of the world[8]. Third, the demand and supply shock of a country does not affect world growth and inflation in the same quarter. Namely, demand and supply shocks in Japan have zero effect on the growth and inflation of the world in the same period.

[8] We impose asymmetry of monetary policy responses to an exchange rate shock between Japan and the rest of the world. We do so because the nominal effective exchange rate of the Japanese yen should affect the Bank of Japan more than any other individual central bank in the rest of the world. This interpretation makes more sense if we assume Japan as a small-country and the rest of the world as a large country in an underlying two-country theoretical model.

5. Empirical results

We estimate a reduced-form VAR with nine variables in equation (2), and with the two specifications of short-run zero, sign, and long-run zero restrictions, we recover structural parameters in equation (1). We retain only those 1,000 models that satisfy restrictions and produce impulse response functions for seven structural shocks on nine variables. In subsection 5.1, we present the key results of this study, i.e., the impulse responses of income balance and trade balance to each structural shock. For the presentation of impulse responses in this paper, the line indicates the median value of impulse responses from 1,000 replications at each quarter, a dark-gray area represents the values of impulse responses between the 16th percentile and the 84th percentile, and a light-gray area represents the values of impulse responses between the 5th percentile and the 95th percentile.

5.1 On income and trade balance

5.1.1 The Forbes-Hjortsoe-Nenova (FHN) specifications

Figure 5 shows, for the FHN specifications, the impulse response functions of trade balance and income balance with respect to Japan's supply shock, world supply shock, Japan's demand shock, world demand shock, exchange rate shock, Japan's monetary policy shock, and world monetary policy shock. We find for the Japanese current account that the local link is less influential than the global link. Neither Japan's demand shocks nor Japan's supply shocks affects income or trade balance. Exogenous exchange rate shocks and both local and global monetary policy shocks play no role in affecting the current account of Japan. Only world supply and demand shocks generate a significant effect on the income or trade balance of Japan.

First, a world supply shock generates an increase in the trade balance with statistical significance for the first eight quarters. How should we interpret this result with economic models? An increase in the world supply spurred by, for example, a rise in productivity lowers the price of the world supply. This may help increase world exports, which should be interpreted as imports for Japan. However, an increase in the world supply also induces a rise in the derived demand for inputs and intermediate products[9]. Therefore, this result is consistent if an increase in the world supply induces relatively

[9] There are some studies that find evidence for positive causality from imported imports to the productivity of exporters at the firm or plant level; Kasahara and Rodrigue (2008) for Chile, Goldberg et al. (2010) for India, Halpern et al. (2015) for Hungary, and Mo et al. (2021) for China. We are not arguing here for reverse causality but simply stating that increased productivity may expand the scope of imported inputs at the national level.

more demand for Japanese intermediate products than an increased import for Japan. For a more concrete example, productivity in China increases, and an associated increase in China's supply to North America and Europe may require inputs from Japanese manufacturers. Japan is one of the major imported-input sources for China's processed exports, i.e., final products that are processed using parts and components imported from the rest of the world, as shown in Thorbecke (2011). This example demonstrates that only exports of Japan rise, not imports.

Second, a world supply shock generates an increase in income balance with statistical significance for three quarters, from the third to the fifth. If we assume again that an underlying mechanism for an increase in the world supply is a rise in productivity, high pay-off dividends along enlarged profits of foreign corporations should increase income receipts for Japan[10]. The fact that there are a few quarter lags between realized productivity increase and realized dividend pay-off at the end of fiscal year is also well captured in the impulse response: a positive effect with statistical significance is not observed on the impact quarter and the next two quarters. It is noteworthy that this effect has economic significance; the size of the effect with respect to GDP is between two and six percent at the 90th percentile confidence interval.

Third, we observe that a world demand shock induces a negative effect on the trade balance, but marginally only in the sixth quarter. We will return to this point in the next subsection when more short-run zero restrictions are added to the FHN specification.

5.1.2 Yoshida-Zhai (YZ) specifications

Figure 6 provides impulse responses of structural shocks on the trade balance and income balance for the YZ specifications. In comparison with FHN specifications, partly due to the difference only existing in short-term zero restrictions, most of the impulse response shapes, i.e., including the median impulse response and confidence interval, are similar for YZ specifications. However, we also find additional evidence with YZ specifications that structural shocks matter for current account dynamics.

First, similar to the results for the FHN specifications, a world supply shock induces significant responses from both the trade balance and the income balance. Impulse response functions for both YZ and FHN are very similar, including the length of quarters in which impulse responses are statistically significant.

Second, the effect of a world demand shock on the trade balance is more

[10] By more than twelve quarters after the shock, however, there exists an opposite effect for a few quarters. This phenomenon is difficult to reconcile on theoretical grounds, but it may be capturing the cyclical nature of corporate profit of the sample period.

prominent in the YZ and is statistically significant between the fourth quarter and the seventh quarter, whereas it is marginally significant only for the sixth quarter in the FHN.

Third, Japan's demand shock generates a negative response from the income balance initially in the first two quarters and later in the period between the seventh and thirteenth quarters. If a demand shock represents an unexpected jump in current expenditure against future expenditures, the total wealth including both domestic and foreign assets is dissaved, and income flows from reduced foreign assets will be lower in future periods. Alternatively, a higher domestic demand uplifts the profit of firms and consequently higher dividend payments to foreign investors, resulting in a negative effect on income balance. Either way, the economic impact is not negligible in magnitude even within a quarter period, ranging from a two to three percent reduction in terms of GDP. Moreover, it has a prolonged effect up to more than two years.

Fourth, unlike the FHN specification results, an exogenous exchange rate shock, i.e., appreciation of the Japanese yen, generates positive impulse responses from the trade balance continuously for almost two years[11]. More specifically, impulse response is statistically significant from the first quarter to the eleventh quarter except for the sixth quarter. This is at odds with the classical Marshall-Learner condition in which the trade balance worsens with the appreciation of home currency when the price elasticity of demands is elastic and the initial trade balance is balanced. However, this is exactly what puzzled policymakers and economists in Japan when the trade balance continued to worsen, even after a huge drop in the value of the Japanese yen in the second Abe administration that began in 2012[12].

