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Macroeconomic Effects of Global Policy and Financial Risks※

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Abstract

Globalization has brought larger spillovers of global risks across borders since the 2000s. Specifically, global policy risk has sharply increased due to policy uncertainty in major countries in the recent decade, as seen in Brexit, US-China trade friction, and the COVID-19 pandemic. This paper empirically investigates the effects of both global policy risk and global financial risk on macroeconomy and financial markets in eight major countries from January 1997 to June 2020. We employed a Vector Autoregressive (VAR) framework to obtain interesting empirical results. First, global risks have recessionary effects on the macroeconomy, reducing production, deteriorating employment, lowering long-term interest rates, depressing prices, and reducing global trade. Second, global risks also have recessionary effects on financial markets, reducing stock prices, appreciating safe-haven currencies, and depreciating the other currencies. Third, the macroeconomies and the financial markets respond to global financial risk more significantly than global policy risk. Fourth, the recessionary effects of global risks vary depending on countries.

Keywords: global policy risk, global financial risk, macroeconomic effects, exchange rate, VAR

JEL classification: E66, F31, G18

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1. Introduction

In the recent decade, there has been an increased emphasis on the effects of global risks on countries' macroeconomy and financial markets due to globalization. As globalization brings development in the global value chain and more integrated financial markets, it also leads to larger spillovers of global risks across borders. Traditionally, several attempts have been made by researchers and policymakers to focus on the effects of global financial risk on macroeconomy after the Global Financial Crisis. The effects of global policy risk on macroeconomy have drawn increasing concerns due to a surge in global policy uncertainty in recent years as are shown in the Brexit, the US-China trade friction, and the COVID-19 pandemic. However, what remains unclear is how differently global risks affect macroeconomy and financial markets in each country. Therefore, this paper has a primary objective to investigate the effects of both global policy risk and global financial risk on major countries' macroeconomy from 1997 to 2020. Further, this paper compares the effects of global risks on countries' macroeconomy to analyze how differently each country responds to both of the global risks.

Though the global economy has gradually recovered from the Global Financial Crisis during the last decade, it has recently shown signs of a great worldwide recession. Its direct cause is the breakout of the COVID-19 pandemic from early 2020, which lead to a crash down in global value chains and domestic industrial productions. Further, the intensifying US-China trade friction has become a full-scale opposition in the US-China trade, international relations, and high technology industries. As a result, the economic policy response to the COVID-19 pandemic, including quantitative easing monetary policy and active fiscal policy, and the US-China trade friction heating move up the global economic uncertainty.

The sharply increasing global policy risk brings some urgent questions about the effects of global risks on the macroeconomy. Firstly, the effects of global risks on the macroeconomy need to be analyzed and compared among economic indicators. Much previous literature found asymmetric impacts of global risks on different economic indicators. Some researchers (Baker, Bloom, and Davis 2016; Jurado, Ludvigson, and Ng 2015; Berger, Grabert, and Kempa 2016) found similar recessionary effects on some macroeconomic indicators, e.g., industrial productions and consumption. On the other hand, Meinen and Roehe (2017) found asymmetric results in some important economic indicators, e.g., exchange rates and prices.

Moreover, the Economic Policy Uncertainty (EPU) Index and the Global EPU (GEPU) Index calculated from the EPU Index provide a new measurement to explore the effects of policy risks on the macroeconomy. These indicators help us understand the different macroeconomic responses to global policy risk and domestic policy risk. Lastly, differences in countries' macroeconomic responses to global policy risk and global financial risk need to be analyzed, mainly depending on various economic structures and economic policy responses. For example, one country which profoundly depends on global trade tends to be more sensitive to global risks.

This paper employs VAR models to investigate the effects of both global policy risk and global financial risk on macroeconomy and financial markets in eight major countries, which include Canada, China, Germany, France, Japan, Korea, the United Kingdom, and the United States, during an analytical period from January 1997 to June 2020. A country-specific Global Economic Policy Uncertainty index and the Financial Stress Index (FSI) represent global policy risk and global financial risk. The empirical results show the recessionary effects of global policy risk and global financial risk on most major countries' macroeconomy. Moreover, these effects vary depending on countries.

The rest of this paper organizes as follows. Chapter 2 summarizes previous literature regarding measurements of global risks and their macroeconomic effects. Chapter 3 provides the empirical methodology. Chapter 4 describes the data employed in the empirical analysis. Chapter 5 reports and discusses the empirical results. Chapter 6 concludes and provides policy implications.

2. Previous literature on global risk measurement and its macroeconomic effects

In general, the term "risk" refers to the extent to which what happens deviates from the expectation, the degree to which the outcome is unpredictable, or the likelihood that it will not work as expected. The "global risk" refers to the risk of adversely affecting multiple countries and regions in the world when an event occurs. The World Economic Forum (2019) defined a global risk as '*an uncertain event or condition that, if it occurs, can cause a significant negative impact on several countries or industries within the next ten years*.' Gai and Vause (2004) suggested measuring global financial risk by investors' risk appetite because investors become risk-averse, or risk-off, responding to a more uncertain financial market. At the same time, they take more risk appetite, or risk-on, when the uncertainty in the financial market decrease.

Since the investors' risk appetite could represent the financial market risk, many indicators have been proposed in the literature for quantifying the evolution of investors' general risk appetite (Illing and Aaron 2005). Among the risk appetite indicators, the VIX index is a representative market-based indicator representing the risk appetite, calculated by the implied volatility of the S&P 500 index for the next 30 days. Due to broad and robust spillovers from the US stock market to stock markets worldwide, the VIX index is also widely employed as a global risk appetite indicator in the previous literature (Koepke 2019; Ogawa, Shimizu, and Luo 2019). Besides the VIX index, some investor risk appetite indicators are also widely used, e.g., JP Morgan's Risk Tolerance index, the Citi Macro Risk Index, and the Morgan Stanley Global Risk Demand Westpac Risk Aversion Index, and the UBS G10 Carry Risk Index. Furthermore, uncertainty could be measured in other ways, such as financial market volatility (Bloom 2009), forecast errors regarding macroeconomic data (Jurado, Ludvigson, and Ng 2015).

Besides the market-based risk appetite indicators, the uncertainty (or the risk) in the economic policies have been paid more attention to. The leading indicator for measurement of uncertainty in the economic policies is the Economic Policy Uncertainty (EPU) index developed by Baker, Bloom, and Davis (2016), which calculates the number of reports or articles in popular newspapers reporting the economic policy uncertainty at a country level. An upward movement in the EPU index is observable when the economic policy uncertainty increases. Building on Baker, Bloom, and Davis (2016), Davis (2016) constructed a monthly index of Global Economic Policy Uncertainty (GEPU) index, which is a GDP-weighted average of national EPU indexes to measure global policy uncertainty.

The EPU and GEPU indexes are currently widely employed to analyze the effect of economic policy uncertainty on financial asset prices and the macroeconomy. For instance, Arouri *et al*. (2016) found that the increasing economic policy uncertainty in the United States significantly lowers stock prices in the United States. An increase in policy uncertainty significantly lowers stock prices in a long-run period during 1900–2014. Some scholars found that the EPU and GPEU indexes negatively affect foreign financial asset prices, such as the Islamic bond yield (Naifar and Hammoudeh 2016) or a crypto-asset Bitcoins (Wang et al. 2019).

Furthermore, the previous literature found apparent uncertainty spillovers around the world. Higher risk in such major countries as the United States will lead to a higher risk globally. Castelnuovo (2019) investigated that the uncertainty spillover on the global scale became larger and widely due to the financial liberalization in the developing countries and the deepening international division in the global trade. Ogawa, Shimizu, and Luo (2019) employed the Federal Fund futures as a proxy of uncertainty on the monetary policy in the United States to find its significant adverse effect on the portfolio capital flows into the emerging market countries during the period of the recent interest rate hike in the United States. Colombo (2013) found that a jump in the policy economic uncertainty in the United States exerted a significant effect on the macroeconomy, such as inflation and output in the Eurozone.

Last, some points are worthy of being carefully analyzed when we focus on the effects of the global risk by country. First, as Berger, Grabert, and Kempa (2016) mentioned, the global risk is a significant driver of the macroeconomy and business cycles, whereas the impact of domestic uncertainty is small and frequently significant. Most literature mentioned that the global risk has a recessionary effect on the domestic economies, such as production, trade, employment. On the contrary, Meinen and Roehe (2017) argued that inflation response to uncertainty shocks is uncertain, especially in countries implementing a robust quantitative easing monetary policy. Secondly, the effects of global risks in different measurements or different fields on the macroeconomy are differentiated. For example, Jurado, Ludvigson, and Ng (2015) estimated the effects of the VIX index and the forecast errors about the macroeconomic indicators on macroeconomic indicators such as production and employment in the United States. They found that the latter one had a more substantial effect than the former one. Besides, the empirical findings of Ludvigson, Ma, and Ng (2016) show that shocks to both macroeconomic and financial uncertainty are found to be recessionary to macroeconomies. Thirdly, the macroeconomic effects of global risks depend on states and economic structures. Cacciatore and Ravenna (2020) analyzed the effects of uncertainty shocks on labor markets and showed that these effects are state-dependent, implying higher uncertainty can substantially deepen a recession. Further, Castelnuovo (2019) investigated that the real effects of uncertainty shocks are more substantial in developing countries than developed countries because developing countries have more volatile business cycles.

3. Methodology on analyzing macroeconomic effects of global risks

This paper employs Vector Autoregressive (VAR) models to analyze the effects of global policy risk and global financial risk on macroeconomic variables, including prices, production, employment, and global trades. Based on such previous literature as Baker, Bloom, and Davis (2016) and Jurado, Ludvigson, and Ng (2015), we construct 9-variables VAR models as follows:

9-variables VAR Model

$$\begin{pmatrix} global\ risk_t \\ domestic\ risk_t \\ NEER_t \\ Interest_t \\ Stock_t \\ CPI_t \\ IP_t \\ Unemp_t \\ Trade_t \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \\ \mu_5 \\ \mu_6 \\ \mu_7 \\ \mu_8 \\ \mu_9 \end{pmatrix} + A(L) \begin{pmatrix} global\ risk_{t-1} \\ domestic\ risk_{t-1} \\ NEER_{t-1} \\ Interest_{t-1} \\ Stock_{t-1} \\ CPI_{t-1} \\ IndusPro_{t-1} \\ Unemp_{t-1} \\ Trade_{t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \\ \varepsilon_{7t} \\ \varepsilon_{8t} \\ \varepsilon_{9t} \end{pmatrix} \quad (1)$$

where $global\ risk_t$ is a global risk indicator, $domestic\ risk_t$ is a domestic risk indicator, $NEER_t$ is the nominal effective exchange rate, $Interest_t$ is the long-term interest rate, $Stock_t$ is the domestic stock price index, CPI_t is consumer price index measuring the prices level in an economy compared to a base period, IP_t is industrial production compared to a base period, $Unemp_t$ is the unemployment rate, and $Trade_t$ is total goods trade summing goods export and import. μ_i is the constant. $A(L)$ is a lag operator. ε_{it} is error term at time t. Here we define two types of risks（the policy risk and the financial risk）for the global economy and domestic economy.. We employ sample country data to estimate the country variation in effects of global risks on the macroeconomy.

Firstly, a country-specific Global Economic Policy Uncertainty index (cGEPU) and the EPU index are employed to measure global and domestic policy uncertainty. Though the GEPU index has been widely employed as a global policy indicator, it is necessary to modify GEPU into a new form to represent the external policy risk to specific countries, to identify the global and domestic policy risks. Since Davis (2016) calculated the GEPU index by taking the GDP-weighted average of 23 sample countries' EPU index, this study revises the GEPU to a country-specific GEPU (cGEPU) index by excluding the domestic policy uncertainty from the GEPU index to avoid the endogeneity between the GEPU and the EPU indexes as follows:

$$cGEPU_{i,t} = \sum_{j}^{22} \omega_{j,t} EPU_{j,t}$$

$$\forall \quad j \neq i \tag{2}$$

where the $cGEPU_{i,t}$ is country-specific GEPU index of country i, $\omega_{j,t}$ is PPP-adjusted GDP weight for country j, $EPU_{j,t}$ is EPU index for country j. Eq. (2) shows that for all $j \neq i$, the country-specific GEPU ($cGEPU_{i,t}$) is calculated by a GDP-weighted average of 23 countries' EPU indexes[1] except for country i. Hence, Eq. (1) is rewritten as the following form in Eq. (3) to analyze the macroeconomic effects of global policy risk as follows:

Model A

$$\begin{pmatrix} cGEPU_t \\ EPU_t \\ NEER_t \\ Interest_t \\ Stock_t \\ CPI_t \\ IP_t \\ Unemp_t \\ Trade_t \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \\ \mu_5 \\ \mu_6 \\ \mu_7 \\ \mu_8 \\ \mu_9 \end{pmatrix} + A(L) \begin{pmatrix} cGEPU_{t-1} \\ EPU_{t-1} \\ NEER_{t-1} \\ Interest_{t-1} \\ Stock_{t-1} \\ CPI_{t-1} \\ IndusPro_{t-1} \\ Unemp_{t-1} \\ Trade_{t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \\ \varepsilon_{7t} \\ \varepsilon_{8t} \\ \varepsilon_{9t} \end{pmatrix} \tag{3}$$

where $cGEPU_t$ is country-specific GEPU calculated by Eq. (2), EPU_t is the EPU index, and the other variables follow the same settings with Eq. (1).