Finally, in the YZ, there are two more cases with statistically significant impulse responses; however, they are only marginally significant for a short period. Namely, a world demand shock has a positive effect on income balance in the first quarter, and a Japanese monetary policy shock has a negative effect on trade balance in the ninth quarter.

5.2 Impulse responses of other variables

[11] One of the explanations for a J-curve is the contract period, or the Magee effect, in which the price of invoice currency and transaction quantity are fixed, as written in a contract. However, this does not last for more than two years since contract terms can be renegotiated. Also, the exchange rate disconnect puzzle of Obstfeld and Rogoff (2000) questions only the causal relationship of macroeconomic fundamentals to exchange rate and not vice versa.

[12] Notably, the peculiar energy crisis situation in Japan after the Tohoku great earthquake in 2011. Because of anti-nuclear-power plant sentiment, the Japanese government increased its bulk purchases of LNG, which uplifted the import's value over the next few years. This period coincides with the depreciation episode of the Japanese yen.

The main objective of this paper is the dynamics of the current account, and we have discussed thus far only the effects of structural shocks on the trade balance and income balance. To provide a full assessment of SVAR models, we should also discuss the impulse responses of other variables in our SVAR models. The summarized results of the two specifications are provided in Table 3, and corresponding impulse response figures and discussions of these results can be found in the appendix figure as supplementary material.

6. Discussions and Robustness Checks

We set up a nine-variable SVAR model and examined impulse responses of the trade and income balance with respect to structural shocks for the period between the first quarter of 1996 and the fourth quarter of 2019. We carefully constructed a dataset and followed the preceding literature in estimating an SVAR model; however, we need to draw attention to some caveats in our paper and present the robustness check results. These caveats are the following: (i) the choice of financial variables; (ii) the global financial crisis in the sample period; and (iii) the exclusion of China's interest rate from the global interest rate.

We chose the short-term interest rate to represent monetary policy, or responses of monetary authority, to macroeconomic shocks. To circumvent the problem of unresponsiveness of the interest rate at zero or an effective lower bound, we apply the shadow interest rates of Krippner (2015) in this paper. However, there are other financial variables that may play important roles in explaining current account dynamics. For example, Caballero et al. (2008), with their theoretical model, propose that a sudden decline in the level of financial development in the rest of the world can trigger a permanent deficit in current accounts. The focus of their paper is to highlight "global imbalances" or a large US current account deficit; however, this financial shock in the model of Caballero et al. (2008) is considered to represent, among other global financial episodes, the bursting of the Japanese bubble economy in the early 1990s. The flip side of their study indicates that the financial problem in the 1990s should have a long-lasting effect of pushing the current account of Japan in surplus.

Similarly, several empirical studies, such as Bijsterbosch and Falagiarda (2015), Mallick and Sousa (2013), and Chiu et al. (2018), also consider other financial variables in empirical macroeconomic models. Bijsterbosch and Falagiarda (2015) investigate the macroeconomic impact of financial fragmentation in the euro area by analyzing the role of credit supply shocks. Mallick and Sousa (2013) examine the real effects of financial stress in the Euro zone. Chiu et al. (2018) also investigate the dynamic relationship between financial market volatility, macroeconomic fundamentals and investor sentiment.

In addition to domestic macroeconomic variables, financial market conditions are also known to affect capital flows, especially during financial crises. Foreign direct investment flows tend to increase as the size of a financial system, measured as stock market capitalization over GDP, increases in both a source country (Di Giovanni, 2005) and a host country (Desbordes and Wei, 2017). Fratzscher (2012) finds that a country with a high financial institutional quality often successfully insulates its capital flows from negative shocks during a global financial crisis[13]. Nonetheless, when our model is viewed as Japan versus the rest of the world, then the capital flows associated with Japanese asset holders, on a global scale, only affect Japan's income balance through a change in country composition rather than the size of total foreign assets. It would be interesting for a future work to investigate the effect of a composition-change channel induced by capital flows on an income balance.

Our choice of interest rate to represent financial condition may not be the best case, and it would be desirable to re-estimate the model with other financial variables. However, with an SVAR model, we cannot simply replace one variable with another; we need to develop another set of restriction specifications based on concrete theoretical models or convincing observable episodes. With more emphasis on Japan's peculiar unconventional monetary policy conducted during the sample period in this study, we chose the short-term shadow interest rate as a key financial variable in our SVAR model.

Inclusion of the global financial crisis in our sample should warrant caution about interpreting overly sensitive responses of the trade balance. One of consequences of the global financial crisis is the 'great trade collapse', i.e., a sharp decline in world trade more than proportionately with a downturn in the world economy. During the great trade collapse, world productivity declined while entering a recession, and global trade shrank; this is captured as a positive response of Japan's trade balance to a world supply shock. It would have been desirable to split the sample into pre-crisis, during-crisis, and post-crisis periods if it were not for the small degree of freedom due to our model having nine variables with four lags.

Contradicting our prior expectation that exchange rate shocks affect income balance, neither the FHN nor YZ specification finds supporting evidence. We suspect that the use of an effective exchange rate based on trade weights may not correctly capture the effect on countries with a larger debt to and a lesser trade with Japan. As a robustness check, we constructed an alternative nominal effective exchange rate with Japan's outstanding foreign assets as of 2017 as the weight, following the research of Bénétrix et al. (2015). With this alternative exchange rate, we find a significant effect of exchange rate shock on income balance on the impact, leaving the qualitative results regarding the remaining parts unchanged.

Regarding the monetary policy rate of the world in this paper, we solely used those countries that adopted the zero lower bound interest rate policy and omitted many

[13] Forbes and Warnock (2012) find that the same measure of financial size does not have any significant relationship with extreme episodes of capital flows, i.e., surges, flights, or retrenchments.

developing countries. Nevertheless, with the combination of US and Euro zone countries, these limited sample countries make up a large portion of Japan's trade partners. However, one concern remains about not including China. As a robustness check, we reconstructed the world interest rate as the weighted average of six countries (including Euro zone countries) and China. We estimated an SVAR model with the modified world interest rate and constructed impulse response functions. The results with world interest rates including China are qualitatively similar to those without China except for a few effects. For the FHN specification, a marginal effect of the world demand shock on the trade balance disappears. For the YZ specification, we obtain new evidence on the effect of exchange rate shocks on income balance. The impact effect is positive with statistical significance, and after 10 quarters, it has a small but lingering negative effect.

7. Conclusion

Japan has endured decades of low economic growth and low or zero inflation, or even deflation, after the bursting of the bubble in the early 1990s despite the efforts made by the Japanese government and central bank to boost the economy, including the first introduction in the world of unconventional monetary policy. After the global financial crisis and the natural disasters of earthquakes and tsunamis, we witnessed a halt to the long-lasting trade balance surplus in Japan. How effective, if at all, was monetary policy or the effective exchange rate of the Japanese yen during the last few decades in helping to boost the economy of Japan or sustain the current account in surplus? To answer these questions, we estimate the SVAR of the Japanese economy with nine variables. Unfortunately, our finding does not support the view that ZLB or ELB monetary policy had positive feedback to the Japanese economy or current account.

More specifically, the monetary policy shocks of either Japan or the world do not affect the trade balance or income balance of Japan. By lowering the interest rate in Japan or raising the interest rate overseas, monetary policy shocks should induce a lower return on Japanese sovereign bonds held by foreigners and a higher return on foreign sovereign bonds held by Japan. However, this effect of monetary policy shocks cannot be captured in our SVAR estimation. This may be a side effect of applying the shadow rate in the SVAR model; a negative shadow rate is not directly linked to the nominal coupon rate of sovereign bonds.

Surprisingly, to prior expectations on the effects of exchange rate shocks, we find significant effects on the current balance only for YZ specifications. This insignificant result for exchange rate shocks in the FHN specification might be due to the use of quarterly frequency adapted in this study; the volatile nature of exchange rate shocks might be over-smoothed by using quarterly averages.

The most robust result is that the global factor is much more influential than the domestic factor for Japan's current account dynamics. Specifically, the world's supply shock affects both the trade balance and income balance in both the FHN and YZ specifications. The world's demand shock affects both the trade balance and income balance, especially with YZ specifications. However, Japan's demand shock affects only the income balance when the YZ specification is used. Japan's supply shock, on the other hand, is not associated with the dynamics of either the Japanese trade balance or the Japanese income balance.

The contributions of this paper to the literature are threefold. First, by constructing the dataset for Japan, we applied the extended model of Forbes et al. (2017) to the Japanese economy, and we examined whether monetary policy and exchange rate have affected the current account dynamics over the last two decades. Second, we introduced trade balance and income balance simultaneously in an SVAR model. Third, we proposed additional short-run zero restrictions to represent the sluggish responses of some macroeconomic variables in quarterly frequency, and we found more significant cases in impulse responses with this proposed specification than the original one.

Appendix table. The list of variables

(a) Exports and imports: goods & services, seasonally adjusted, 100 million yen, Japan's Balance of Payments, Ministry of Finance, Japan. (b) Primary income debit and asset: seasonally adjusted, 100 million yen, Japan's Balance of Payments, Ministry of Finance, Japan. (c) Exchange rate: nominal effective exchange rate index, IFS. (d) Japan’s interest rate: Japan’s shadow rate from Krippner (2015) and his website. (e) World interest rate: US shadow rate from Krippner (2015) and his website. (f) Price: consumer price index, all items, IFS. (g) World price: weighted average of consumer price index with weight being the sum of trade with Japan’s top twenty-one trade partners. (h) Real gross domestic product, expenditure approach, reference chained, seasonally adjusted, domestic currency, IFS. (i) Sum of exports and imports with Japan, annual, UN Comtrade, UN. (j) World GDP: weighted average of real gross domestic product with weight being the sum of trade with Japan’s top twenty-one trade partners. Nominal gross domestic products are converted to the real GDP index for Brazil, China, India, Indonesia, Mexico, Thailand, and the UK. Real gross domestic product is also normalized to become an index.

Appendix Figure. The impulse responses of the other seven variables.

See the figures in the supplementary file.

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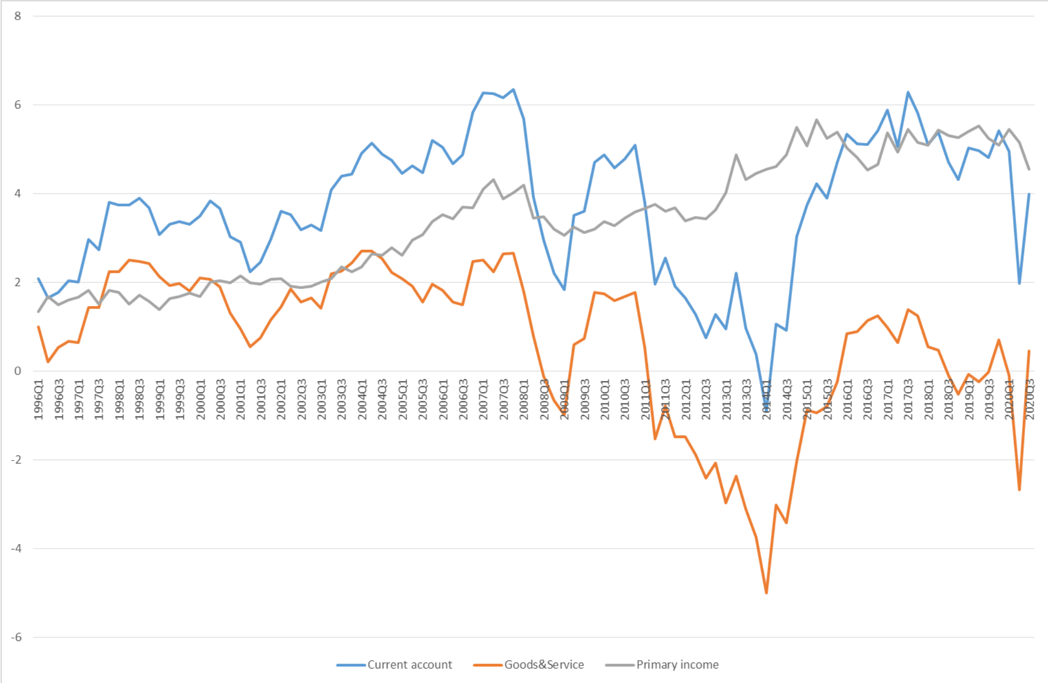
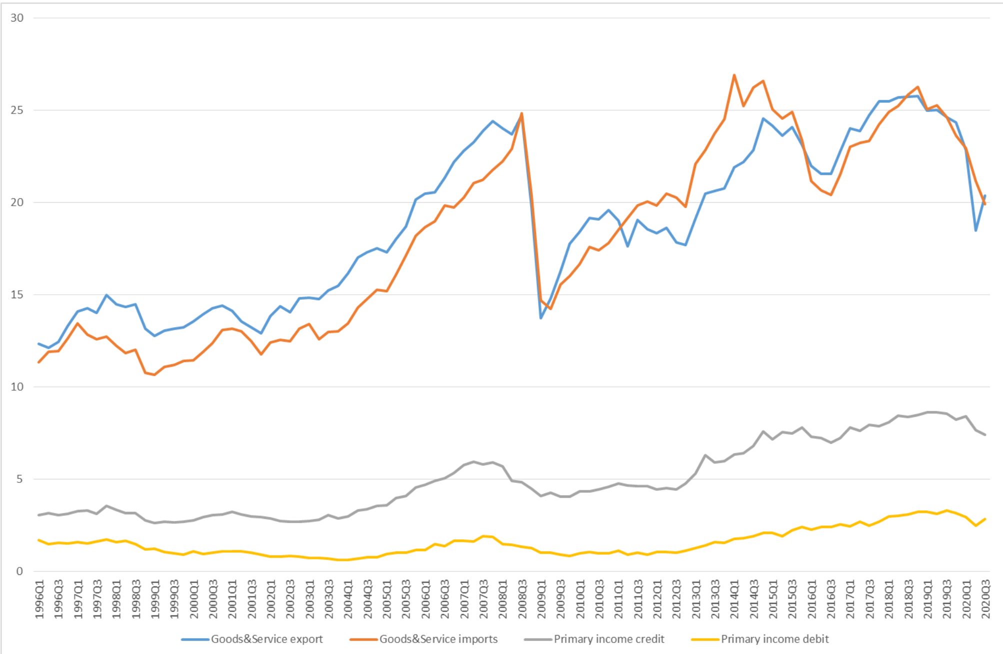
Figure 1. Japan’s current account, trade balance, and primary income balance