To address the concerns about newspaper reliability, accuracy, basis, and consistency of the EPU index to represent the domestic policy risk, Baker, Bloom, and Davis (2016) compared the EPU index with other measurements of economic policy uncertainty and conducted an extensive audit study of randomly selected newspaper articles. The results show that the EPU index has high correlations with other policy uncertainty indicators and human-generated indexes (0.86 in quarterly data and 0.93 in annual data), showing high reliability to represent the domestic policy risk. Further, comparing with the GEPU index by Davis (2016), the cGEPU index is a more precise measurement of global policy risk to one country by taking the GDP-average of EPU indexes in other countries. It helps handle the endogeneity problem between the EPU and GEPU indexes. Hence, the EPU and cGEPU indexes are reliable to represent the domestic (internal) and global (external) policy risks to countries.

Further, we define another form of VAR model to analyze the macroeconomic effects of global

[1] Australia, Brazil, Canada, Chile, China, Colombia, France, Germany, Greece, India, Ireland, Italy, Japan, Mexico, the Netherlands, Russia, South Korea, Spain, Sweden, the United Kingdom, and the United States

financial risk. The Financial Stress Index (FSI) developed by the Office of Financial Research (OFR) measures the common risk factors from multiple financial market indicators in multiple regions, including both the developed and the developing countries. It is a popular global financial risk indicator. Meanwhile, the implied volatility index is a widely used indicator for domestic financial risk, representing investors' risk appetite. Hence, the basic VAR model in Eq.(1) is reformed as follows:

Model B

$$\begin{pmatrix} FSI_t \\ IV_t \\ NEER_t \\ Interest_t \\ Stock_t \\ CPI_t \\ IP_t \\ Unemp_t \\ Trade_t \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \\ \mu_5 \\ \mu_6 \\ \mu_7 \\ \mu_8 \\ \mu_9 \end{pmatrix} + A(L) \begin{pmatrix} FSI_{t-1} \\ IV_{t-1} \\ NEER_{t-1} \\ Interest_{t-1} \\ Stock_{t-1} \\ CPI_{t-1} \\ IndusPro_{t-1} \\ Unemp_{t-1} \\ Trade_{t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \\ \varepsilon_{7t} \\ \varepsilon_{8t} \\ \varepsilon_{9t} \end{pmatrix} \tag{4}$$

where FSI_t is the OFR FSI index, IV_t is implied volatility index, and the other variables follow the same settings with Eq. (1).

By estimating Model A and B by country, we can analyze the effects of global and domestic risks on the macroeconomy and financial markets. Table 1 indicates the expected signs of impulse responses to global and domestic risk shocks basing on the above-mentioned previous literature. We assumed the interactions between global and domestic risks by their widely existed spillovers. A global risk shock is assumed to lead to recessionary effects on most macroeconomic and financial variables, including long-term interest rates, stock prices, industrial production, unemployment rates, and trades. Further, due to inflation targeting monetary policies and producers' price stickiness, responses in prices to global and domestic risk shocks are uncertain and need to be analyzed. Lastly, such safe-haven currencies as the US dollar and the Japanese yen are assumed to appreciate when global risk increases while other currencies are assumed to depreciate.

Table 1. Expected Signs of Impulse Responses to Global and Domestic Shocks

		Impulse Responses								
		Global risk	*Domestic risk*	*NEER*	*Interest*	*Stock*	*CPI*	*IP*	*Unemp*	*Trade*
Shocks	*Global risk*	+	+	Safe-haven currencies: + Others: □	□	□	+ or□	□	+	□
	Domestic risk	+	+	□	□	□	+ or□	□	+	□

4. Data

Table 2 reports economic variables employed in the empirical analysis. We obtained monthly macroeconomic and financial data of the eight sample countries (Canada, China, Germany, France, Japan, South Korea, the United Kingdom, and the United States) during a period from January 1997 to June 2020 from the IMF IFS database, BIS, and Yahoo Finance. Monthly EPU data is obtained from the economic policy website (www.policyuncertainty.com). Daily FSI data is obtained from the Office of Financial Research website (www.financialresearch.gov) and transformed into monthly data by taking a daily average, which is available from January 2000. cGEPU data is the authors' calculation.

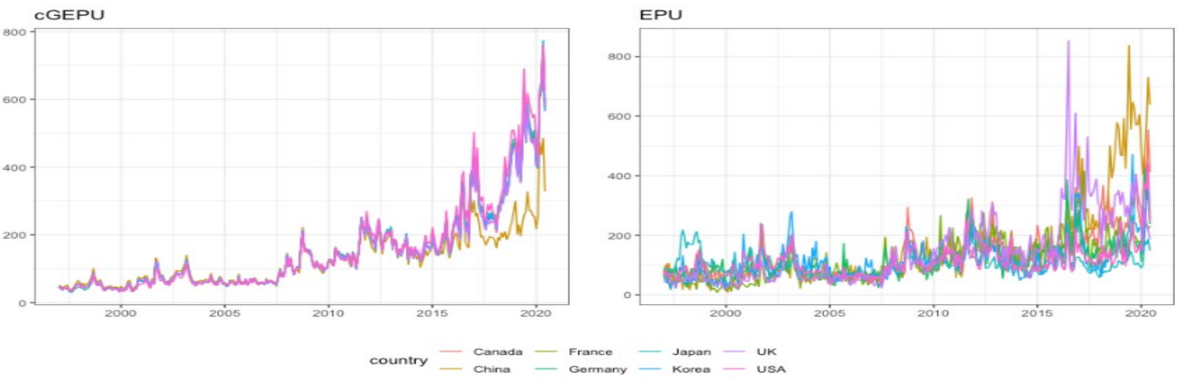
Table 2. Variables Descriptions

Variable Names	Descriptions	Source	Solutions
cGEPU	Country-specific global EPU index, 1997-2015=100	Authors' calculation	Logarithm difference*100
EPU	Economic policy index, 1997-2015=100	policy uncertainty website	Logarithm difference*100
FSI	Financial Stress Index	Office of Financial Research website	1st difference
IV	Implied volatility index	Yahoo Finance	Logarithm difference*100
NEER	Nominal effective exchange rate	BIS	Logarithm difference*100
Interest	Long-term interest rate, percentage	IMF IFS	1st difference
Stock	Stock price index	Yahoo Finance	Logarithm difference*100
CPI	Consumer price index, 1997M1=100	IMF IFS	Logarithm difference*100
IP	Industrial production index, 2015=100	IFS	Logarithm difference*100
Unemp	Unemployment rate, percentage	IFS	1st difference
Trade	Total goods trade volume including import and export, Billion USD	IFS	Logarithm difference*100

Panels in Fig. 1 show movements in the variables employed in empirical analysis, including policy risk indicators in Fig. 1-1, financial risk indicators in Fig. 1-2, and macroeconomic and financial indicators in Fig. 1-3. Regarding the global policy risk indicators, the cGEPU indexes in most of the sample countries have sharply increased since 2016 and reached a historically high level which is three times that of the Global Financial Crisis. It shows the tremendous impacts of the crisis in recent years when we faced, the Brexit, the US-China trade friction, and the COVID-19 pandemic. Regarding the global financial risk indicators, the FSI index had kept low from 2015 to 2020 and reached only one-fourth of that in the Global Financial Crisis when the COVID-19 pandemic broke out. Global policy risk and global financial risk have diverged in recent years due to the quantitative easing monetary policies in major countries. Variations in global risks make it easier to obtain statistically significant results in analyzing their recessionary effects.

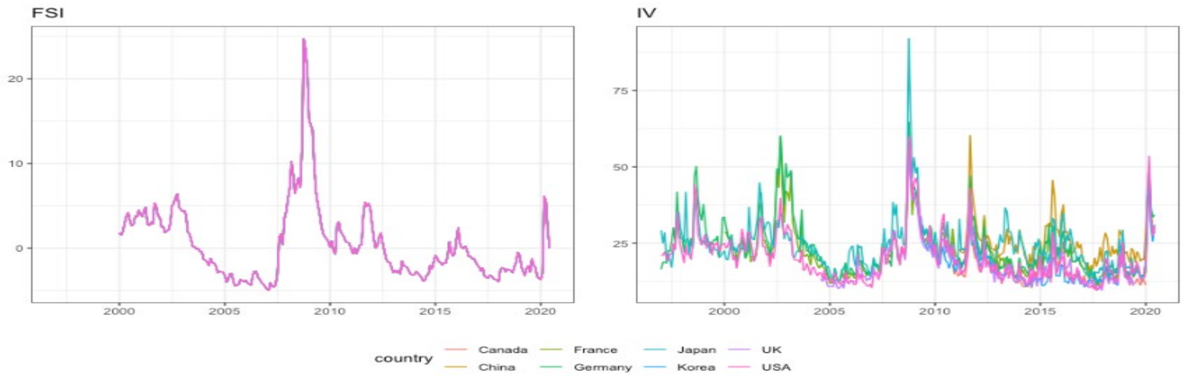
All of the variables are taken first difference or logarithm difference for stationarity since Augmented Dicky-Fuller unit root tests indicate that they are I (1) non-stationary.

Fig. 1-1. Policy Risk Indicators



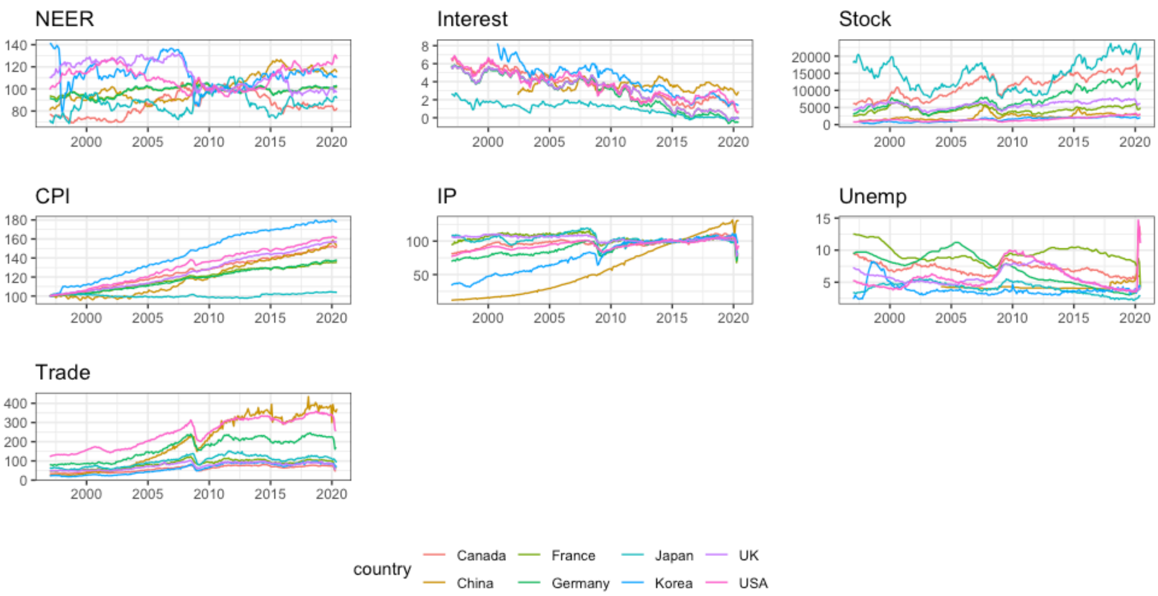
Note: This figure shows monthly country-specific GEPU (cGEPU) and EPU indexes from 1997M1 to 2020M6 in eight sample countries, including Canada, China, Germany, France, Japan, Korea, the United Kingdom, and the United States.
Source: policy uncertainty website, authors' calculation.

Fig. 1-2. Financial Risk Indicators



Note: This figure shows monthly Financial Stress Index (FSI) and implied volatility indexes (IV) from January 2000 to June 2020 in eight sample countries, including Canada, China, Germany, France, Japan, Korea, the United Kingdom, and the United States.
Source: Office of Financial Research website, Yahoo Finance, authors' calculation.

Fig. 1-3. Macroeconomic and Financial Indicators



Note: Panels in this figure show monthly Nominal Effective Exchange Rates (*NEER*), long-term interest rates (*Interest*), stock price indexes (*Stock*), consumer price indexes (*CPI*, 1997M1=100), industrial production indexes (*IP*, 2015=100), unemployment rates (*Unemp*), and total goods trade (*Trade*, Billion USD) from 2000M1 to 2020M6 in eight sample countries, including Canada, China, Germany, France, Japan, Korea, the United Kingdom, and the United States. Source: IFS, BIS, Yahoo Finance, authors' calculation.

5. Empirical results on macroeconomic effects of global risks

5.1 Impulse responses to global risk shocks

The Akaike Information Criterion (AIC) is used to determine that the lag lengths in VAR model settings for sample countries are either one or two periods (months). Panels of Fig 2 show the impulse responses and cumulative impulses with 90% confidence intervals. They show how the macroeconomy and financial markets of the sample countries respond to global risk shocks in the short run and in the long run.

<insert Fig 2 here>

- Canada

In Model A for Canada, impulse response functions (IRFs) and cumulative impulse response functions (CIRFs) to *cGEPU* shock in Model A show that the global policy risk has significant recessionary effects on most of the macroeconomic and financial variables except for employment in the short run. These recessionary effects of the global policy risk plunge the stock price, lower the long-term interest rate, and depress the prices in the long run. On one hand, the IRFs and CIRFs to *EPU* shock show significant recessionary effects of domestic policy risk only on the exchange rate and stock price.