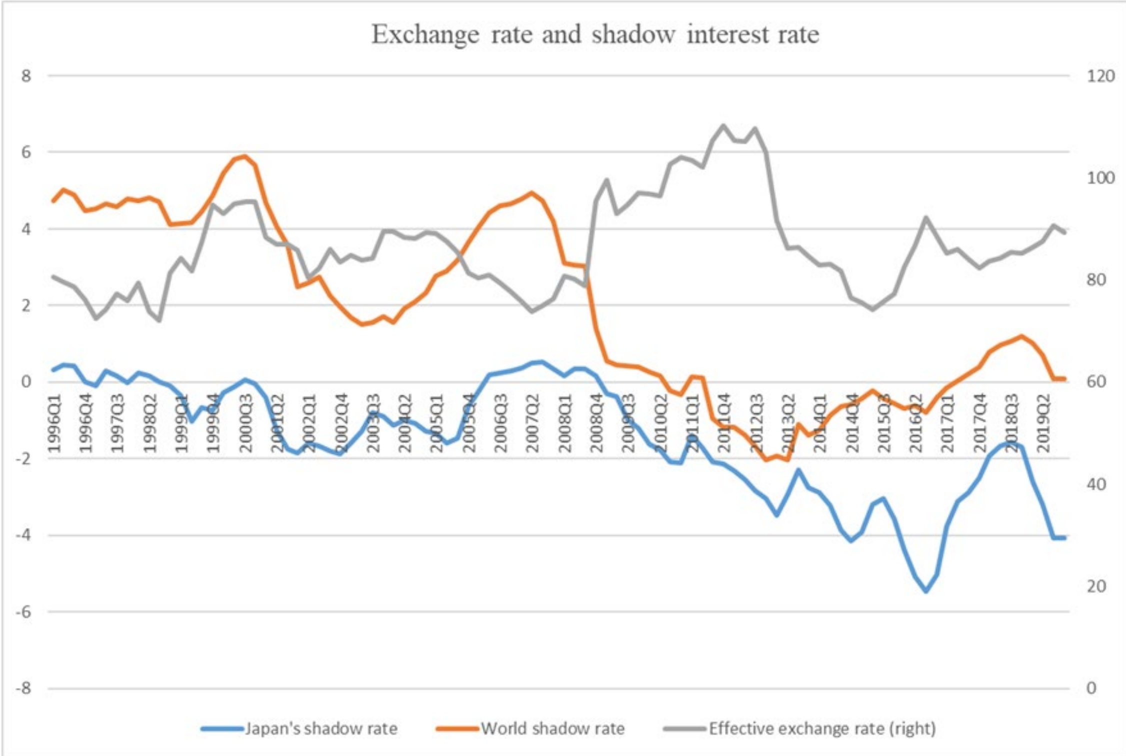
Note: The sample is from 1996:Q1 to 2019:Q4. Both the trade balance and primary income balance are seasonally adjusted.