In Model B, the IRFs and CIRFs to *FSI* shock show that global financial risk has significant recessionary effects on all of the financial variables, including the exchange rate, the interest rate, the stock price, and only the global trade, both in the short run and in the long run. On one hand, the IRFs and CIRs to *IV* shock show recessionary effects of domestic financial risk on the exchange rate, the stock price, and the global trade both in the short run and in the long run.

- China

In Model A for China, the IRFs to *cGEPU* shock show that the global policy risk has significant recessionary effects on the interest rate and trade in China. In contrast, it unexpectedly has a positive effect on Chinese production in the short run. The CIRFs to *cGEPU* shock shows that the global policy risk has significant recessionary effects only on the interest rate in the long run. On one hand, the IRFs to *EPU* shock show significant recessionary effects of the domestic policy risk on the interest rate, the stock price, the prices, and the production in the short run. The CIRFs to *EPU* shock show that the domestic policy risk has recessionary effects only on the stock price in the long run.

In Model B, the IRFs to *FSI* shock show significant recessionary effects of the global financial risk on the interest rate, the stock price. At the same time, it has a positive effect on the production. The CIRFs to *FSI* shock show a significant recessionary effect of the global financial risk only on the global trade though there is an unexpectedly positive effect on the production. A possible interpretation is that China is playing a core role in the global value chain. Therefore, the global financial risk has increased global demand for Chinese products leading to increased the production in China. This interpretation is consistent with the scenario after the Global Financial Crisis. Further, the IRFs and CIRFs to *IV* shock show significant recessionary effects of the domestic financial risk on the production and the employment in China both in the short run and in the long run. The Chinese economy experiences a Renminbi appreciation in the short run.

- Germany

In Model A for Germany, the IRFs to *cGEPU* shock show that the global policy risk has significant recessionary effects on all of the macroeconomic and financial variables in the short run. In contrast, the CIRFs to *cGEPU* shock show that recessionary effects are significant only on the interest rate and the stock price in the long run. On one hand, the IRFs to *EPU* shock show significant recessionary effects of the domestic policy risk on all of the macroeconomic and financial variables except for the interest rate and the prices. The CIRFs to *EPU* shock show that the recessionary effects on the production and the global trade exist in the long run.

In Model B, the IRFs to *FSI* shock show the significant recessionary effects of the global financial risk on all of the macroeconomic and financial variables. The CIRFs to cGEPU show the persistence of these recessionary effects for the macroeconomy and financial markets even in the long run. On one hand, the IRFs and CIRFs to *IV* shock show that the domestic financial risk has recessionary effects on most of the macroeconomic and financial variables both in the short run and in the long run. The exchange rate significantly appreciates in the short run.

- France

In Model A for France, the IRFs to *cGEPU* shock show that the global policy risk has significant recessionary effects on all of the macroeconomic and financial variables except for exchange rate appreciation in the short run. The CIRFs to *cGEPU* shock show that the recessionary effects of the global policy risk on the interest rate, the stock price, and the prices in the long run. On the one hand, the IRFs and CIRFs to *EPU* shock indicate no significant recessionary effect of the domestic policy risk on the macroeconomic and financial variables.

In Model B, the IRFs to *EPU* shock show that the global financial risk has significant recessionary effects on all of the macroeconomic and financial variables in the short run. The CIRFs to *EPU* shock show that there are recessionary effects of the global financial risk on the interest rate, the stock price, production, and the trade in the long run. On one hand, the IRFs to *IV* shock show significant recessionary effects of the domestic financial risk on most of the macroeconomic and financial variables except for prices in the short run. The CIRFs to *IV* shock indicate the significant recessionary effects of the domestic financial risk on the interest rate, the stock price, the prices, and the employment even in the long run.

- The United Kingdom

In Model A for the United Kingdom, the IRFs and IRFs to *cGEPU* shock show that the global policy risk has significant recessionary effects on the interest rate, the stock price, and the prices both in the short run and in the long run. It significantly depreciates the exchange rate in the long run. However, such macroeconomic variables as production, employment, and global trade do not significantly respond to global policy risk, while the IRFs and CIRFs have expected signs for them. On one hand, IRFs and IRFs to *EPU* shock show unexpected results that domestic policy risk increases British prices and production in both the short run and in the long run.

In Model B, the IRFs and CIRFs to *FSI* shock show that the global financial risk significantly has currency depreciation effect. Moreover, it has recessionary effects on all of the financial variables and most of the macroeconomic variables except for employment in the short run while these effects on the exchange rate, interest rate, and global trade are persistent even in the long run. On one hand, IRFs and CIRFs to *IV* shock show that the domestic financial risk has recessionary effects on the exchange rate, the stock price, the employment, and the global trade in the short run. There are recessionary effects on only the stock price in the long-run.

- Japan

In Model A for Japan, the IRFs to *cGEPU* shock show that the global policy risk has significantly appreciated the exchange rate and recessionary effects on the stock price, the prices, and the production. However, there is significantly an unexpectedly positive effect on global trade. The CIRFs to *cGEPU* shock show that the global policy risk has an appreciation effect on the exchange rate and recessionary effects on the stock price and the production while remaining persistent in the long run. On one hand, the IRFs and CIRFs to *EPU* shock indicate that the domestic policy risk only has recessionary effects on the interest rate, the stock price, and the prices both in the short run and in the long run.

In Model B, the IRFs and CIRFs to *FSI* shock show significant appreciation effect on the exchange rate and recessionary effects on the macroeconomy and financial markets except for the prices both in the short run and in the long run. On one hand, the IRFs to *IV* shock show that the global financial risk has an appreciation effect on the exchange rate and recessionary effects on all of the variables. Further, the domestic financial risk significantly plunges the stock price, lowers the prices, and reduces Japan's production both in the short-run and in the long-run.

- Korea

In Model A for Korea, the IRFs and CIRFs to *cGEPU* shock show that the global policy risk has significant recessionary effects on most of the macroeconomic and financial variables both in the short run and in the long run, including depreciating the exchange rate and lowering the interest rate, the stock price, prices, the production, and the global trade. On one hand, the IRFs and CIRFs to *EPU* shock show that the domestic policy risk has recessionary effects on the exchange rate, the stock price, the prices, and the employment in the short run. Simultaneously, there are only significant recessionary effects of the domestic policy risk on the exchange rate and the stock price in the long run.

In Model B, the IRFs and CIRFs to *FSI* shock show the significant recessionary effects of the global financial risk on most macroeconomic and financial variables except for the interest rate in the short run. The recessionary effects on most variables except for the interest rate and employment remain persistent in the long run. Also, the IRFs and CIRFs to *IV* shock show the wide recessionary effects of the domestic financial risk on the macroeconomy and the financial market except for the interest rate and the employment. These recessionary effects are persistent on the exchange rate, the stock price, the prices, and the global trade in the long run.

- The United States

Lastly, in Model A for the United States, the IRFs to *CGEPU* shock show that the global policy risk appreciates the exchange rate and has recessionary effects on the interest rate, the stock price, and the prices in the short run. In contrast, there are only significant recessionary effects of the global policy risk on the financial market rather than the macroeconomy in the long run. On one hand, the IRFs and CIRFs to *EPU* shock show the significant recessionary effects on all of the macroeconomic and financial variables in the short run and the persistence of these effects on most of the variables except for the prices and the global trade in the long run. This result indicates the independence of the US macroeconomy against the global policy uncertainty. A possible interpretation is the United States' key role in the global economy, leading to a one-side policy spillover to the world economy.

In Model B, the IRFs and CIRFs to *FSI* shock show that the global financial risk significantly leads to currency appreciation and has recessionary effects on all of the macroeconomic and financial variables in the short run. These recessionary effects are persistent for most of the variables in the long run, except for employment. Further, the IRFs and CIRFs to *IV* shock show that both the currency appreciation effect and recessionary effects of domestic financial risk are significant for all of the macroeconomic and financial variables both in the short run and in the long run.

In summary, the IRFs and CIRFs show the recessionary effects of the global risks on the macroeconomy and financial markets both in the short run and in the long run, including lowering the interest rates, plunging the stock price, and reducing the production, employment, and the global trade, though not all of the recessionary effects are significant at 90% confidence level. Further, the global risks appreciate such safe-haven currencies as the US dollar and Japanese yen and depreciate the other currencies. Last, the global risks lower the prices for most countries though many are insignificant at 90% confidence level.

5.2 Magnitudes of global and domestic risk shocks' effects on the macroeconomy and financial markets

The analytical results shown in Section 5.1 indicate the recessionary effects of the global risks on most of the macroeconomic and financial variables with expected signs. Moreover, it is necessary to compare the magnitudes of the impulse responses to the global risks among countries to identify cross-country variations. Table 3 to 6 report the magnitudes of CIRFs to *cGEPU*, *EPU*, *FSI*, and *IV* shocks respectively after 20 months when all CIRFs become stable and unchanged. The CIRFs to one standard deviation shocks are rescaled to that to one unit shocks for country comparison. Since the sizes of one standard deviation shocks vary depending on VAR models for countries, we rescaled the CIRFs to one unit shocks by dividing one standard deviation as $CIRF/one\ SD\ shock$ after estimated by Cholesky decomposition.

Regarding policy risks, Table 3 and 4 show the magnitudes of variables' CIRFs to one unit of *cGEPU* and *EPU* shocks. Averagely, a 1% (logarithm) shock in the global policy risk leads to a 0.59% increase in the domestic policy risk, 0.77% appreciation in the safe-haven currencies and 0.01% depreciation in the other currencies, 0.003% decrease in the interest rate, 0.016% plunge in the stock price, 0.003% deflation in the prices, 0.024% decrease in the production, 0.004% decrease in the employment, and 0.047% in the goods trade. On one hand, as shown in Table 4, a 1% (logarithm) shock in the domestic policy risk (*EPU*) averagely leads to 0.062% increase in global policy risk, 0.009% depreciation in the safe-haven currencies, and 0.005% depreciation in the other currencies, 0.001% decrease in the interest rate, 0.051% plunge in stock price, 0.001% deflation in the prices, 0.009% decrease in the production, 0.002% decrease in the employment, and 0.024% decrease in the total goods trade. These results indicate that macroeconomy and financial markets are more sensitive to global policy risk than the domestic policy risk though both the global policy risk and the domestic policy risk have recessionary effects.

Regarding the global financial risks, Table 5 and 6 show the magnitudes of variables' CIRFs to one unit *IFS* and *IV* shocks. Averagely, a one unit shock in the global financial risk leads to 6.1% increase in the domestic financial risk, 0.94% appreciation in the safe-haven currencies and 0.25% depreciation in the other currencies, 0.066% decrease in long-term interest rate, 2.85% plunge in the stock price, 0.08% deflation in the prices, 0.41% decrease in the production, 0.032% decrease in the unemployment, 1.27% in the total goods trade. On one hand, a 1% shock in the domestic financial risk leads to 0.025 increase in the global financial risk, 0.028% appreciation in safe-haven currencies and

0.007% depreciation in other currencies, 0.002% decrease in the interest rate, 0.113% plunge in the stock price, 0.005% deflation in the prices, 0.02% decrease in the production, 0.002% decrease in the employment, and 0.048% decrease in the total goods trade.

In summary, the magnitudes of IRFs indicate that the global risk and the domestic risk have recessionary effects on the macroeconomy and the financial markets among major countries in our empirical analysis. Further, it shows that the global risks have larger recessionary effects than domestic risks. Lastly, we can find the recessionary effects of the global risks significantly vary depending on countries.

Table 3. Accumulated Impulse Responses to One Unit cGEPU shock

	cGEPU	*EPU*	*NEER*	*Interest*	*Stock*	*CPI*	*IP*	*Unemp*	*Trade*
Expected signs	+	+	USA/Japan: + Others: -	-	-	-	-	+	-
Canada	0.902*	0.46*	-0.011	-0.003*	-0.071*	-0.004*	-0.099	0.031	-0.197
China	0.698*	0.443*	0.01	-0.002*	-0.053	-0.004	0.004	-5.1.E-05	-0.019
Germany	0.587*	0.712*	0.006	-0.005*	-0.152*	-0.002	-0.028	0.003	-0.038
France	0.791*	0.647*	0.005	-0.004*	-0.158*	-0.003*	-0.008	-2.3.E-04	-0.017
UK	0.771*	0.693*	-0.019*	-0.003*	-0.076*	-0.003*	-0.003	-0.001	-0.019
Japan	0.849*	0.418*	0.037*	-4.7.E-04	-0.155*	-0.002	-0.022*	-1.6.E-05	-0.001
Korea	0.692*	0.579*	-0.053*	-0.003*	-0.15*	-0.004*	-0.03*	0.001	-0.073*
USA	0.763*	0.786*	0.024*	-0.005*	-0.115*	-0.003	-0.003	0.002	-0.013
average	0.757	0.592	-0.0003	-0.003	-0.116	-0.003	-0.024	0.004	-0.047

Note: This table reports the cumulative impulse responses to one unit cGEPU shock after 20 months by VAR Model 1. Impulse responses are estimated by Cholesky decomposition and rescaled to one unit shock. '*' means significance at 90% confidence level.