Figure 2. Japan’s export, import, income receipt, and income payment



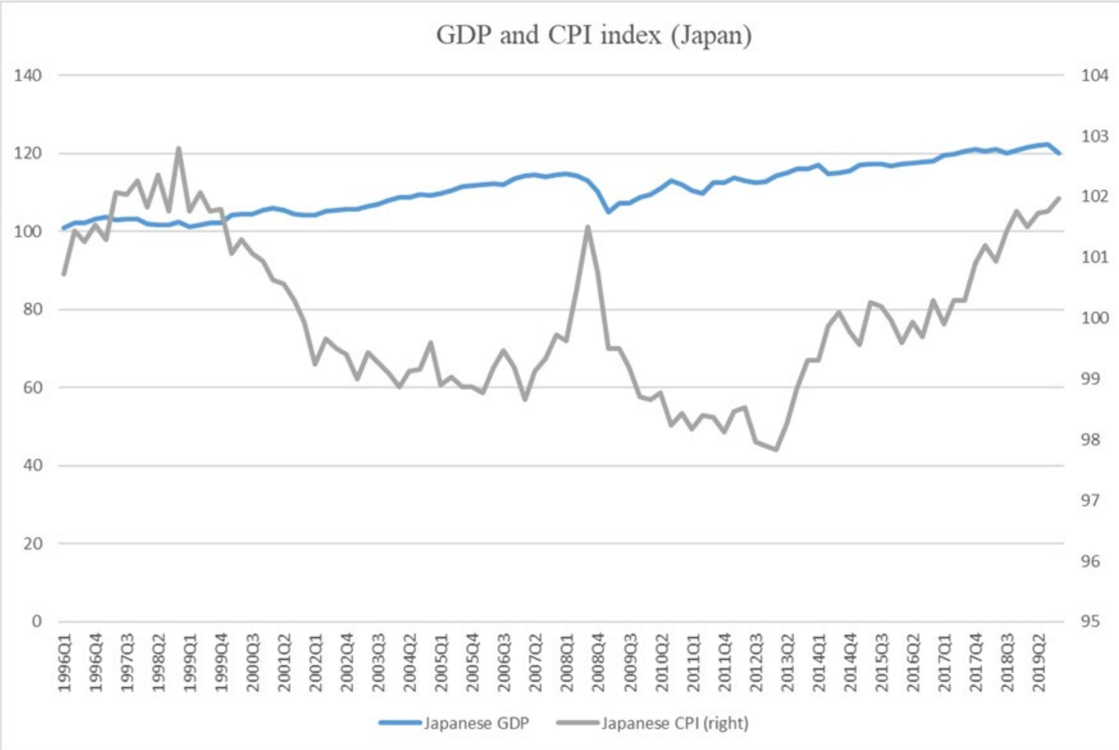
Note: The sample is from 1996:Q1 to 2019:Q4. All series are seasonally adjusted.

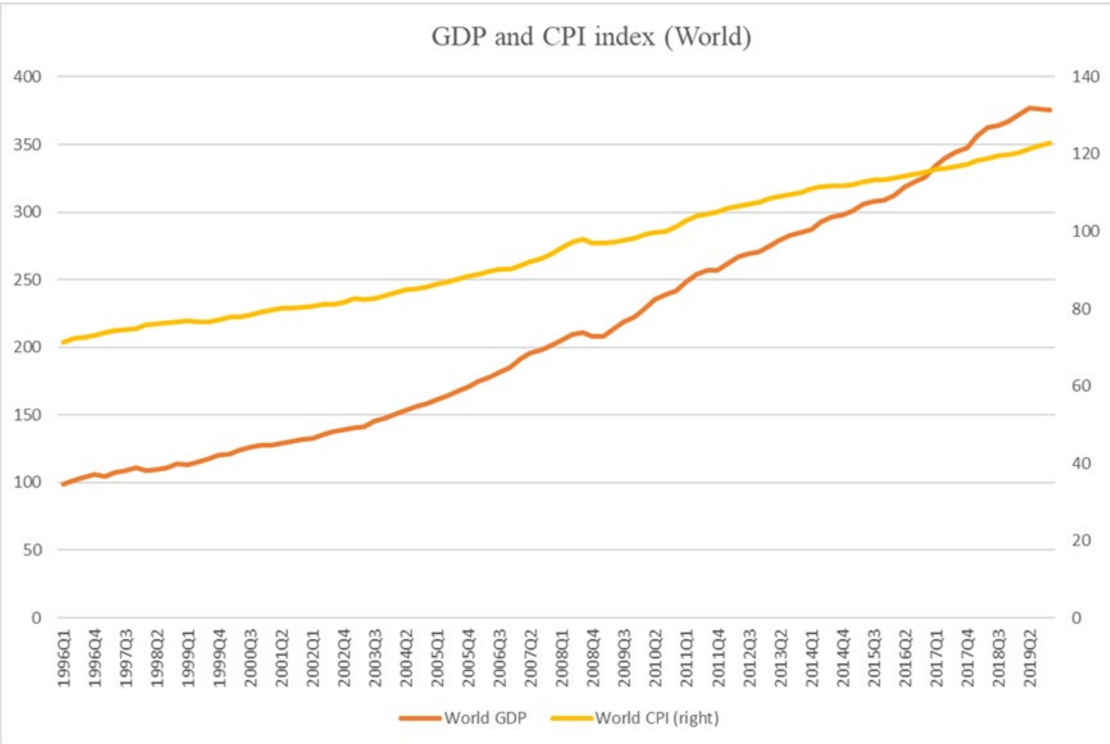
Figure 3. Exchange rate and shadow interest rates



Note: Shadow interest rates are taken from Krippner's website. Daily rates are averaged over quarter. The nominal effective exchange rate on the right vertical axis is defined such that an increase indicates appreciation of the Japanese yen.

Figure 4. Gross domestic products and consumer price index





Note: Top (bottom) panel shows gross domestic product and consumer price index of Japan (world). The consumer price index is scaled on the right vertical axis.

Figure 5. Impulse response functions of trade and income balance, FHN restrictions

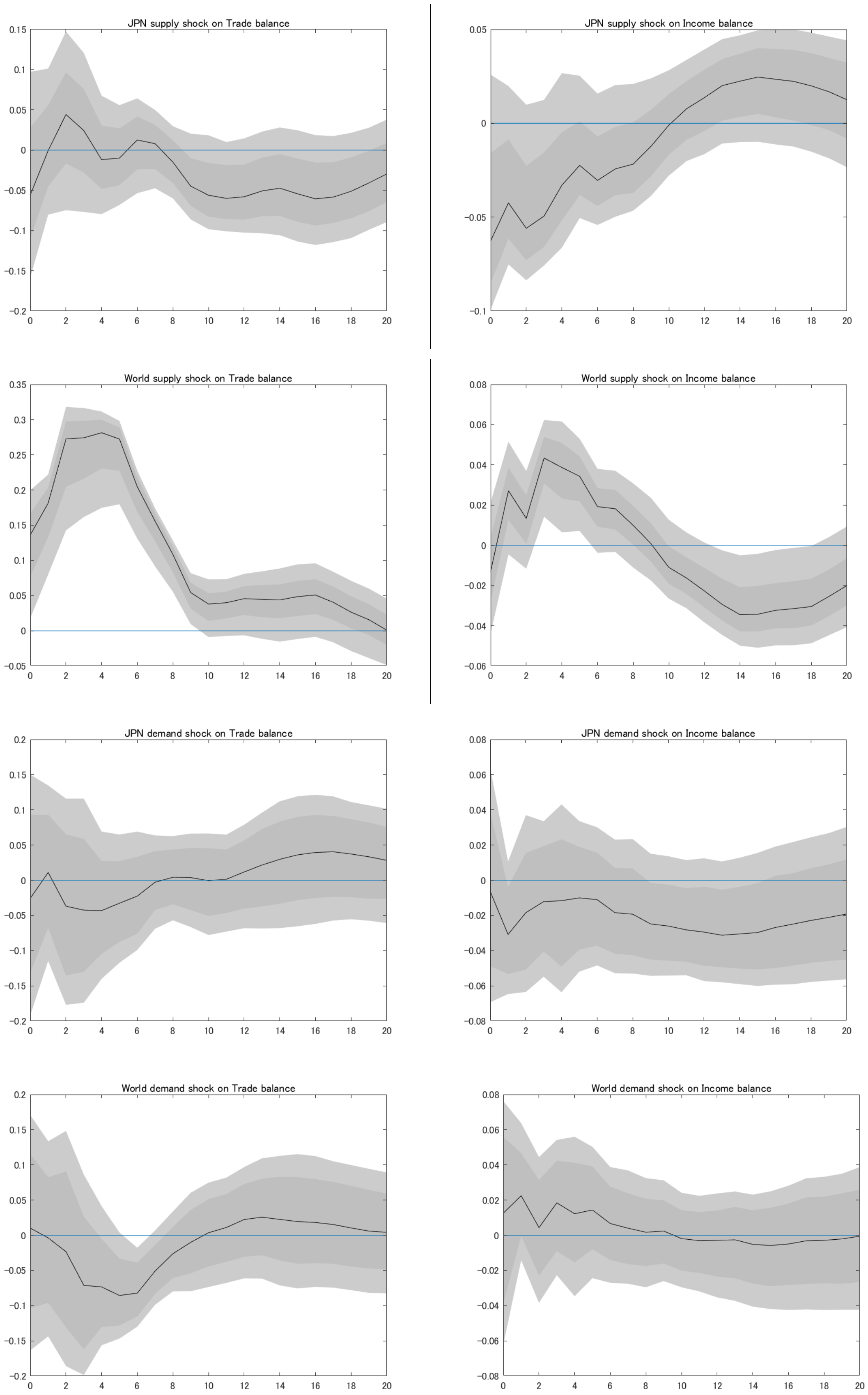
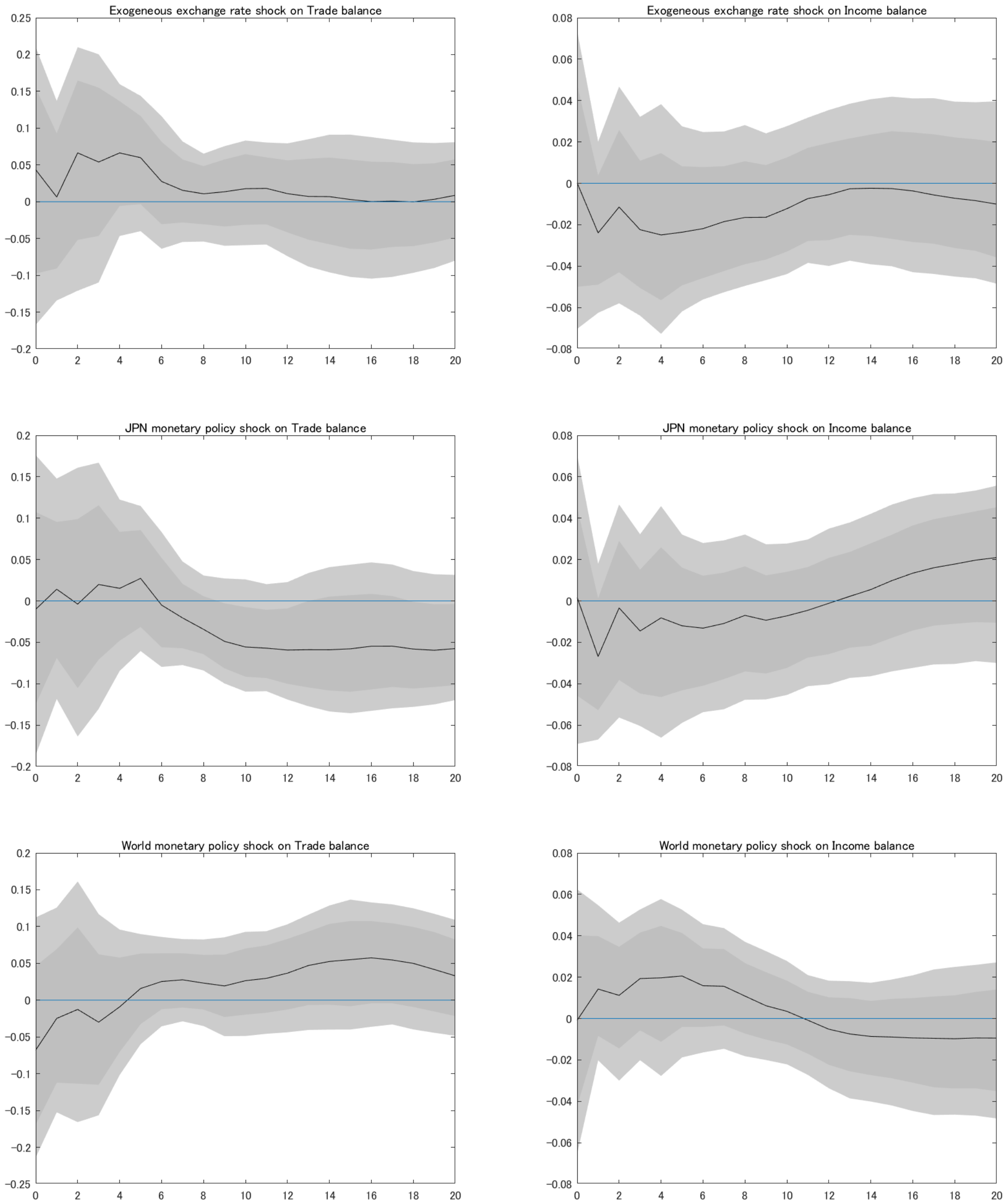


Figure 5. Impulse response functions of trade and income balance, FHN restrictions (continued)



Note: The median value of 1,000 responses at each quarter is shown as a solid black line. The dark gray area represents the 68 percent interval, and the light gray area covers the 90 percent interval of 1,000 responses.