Table 4. Accumulated Impulse Responses to One Unit EPU shock

	cGEPU	*EPU*	*NEER*	*Interest*	*Stock*	*CPI*	*IP*	*Unemp*	*Trade*
Expected signs	+	+	USA/Japan: + Others: -	-	-	-	-	+	-
Canada	0.06*	0.719*	-0.014*	-0.001	-0.034	-0.001*	-0.022	0.007	-0.059
China	0.039	0.506*	0.002	-0.001	-0.084*	0.002	-0.002	-5.4.E-05	-0.014
Germany	0.048*	0.506*	-0.004	-0.001	-0.021	-0.001	-0.015*	-0.001	-0.038*
France	0.017	0.545*	-0.003	-1.7.E-05	-0.004	4.1.E-04	-0.003	-1.9.E-04	-0.015
UK	0.029	0.614*	0.006	0.0001	0.009	0.003*	0.011*	2.0.E-04	0.024
Japan	0.119*	0.848*	0.012	-0.002*	-0.119*	-0.004*	-0.012	-4.8.E-05	-0.026
Korea	0.114*	0.74*	-0.019*	-0.001	-0.06*	-0.001	-0.011	2.1.E-04	-0.021
USA	0.068	0.71*	0.006	-0.003*	-0.094*	-0.005	-0.02*	0.009*	-0.041
average	0.062	0.648	-0.002	-0.001	-0.051	-0.001	-0.009	0.002	-0.024

Note: This table reports the cumulative impulse responses to one unit EPU shock after 20 months by VAR Model 1. Impulse responses are estimated by Cholesky decomposition and rescaled to one unit shock. '*' means significance at 90% confidence level.

Table 5. Accumulated Impulse Responses to One Unit FSI shock

	FSI	*IV*	*NEER*	*Interest*	*Stock*	*CPI*	*IP*	*Unemp*	*Trade*
Expected signs	+	+	USA/Japan: + Others: -	-	-	-	-	+	-
Canada	1.178*	11.543*	-0.697*	-0.124*	-2.084*	-0.074	0.021	0.013	-0.725*
China	0.97*	6.188*	0.04	-0.042	-3.123*	-0.071	0.369*	-0.017	-0.995*
Germany	0.828*	5.427*	0.054	-0.082*	-3.63*	-0.071*	-0.939*	0.066*	-1.537*
France	1.062*	5.091*	-0.029	-0.055*	-2.8*	-0.037	-0.463*	-0.001	-1.324*
UK	1.285*	5.5*	-0.457*	-0.049*	-1.566*	-0.02	-0.114	-0.005	-0.918*
Japan	0.931*	4.913*	1.203*	-0.022*	-3.77*	-0.042	-1.297*	0.026*	-1.749*
Korea	1.069*	5.111*	-0.431*	-0.031	-2.271*	-0.09*	-0.296	0.017	-1.277*
USA	0.931*	5.065*	0.681*	-0.12*	-3.514*	-0.209*	-0.55*	0.159	-1.638*
average	1.032	6.105	0.045	-0.066	-2.845	-0.077	-0.408	0.032	-1.271

Note: This table reports the cumulative impulse responses to one unit FSI shock after 20 months by VAR Model 2. Impulse responses are estimated by Cholesky decomposition and rescaled to one unit shock. '*' means significance at 90% confidence level.

Table 6. Cumulative Impulse Responses to One Unit IV shock

	FSI	*IV*	*NEER*	*Interest*	*Stock*	*CPI*	*IP*	*Unemp*	*Trade*
Expected signs	+	+	USA/Japan: + Others: -	-	-	-	-	+	-
Canada	0.023*	0.915*	-0.032*	0	-0.078*	-0.003	0.015	0	-0.035*
China	0.038*	0.828*	0.028	-0.001	0.038	-0.002	-0.022*	0.003*	-0.025
Germany	0.021*	0.809*	0.009	-0.003*	-0.211*	-0.005*	-0.038*	0.003	-0.047*
France	0.024*	0.74*	0.002	-0.002*	-0.172*	-0.004*	-0.02	0.002*	-0.038
UK	0.026*	0.792*	-0.006	-0.001	-0.116*	-0.003	-0.007	0.002	-0.032
Japan	0.018*	0.718*	0.026	-0.001	-0.114*	-0.005*	-0.042*	0.001	-0.05
Korea	0.03*	0.855*	-0.041*	-0.001	-0.084*	-0.009*	-0.02	-0.001	-0.062*
USA	0.018*	0.739*	0.029*	-0.005*	-0.17*	-0.007*	-0.03*	0.009*	-0.094*
average	0.025	0.799	0.002	-0.002	-0.113	-0.005	-0.020	0.002	-0.048

Note: This table reports the cumulative impulse responses to one unit IV shock after 20 months by VAR Model 2. Impulse responses are estimated by Cholesky decomposition and rescaled to one unit shock. '*' means significance at 90% confidence level.

5.3 Robustness checks

We constructed two alternative VAR models for robustness check on recessionary effects of the global risks on the macroeconomy and financial markets. First, the UK EPU index is employed as a global policy risk indicator in the VAR model A for the United States. Panels in Figure 3 show the IRFs and CIRFs of the US macroeconomic and financial variables to one standard deviation *UK EPU* shock. Table 7 shows the rescaled CIRFs to one unit *UK EPU* shock. The CIRFs show that recessionary effects of the UK EPU index on most of the US macroeconomic variables such as production and employment are not significant in the long run by CIRFs. It indicates the United States' externality to policy uncertainty in other countries.

<insert Fig 3 here>

Table 7. Accumulated Impulse Responses to One Unit UK EPU shock

	FSI	*IV*	*NEER*	*Interest*	*Stock*	*CPI*	*IP*	*Unemp*	*Trade*
Expected signs	+	+	+	-	-	-	-	+	-
USA	0.06*	0.719*	-0.014	-0.001	-0.034	-0.001	-0.022	0.007	-0.059

Note: This table reports the cumulative impulse responses to one unit UK EPU shock after 20 months by VAR Model 1. Impulse responses are estimated by Cholesky decomposition and rescaled to one unit shock. '*' means significance at 90% confidence level.

Further, the VIX index (*US IV*) is employed as a global financial risk indicator for countries other than the United States due to the US financial market's pivotal role in the global financial market. Panels in Figure 4 show the IRFs and CIRFs of the other countries' macroeconomic and financial variables to one standard deviation *US IV* shock. Table 8 shows the CIRFs to one unit *US IV* shock. As we assumed, the results show the significant recessionary effects of VIX on the macroeconomic and financial variables in most countries. It supports robustness of our empirical results.

<insert Fig 4 here>

Table 8. Accumulated Impulse Responses to One Unit US IV shock

	US IV	*IV*	*NEER*	*Interest*	*Stock*	*CPI*	*IP*	*Unemp*	*Trade*
Expected signs	+	+	Japan: +; Others:-	-	-	-	-	+	-
Canada	0.812*	0.553*	-0.028*	-0.003*	-0.076*	-0.005*	0.002	-0.0004	-0.031*
China	0.818*	0.503*	0.003	-0.001*	-0.079	0.001	-0.006	0.0017*	-0.018
Germany	0.654*	0.596*	0.01*	-0.004*	-0.247*	-0.005*	-0.044*	0.0028*	-0.061*
France	0.707*	0.59*	0.002	-0.003*	-0.192*	-0.004*	-0.025*	0.0011	-0.062*
UK	0.816*	0.642*	-0.009	-0.002*	-0.136*	-0.002	-0.008*	0.0011	-0.045*
Japan	0.656*	0.461*	0.063*	-0.002*	-0.238*	-0.003	-0.06*	0.002*	-0.08*
Korea	0.784*	0.502*	-0.025*	-0.002*	-0.102*	-0.003	0.001	-0.0009	-0.029
average	0.750	0.550	0.002	-0.003	-0.153	-0.003	-0.020	0.001	-0.047

Note: This table reports the cumulative impulse responses to one unit US IV shock after 20 months by VAR Model 2. Impulse responses are estimated by Cholesky decomposition and rescaled to one unit shock. '*' means significance at 90% confidence level.

6. Conclusions and policy implications

The surge in global risks in recent years has increased uncertainty in countries' macroeconomy and financial markets. This paper employed a 9-variable VAR model during a sample period from January 1997 to June 2020 to analyze the macroeconomic effects of both the global policy risk and the global financial risk on the eight major countries.

The main empirical results are as follows. First, we found that both the global policy risk and the global financial risk have recessionary effects on real economies, including reducing production, lowering the prices, weakening employment, and reducing the global trade volume for most of the sample countries. The production in some of the sample countries such as Japan and Korea suffered a reduction for more than two years, showing a long-run deterioration in production by the global risks. Further, we found the negative effects of global risks on long-term interest rates in most of the sample countries. A possible interpretation is that long-term interest rates will be induced to be lower in order that central banks should lower short-term interest rates and, in turn, the long-term interest rates stimulate aggregate demand, GDP and prices for economic recovery when central banks face recession caused by the global risks.

Second, we found the significant deflationary effects of the global risks on the prices. Our empirical results show that the global risks significantly lower prices both in the short run and in the long run, although inflation targeting monetary policy and price stickiness keep prices sticky even though the global risks occur. Third, we investigated the different responses to the global risks in the safe-haven currencies (the US dollar and the Japanese yen) and the other currencies. An increase in the global risks appreciates the safe-haven currencies while depreciating the other currencies mainly due to investors' risk aversion. Fourth, we found recessionary effects of the global risks vary depending on countries. For example, the United States does not suffer a production reduction by the global policy risk in the long run. These results are robust even the UK EPU index is employed as a global policy risk indicator. Lastly, regarding the statistical significance of IRFs and CIRFs to the global risks, the global financial risk is a more effective indicator than the global policy risk for predicting the effects of the global risks on the macroeconomy.

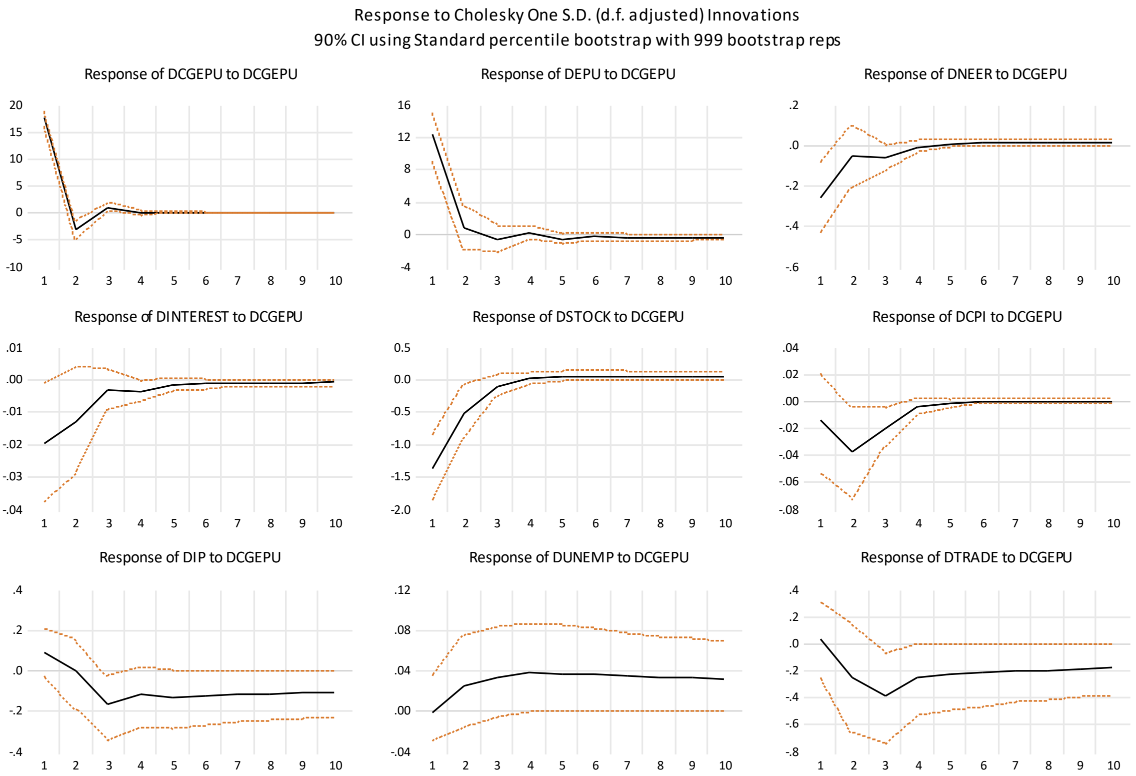
Based on the empirical result that the global risks have the negative effects on long-term interest rates, a possible interpretation is that long-term interest rates are induced to be lower in order that central banks should lower short-term interest rates and, in turn, the long-term interest rates stimulate aggregate demand, GDP and prices for economic recovery when central banks face recession caused by the global risks. The result is obtained in a macroeconomic system in which the global shocks have effects on macroeconomy while central banks, at the same time, conduct monetary policy to offset the negative effects. Central banks including the Bank of Japan have conducted monetary policy by targeting both the short-term and the long-term interest rates as well as quantitative easing since the 2010s in the situation where the zero lower bound on short-term interest rates and fears of financial bubbles limit their monetary policy instruments. Lower long-term interest rates stimulate capital formation, which influenced production growth and economic recovery from a recession, thereby wiping out the deflationary effects of global risks on the economy. Therefore, central banks should conduct not only quantitative easing but also lower the long-term interest rates to stimulate the economy for recovery from the COVID-19 pandemic recession. Moreover, central banks need international coordination in lowering the long-term interest rates in order prevent from fluctuation in exchange rates caused by widened interest rate differentials due to their different timing of lowering the interest rates.