Figure 6. Impulse response functions of trade and income balance, Yoshida and Zhai restrictions

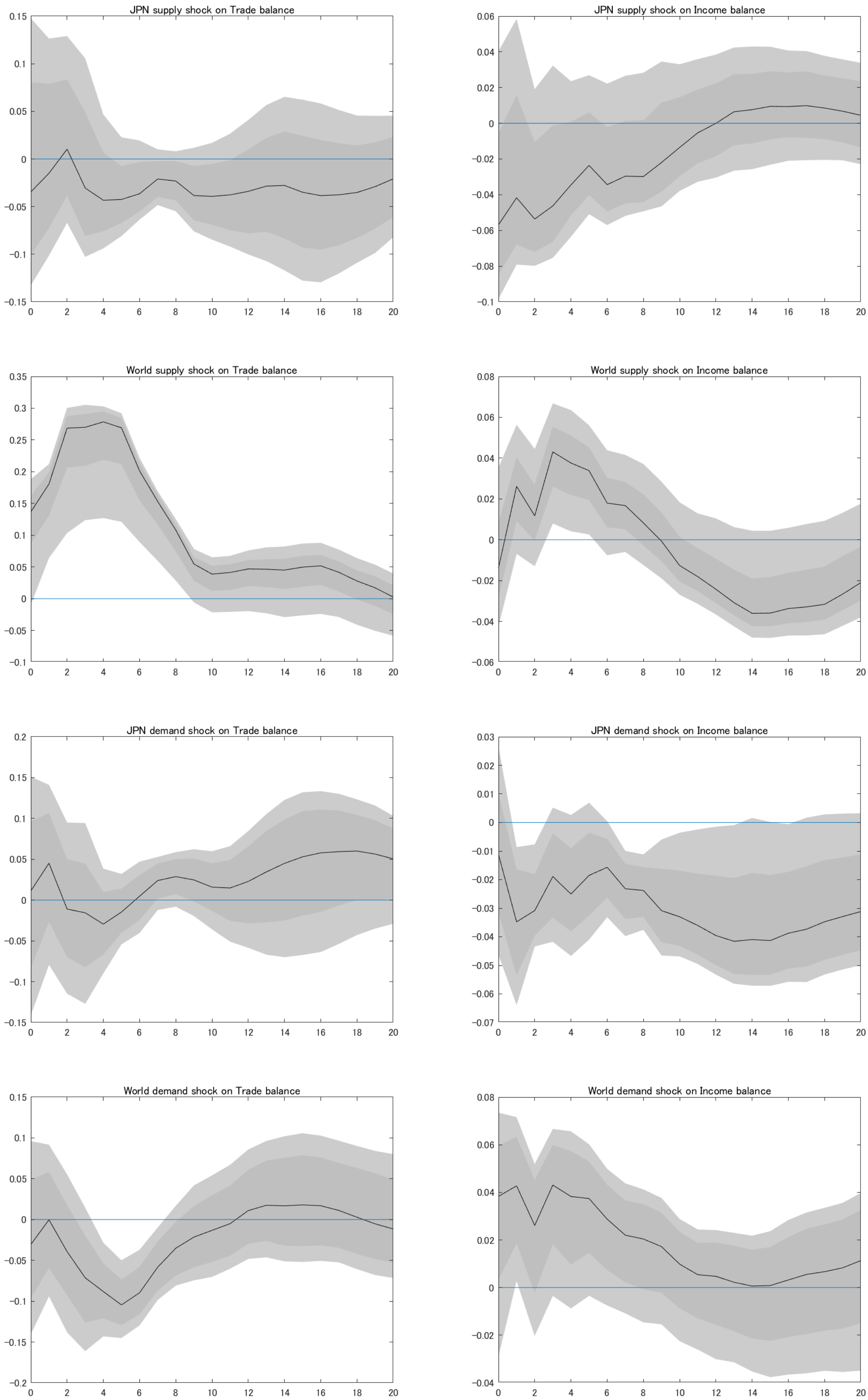
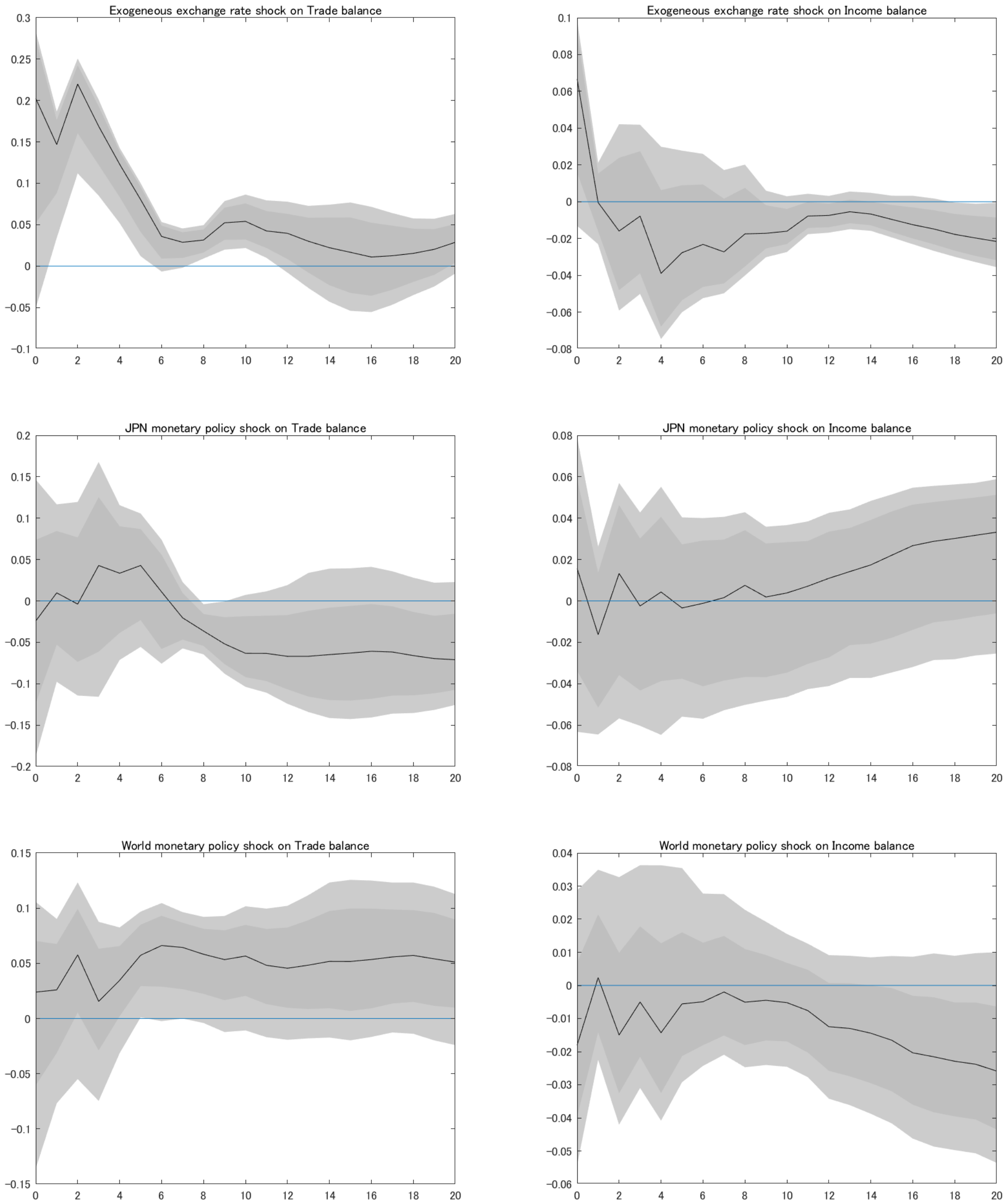