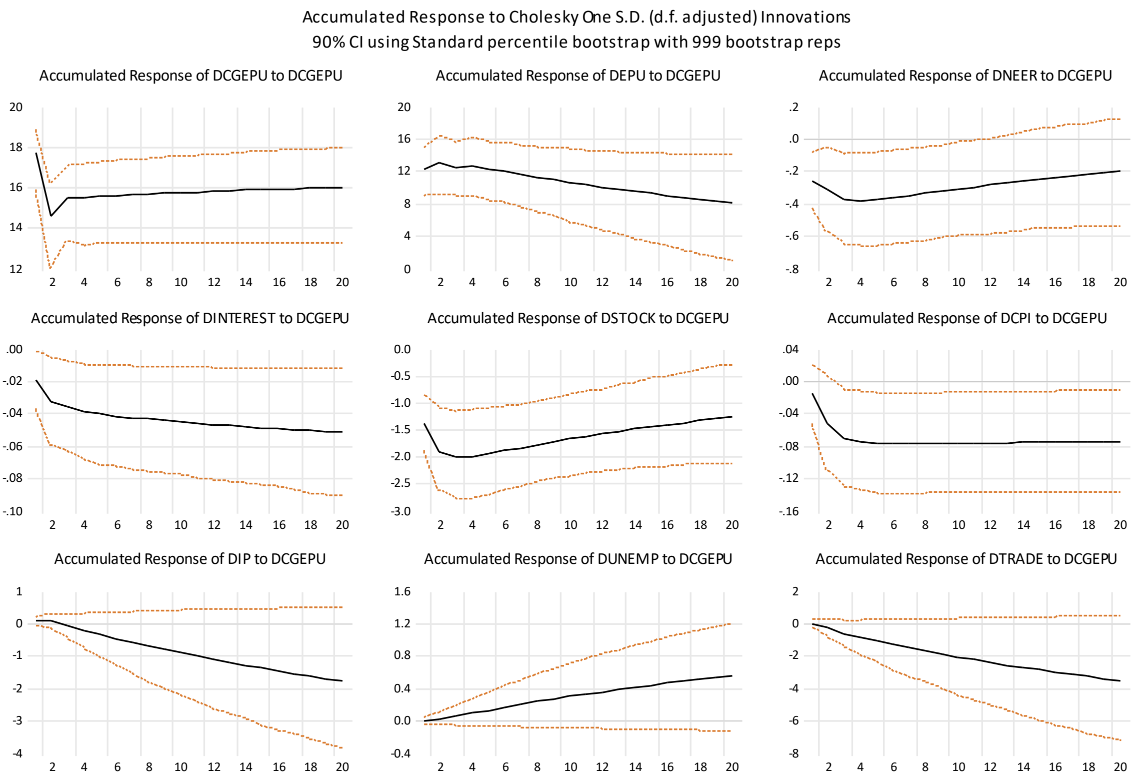
Besides the quantitative easing monetary policies with lowering the long-term interest rates, fiscal policies, innovation-promoting policy, and structural reform are necessary for recovery from the COVID-19 pandemic recession. While many developed countries such as Japan and European countries have suffered the Secular Stagnation scenario since the 2000s, our empirical results indicate the increase in global risks as one of the important reasons for low productivity growth both in the short run and in the long run. The limitation of monetary policy by the zero lower bound enhance the urgency of fiscal policy for directly stimulating the economy. Further, innovation-promoting policies and structural reforms will be useful for economic recovery by growing long-term production.

Fig 2. Impulse Responses Functions (IRFs) and Cumulative Impulse Responses Functions (CIRFs)

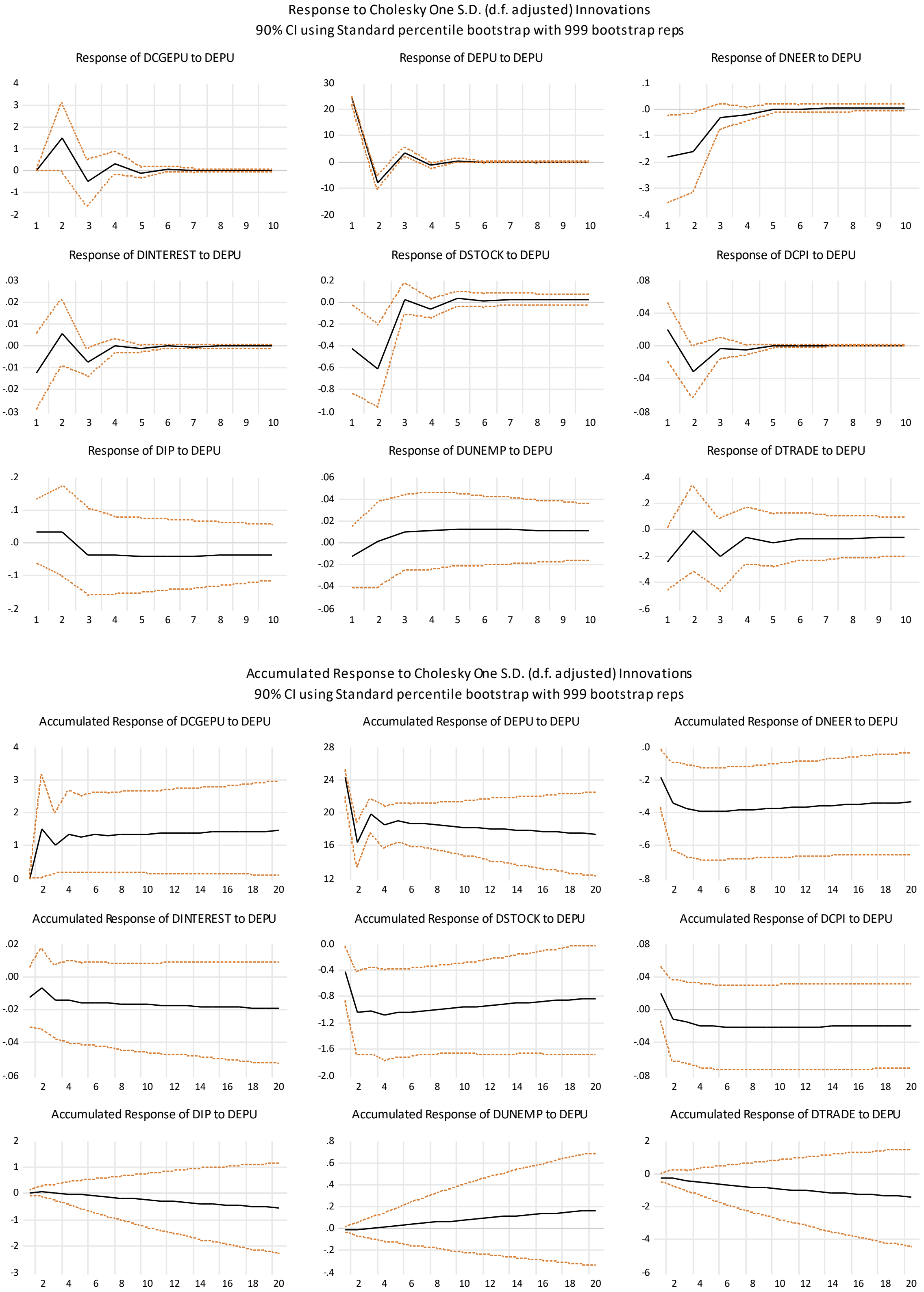
Fig 2-1. Canada

(a) IRFs and CIRFs to one SD cGEPU shock: Model A

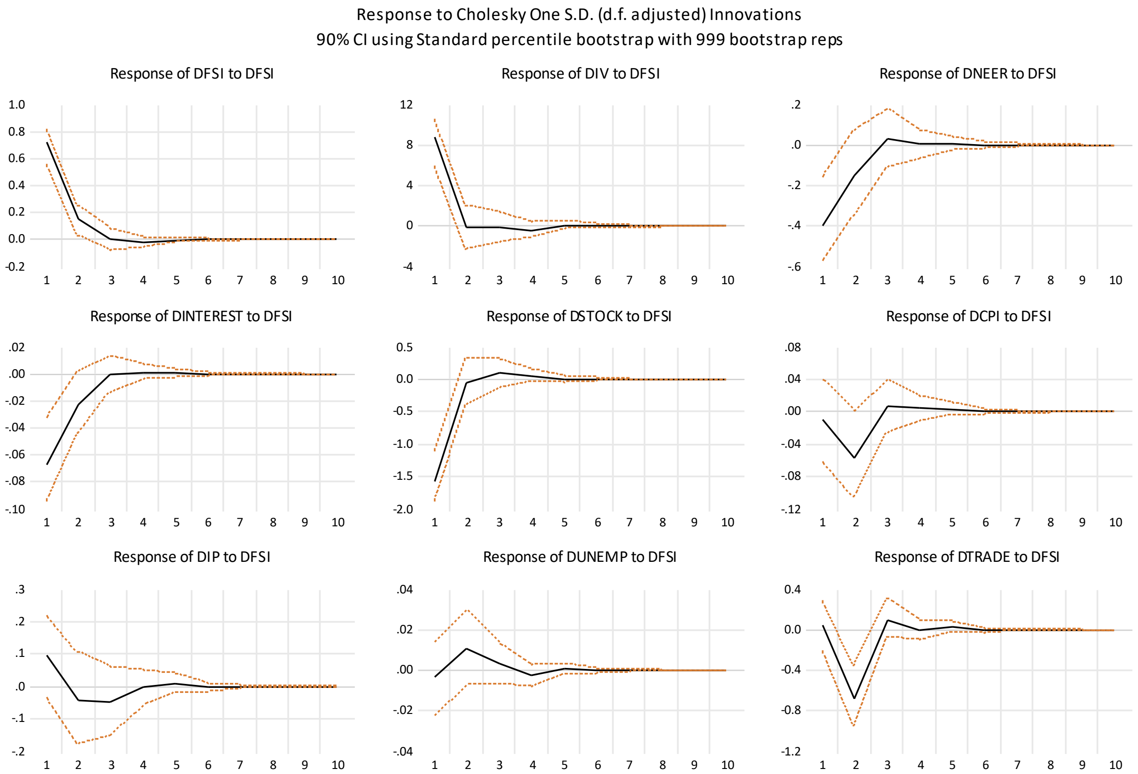


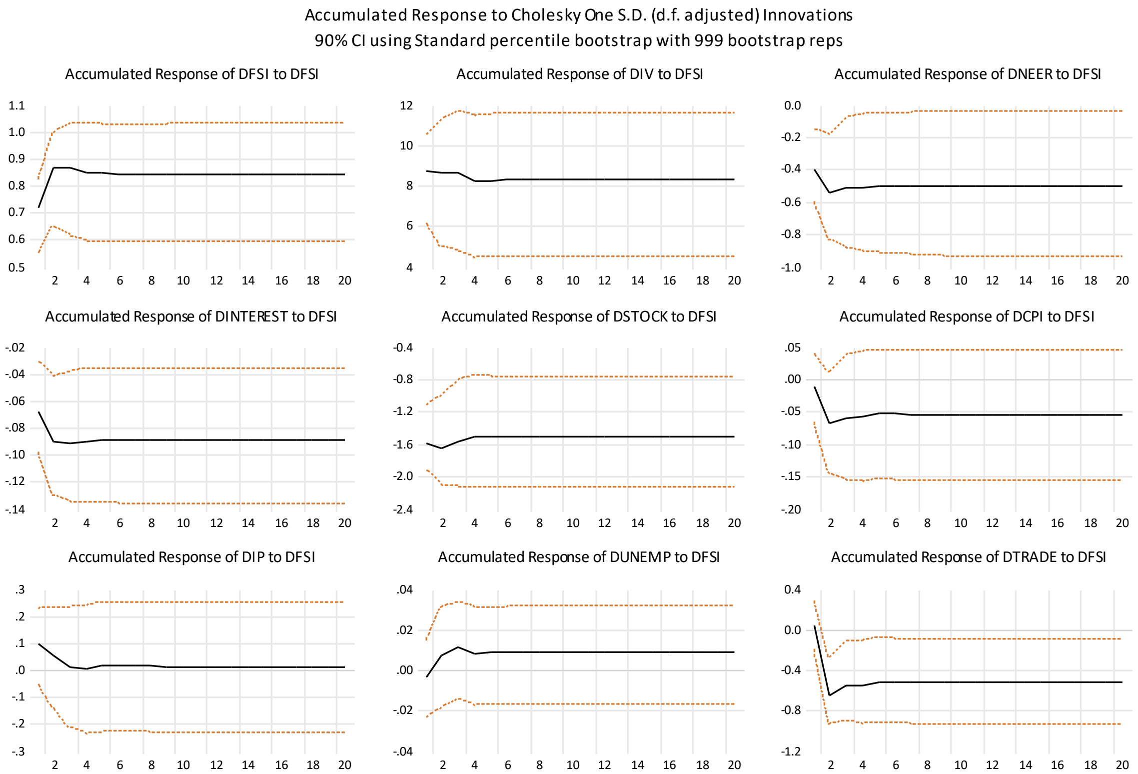


(b) IRFs and CIRFs to one SD EPU shock: Model A

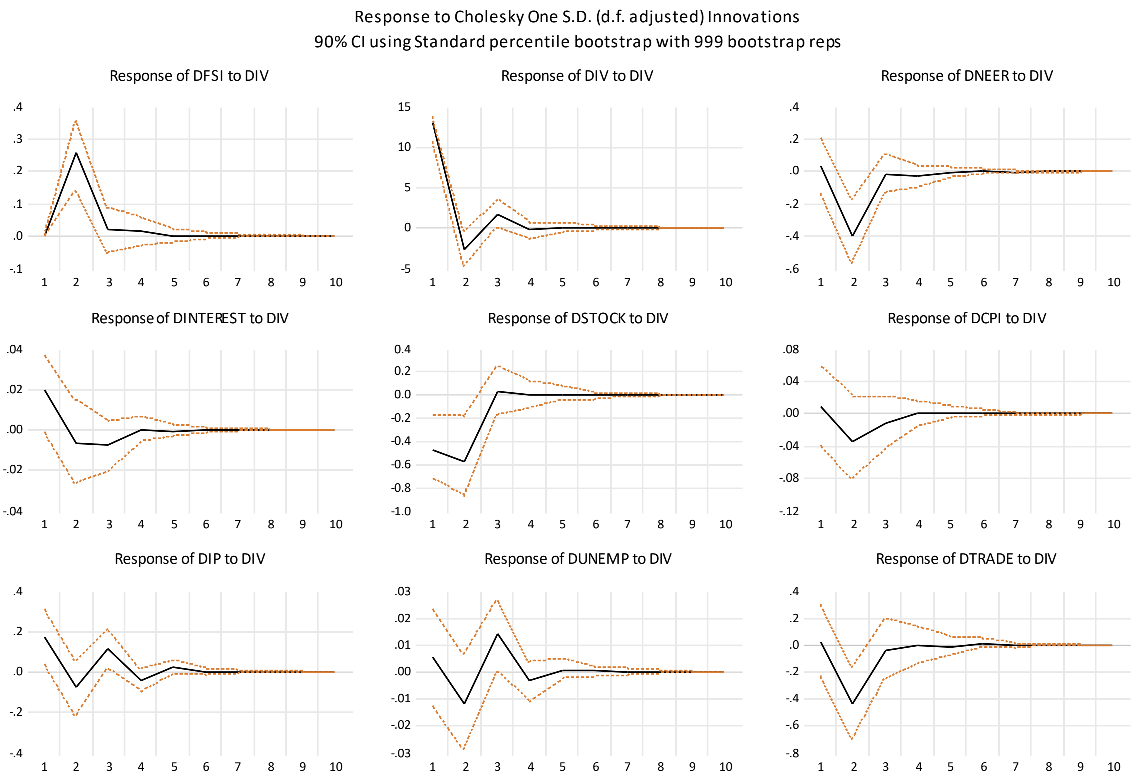


(c) IRFs and CIRFs to one SD FSI shock: Model B





(d) IRFs and CIRFs to one SD IV shock: Model B



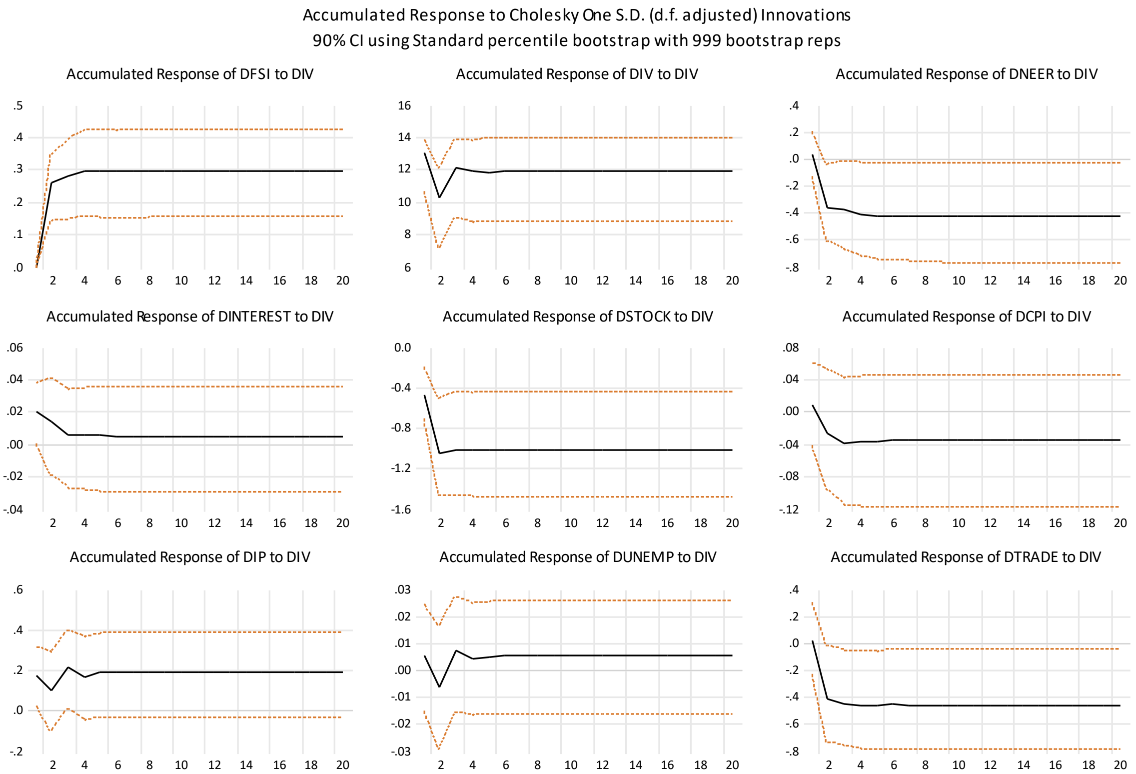
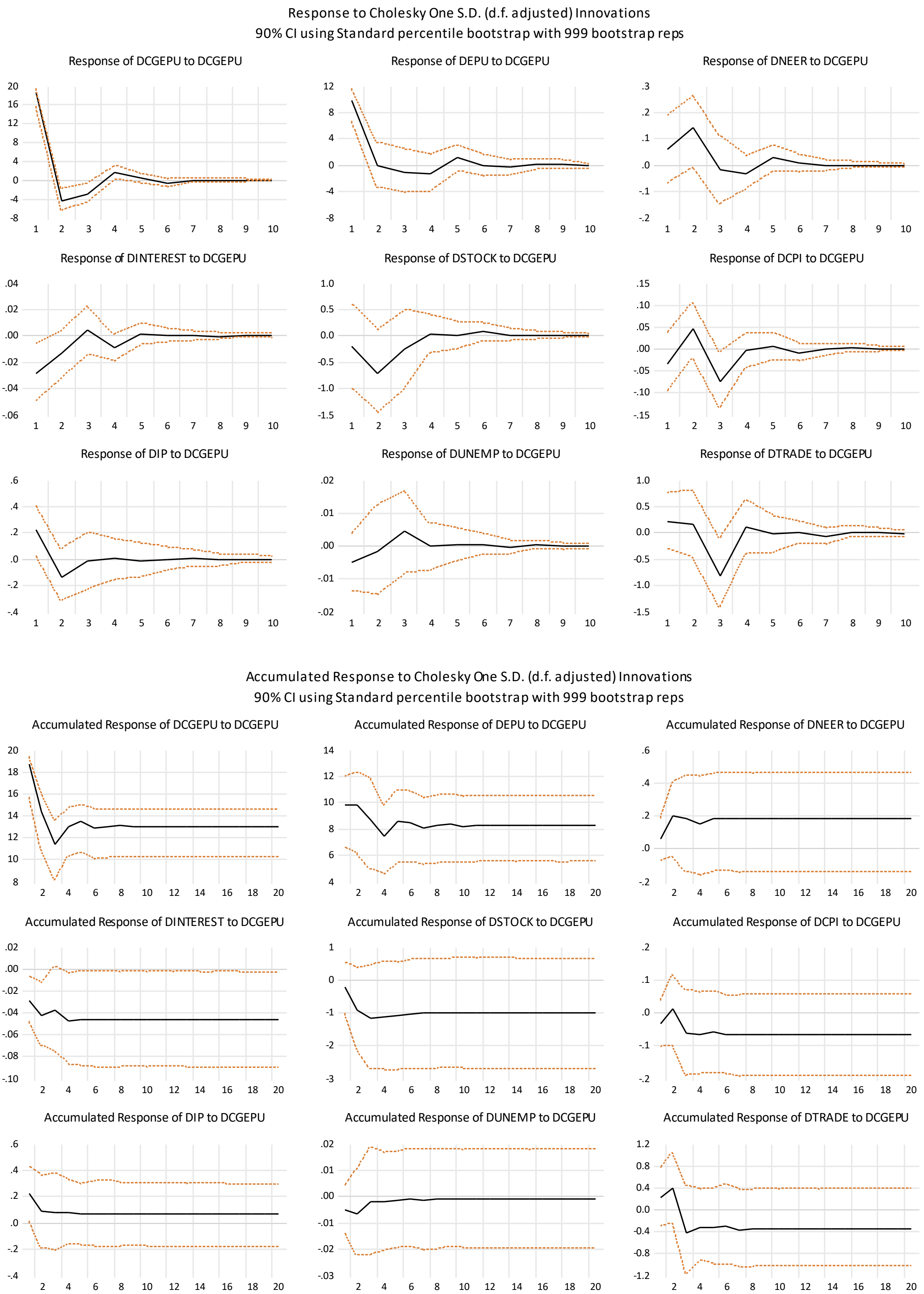
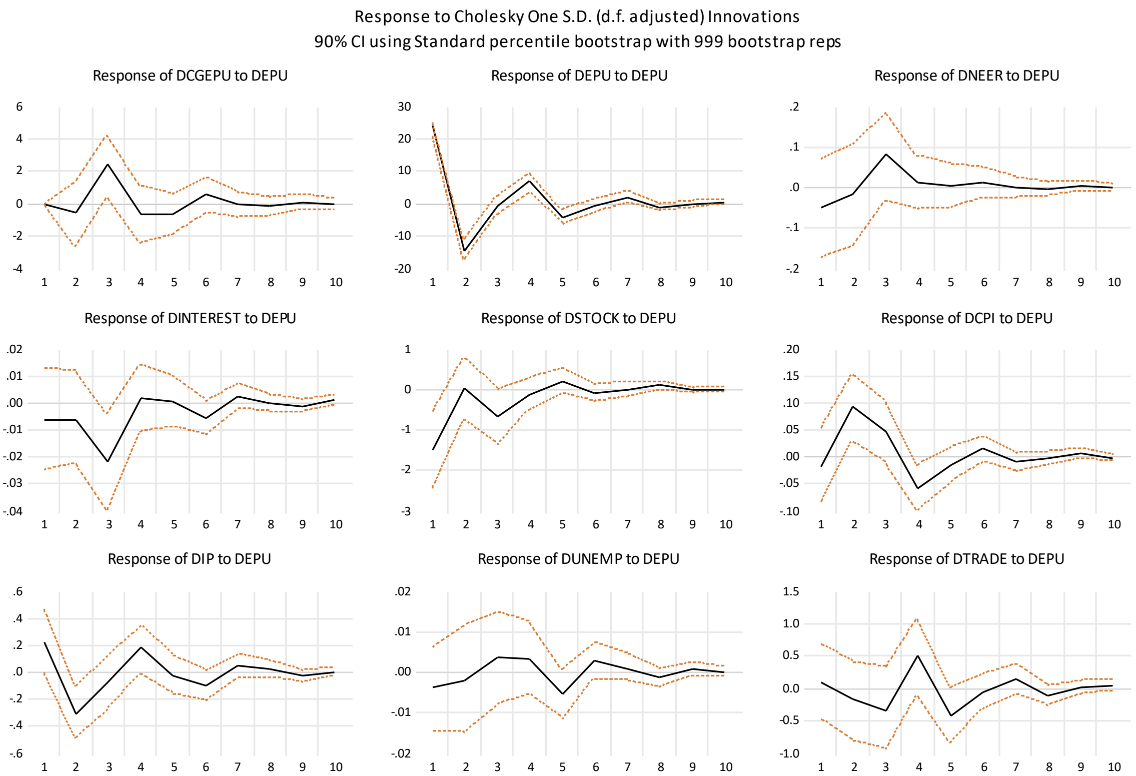