Figure 6. Impulse response functions of trade and income balance, Yoshida and Zhai restrictions (continued)



Note: The median value of 1,000 responses at each quarter is shown as a solid black line. The dark gray area represents the 68 percent interval, and the light gray area covers the 90 percent interval of 1,000 responses.

Table 1. Zero and sign restrictions for the modified Forbes-Hjortsoe-Nenova (FHN) specifications

Shocks	JPN supply	World supply	JPN demand	World demand	Exchange rate	JPN monetary policy	World monetary policy
Forbes-Hjortsoe-Nenova							
Short-run restriction							
Trade balance							
Income balance							
JPN GDP	+		+			-	
World GDP		+		+			-
JPN CPI	-		+		-	-	
World CPI		-		+			-
Exchange rate			+	-	+	+	-
JPN shadow rate			+		-	+	
World shadow rate				+			+
Long-run restriction							
Trade balance							
Income balance							
JPN GDP		0	0	0	0	0	0
World GDP	0		0	0	0	0	0
JPN CPI							
World CPI							
Exchange rate							
JPN shadow rate							
World shadow rate							

Note: Short-run zero and sign restrictions are indicated in the top panel by ‘0’, ‘-’, and ‘+’ on the impact of shock. Long-run restrictions are indicated by ‘0’ in the bottom panel.

Table 2. Zero and sign restrictions for the Yoshida and Zhai (YZ) specifications

Shocks	JPN supply	World supply	JPN demand	World demand	Exchange rate	JPN monetary policy	World monetary policy
Yoshida and Zhai							
Short-run restriction							
Trade balance							
Income balance							
JPN GDP	+		+		0	-	0
World GDP	0	+	0	+	0	0	-
JPN CPI	-		+		-	-	
World CPI	0	-	0	+			-
Exchange rate			+	-	+	+	-
JPN shadow rate			+		-	+	
World shadow rate				+	0		+
Long-run restriction							
Trade balance							
Income balance							
JPN GDP		0	0	0	0	0	0
World GDP	0		0	0	0	0	0
JPN CPI							
World CPI							
Exchange rate							
JPN shadow rate							
World shadow rate							

Note: Short-run zero and sign restrictions are indicated in the top panel by ‘0’, ‘-’, and ‘+’ on the impact of shock. Long-run restrictions are indicated by ‘0’ in the bottom panel.

Table 3. Summary of impulse responses of Forbes-Hjortsoe-Nenova (FHN) and Yoshida-Zhai (YZ) specifications

(Shocks)	JPN supply		World supply		JPN demand		World demand		Exchange rate		JPN monetary policy		World monetary policy	
Trade balance			F(+)	Y(+)			F(-)	Y(-)		Y(+)		Y(-)		
Income balance			F(+,-)	Y(+)		Y(-)		Y(+)		Y(-)				
JPN GDP	F(+,-)	Y(+)	F(+,-)	Y(+,-)	F(+)	Y(+,-)		Y(+,-)	F(-)	Y(+,-)	F(-)	Y(-)		Y(+,-)
World GDP	F(+)	Y(+,-)	F(+,-)	Y(+,-)		Y(-)	F(+,-)	Y(+,-)		Y(+,-)			F(-)	Y(+,-)
JPN CPI	F(-)	Y(+,-)	F(+,-)	Y(+,-)	F(+)	Y(+)		Y(+)	F(-)	Y(+,-)	F(-)	Y(-)	F(-)	Y(+,-)
World CPI	F(+,-)	Y(-)	F(+,-)	Y(+,-)			F(+,-)	Y(+,-)		Y(+,-)	F(+)	Y(+)	F(+,-)	Y(+,-)
Exchange rate	F(-)		F(+,-)	Y(+,-)	F(+)	Y(+)	F(-)	Y(-)	F(+)	Y(+,-)	F(+,-)	Y(+,-)	F(-)	Y(+,-)
JPN shadow rate	F(-)		F(+)	Y(+)	F(+)	Y(+)		Y(+,-)	F(-)	Y(+,-)	F(+)	Y(+)		Y(+,-)
World shadow rate	F(-)		F(+,-)	Y(+,-)			F(+)	Y(+)		Y(+)			F(+)	Y(+)

Note: Statistically significant impulse responses of the Forbes-Hjortsoe-Nenova (FHN) model and Yoshida-Zhai (YZ) model are represented by F and Y, respectively. Signs in parentheses indicate the signs of effects of structural shock on the corresponding variables.