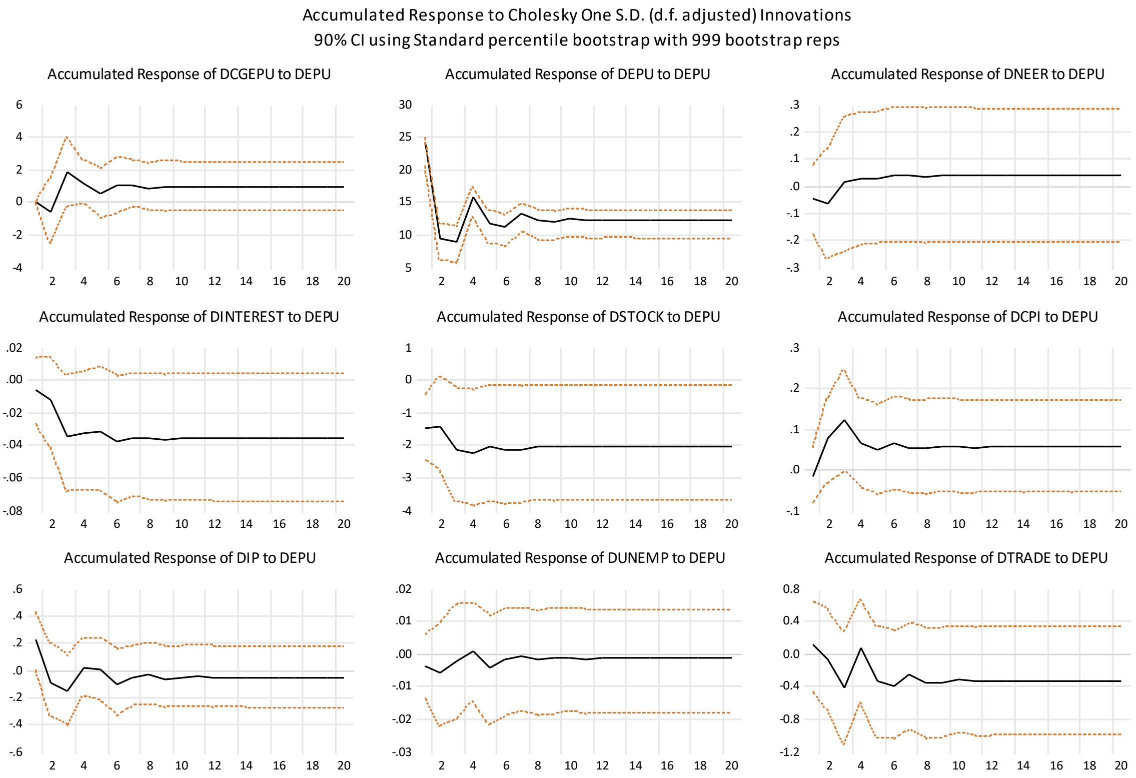
Fig 2-2. China

(a) IRFs and CIRFs to one SD cGEPU shock: Model A

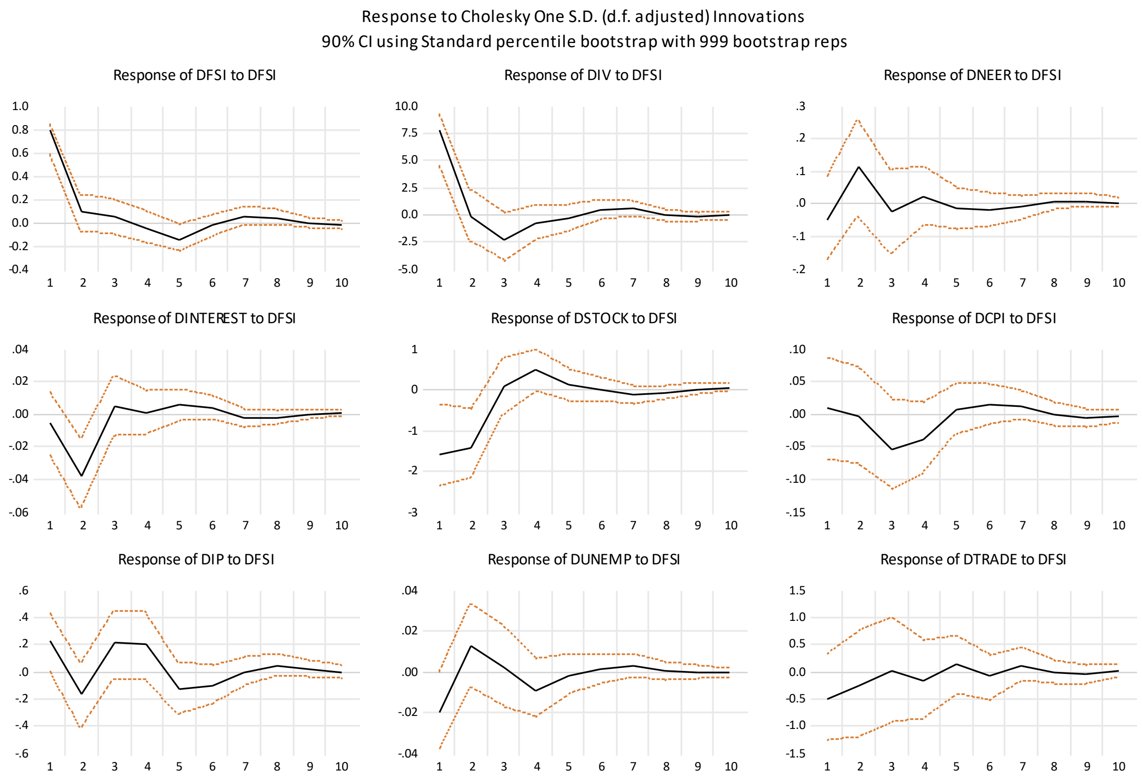


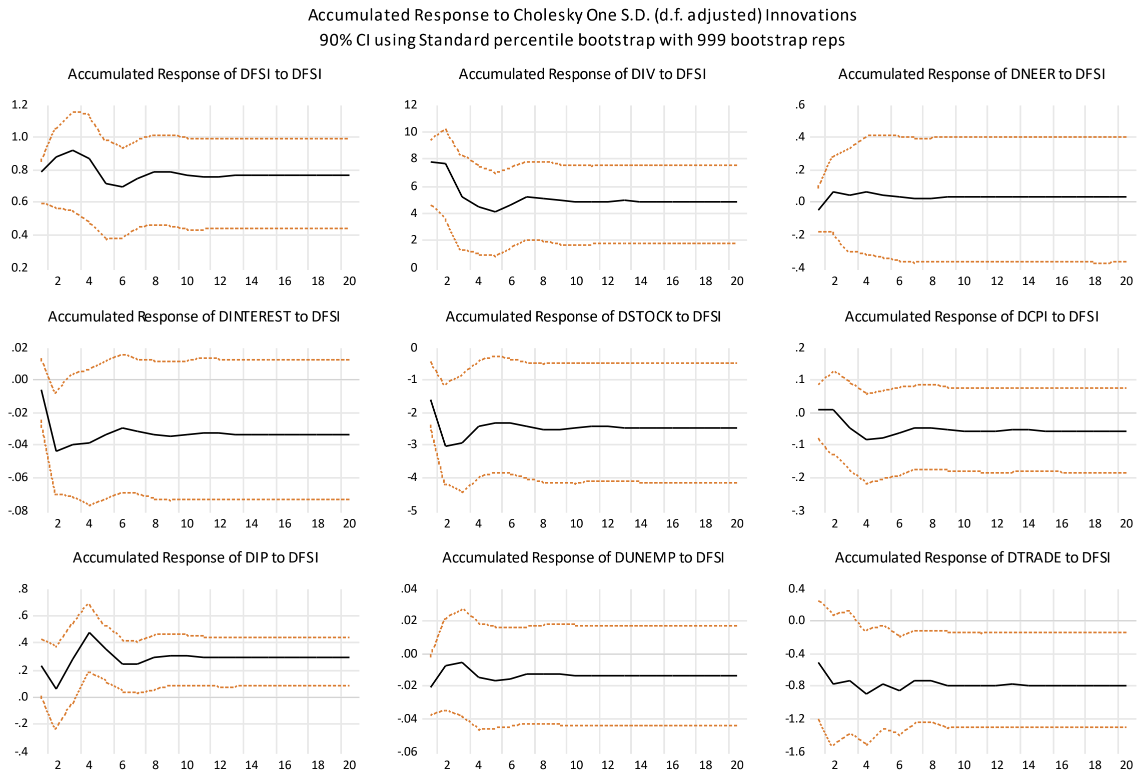
(b) IRFs and CIRFs to one SD EPU shock: Model A



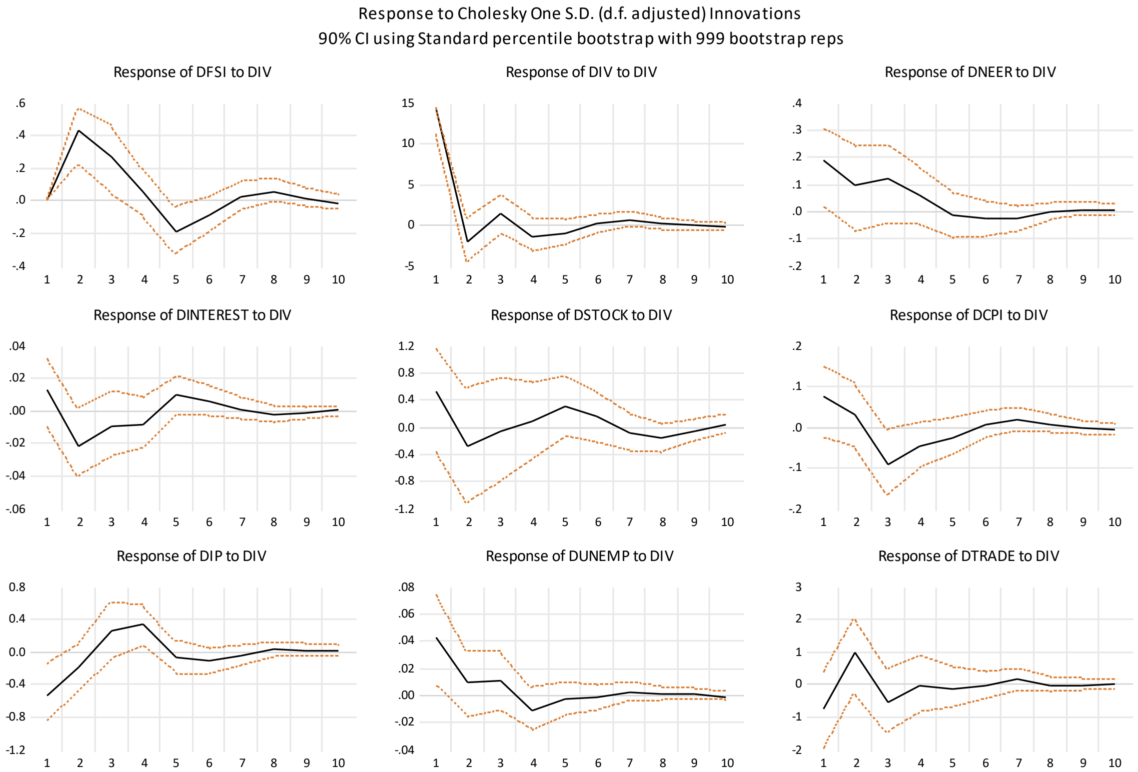


(c) IRFs and CIRFs to one SD FSI shock: Model B





(d) IRFs and CIRFs to one SD IV shock: Model B



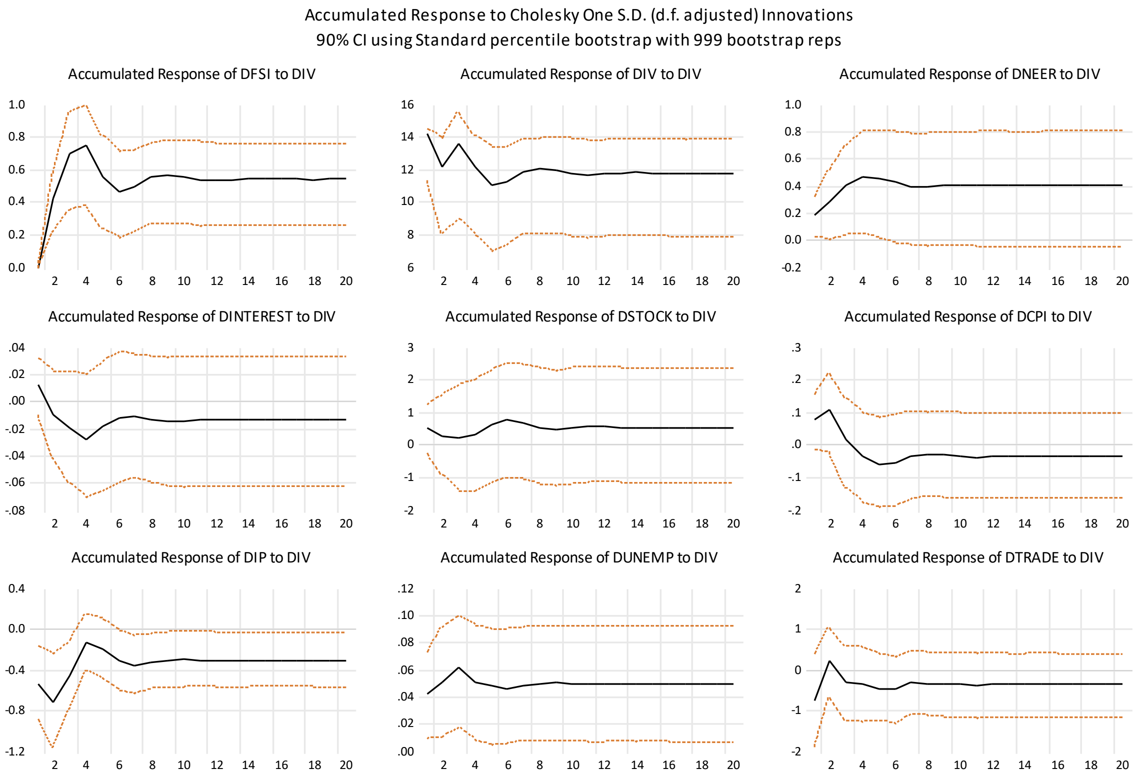
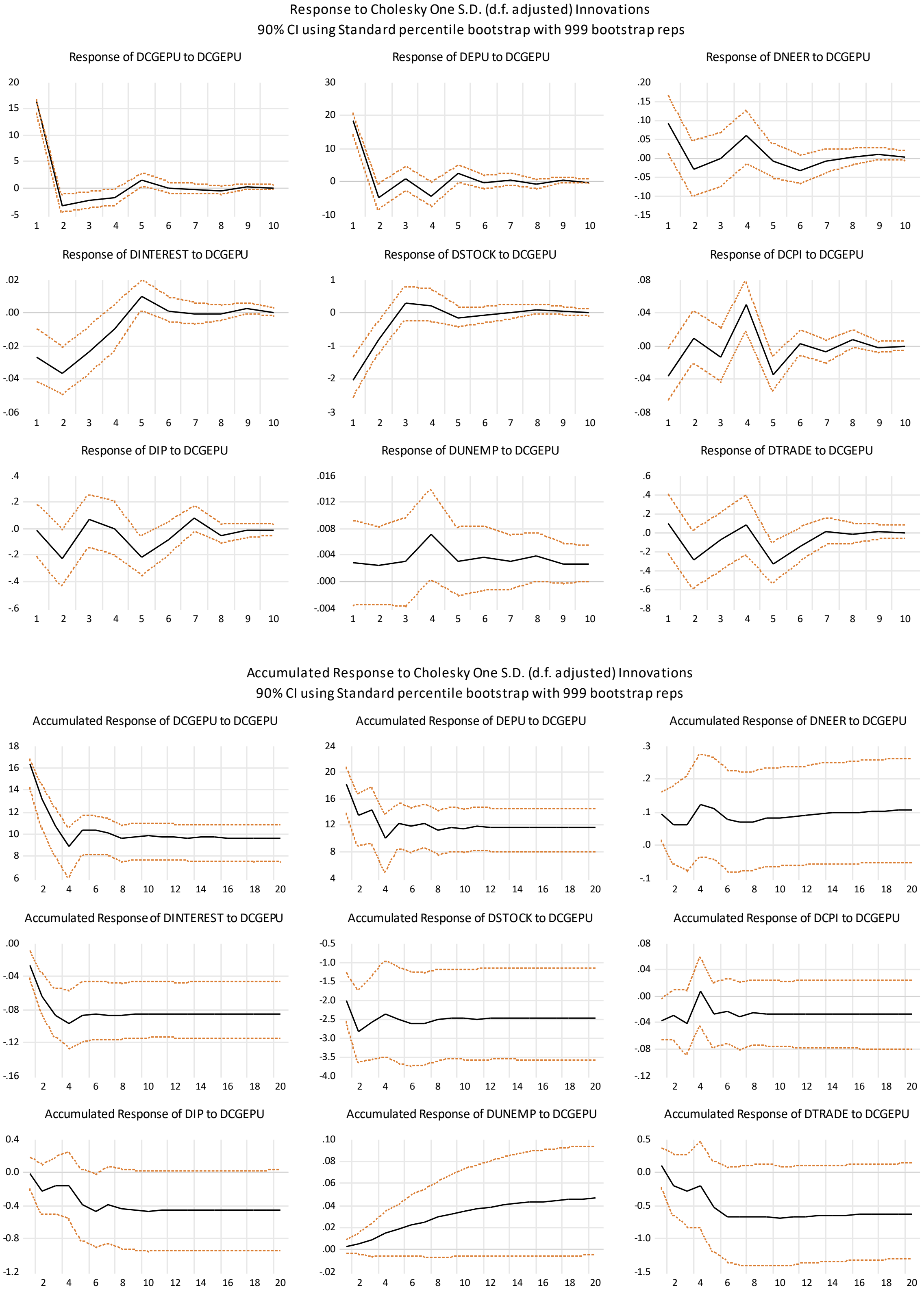
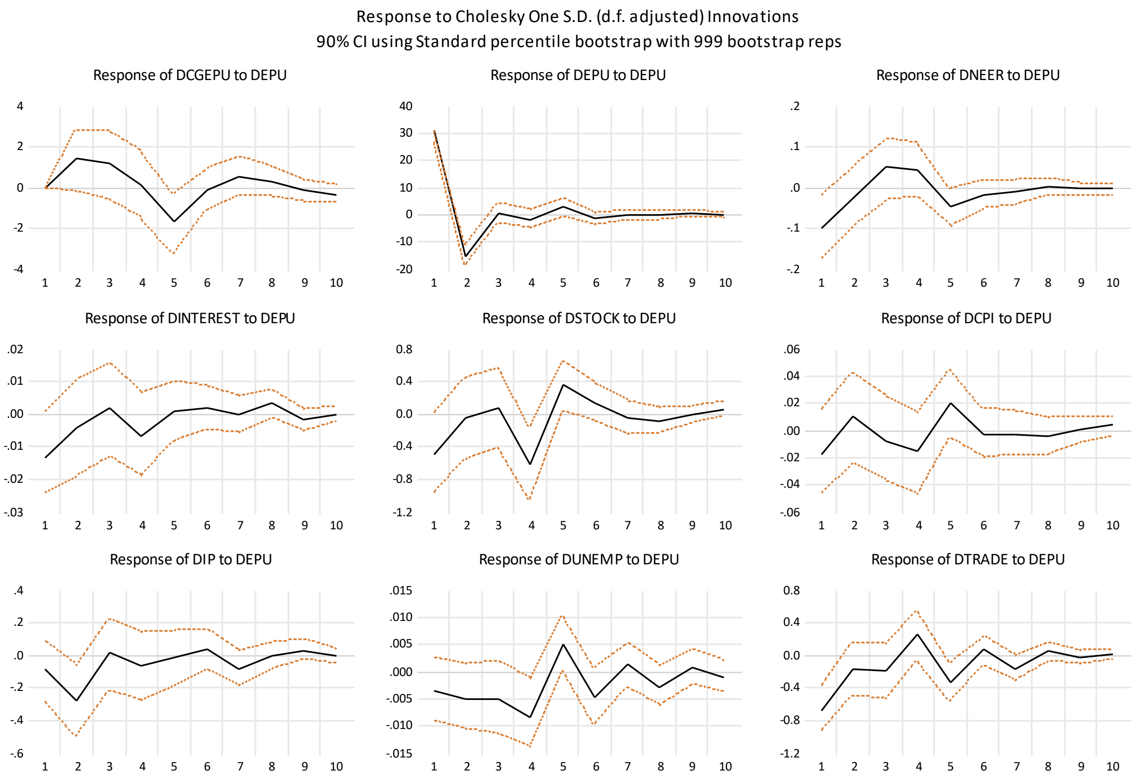


Fig 2-3. Germany

(a) IRFs and CIRFs to one SD cGEPU shock: Model A

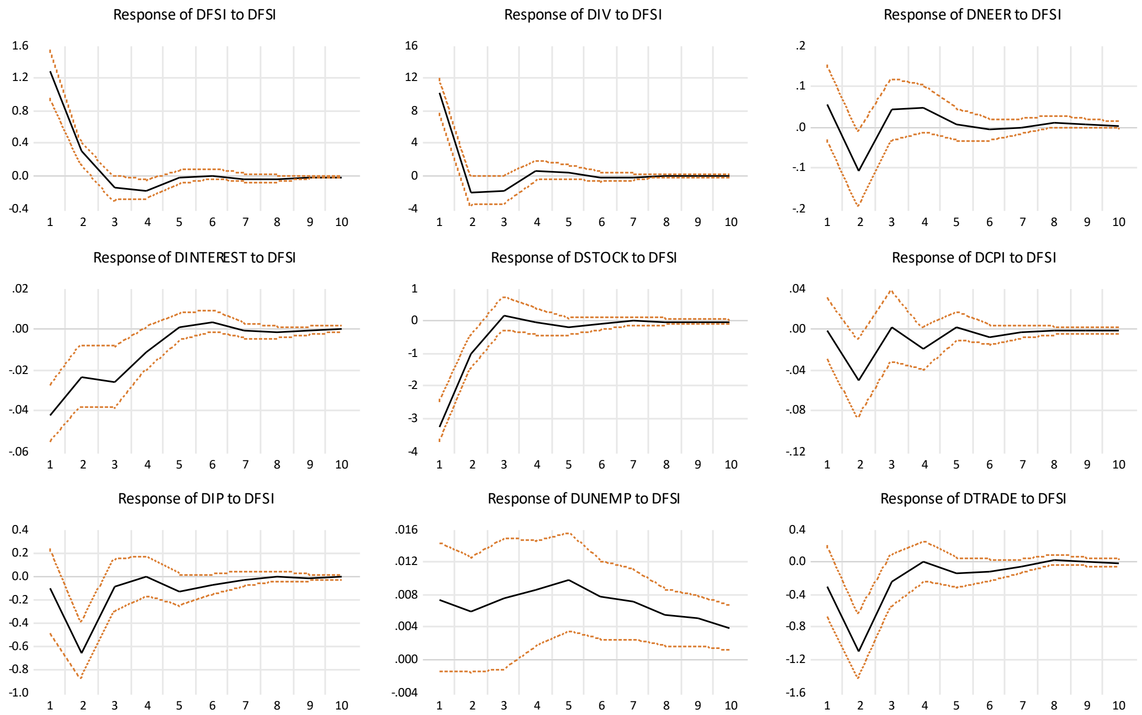


(b) IRFs and CIRFs to one SD EPU shock: Model A

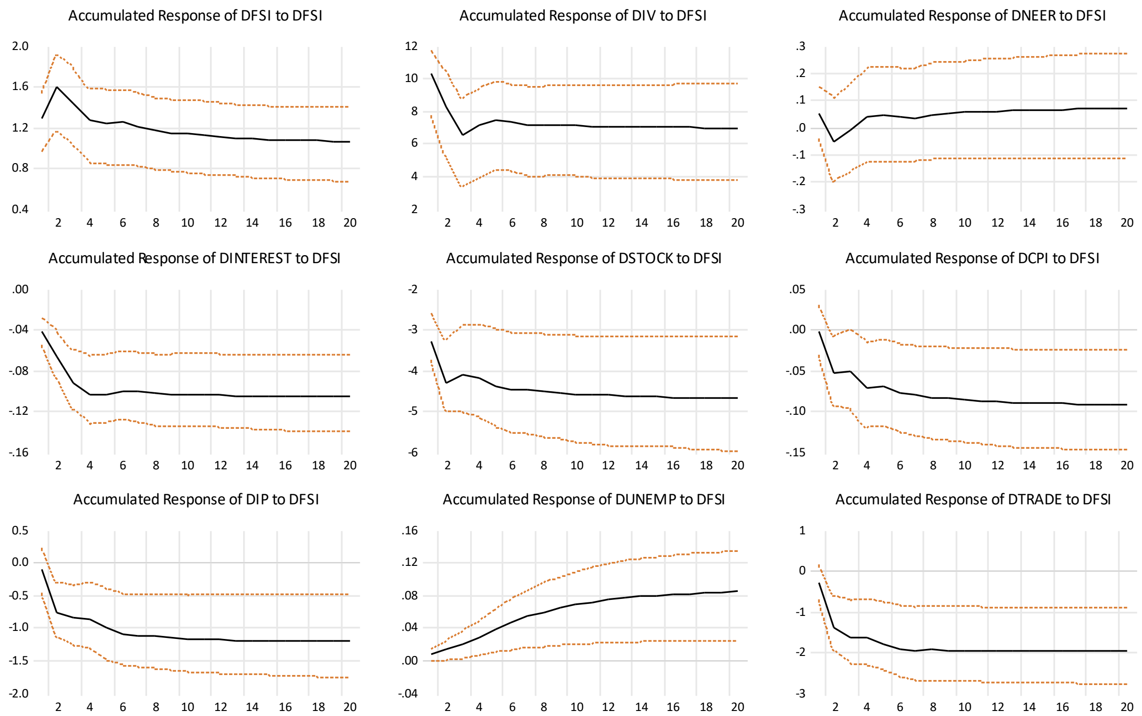


(c) IRFs and CIRFs to one SD FSI shock: Model B

Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps

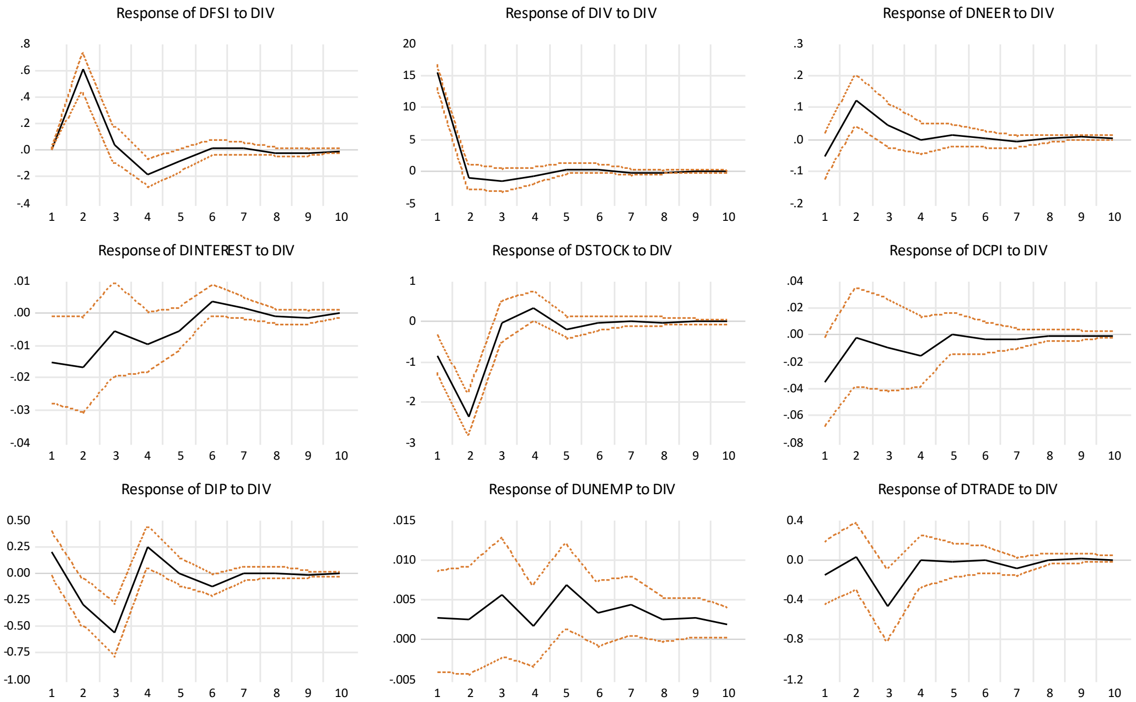


Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps



(d) IRFs and CIRFs to one SD IV shock: Model B

Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps



Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps

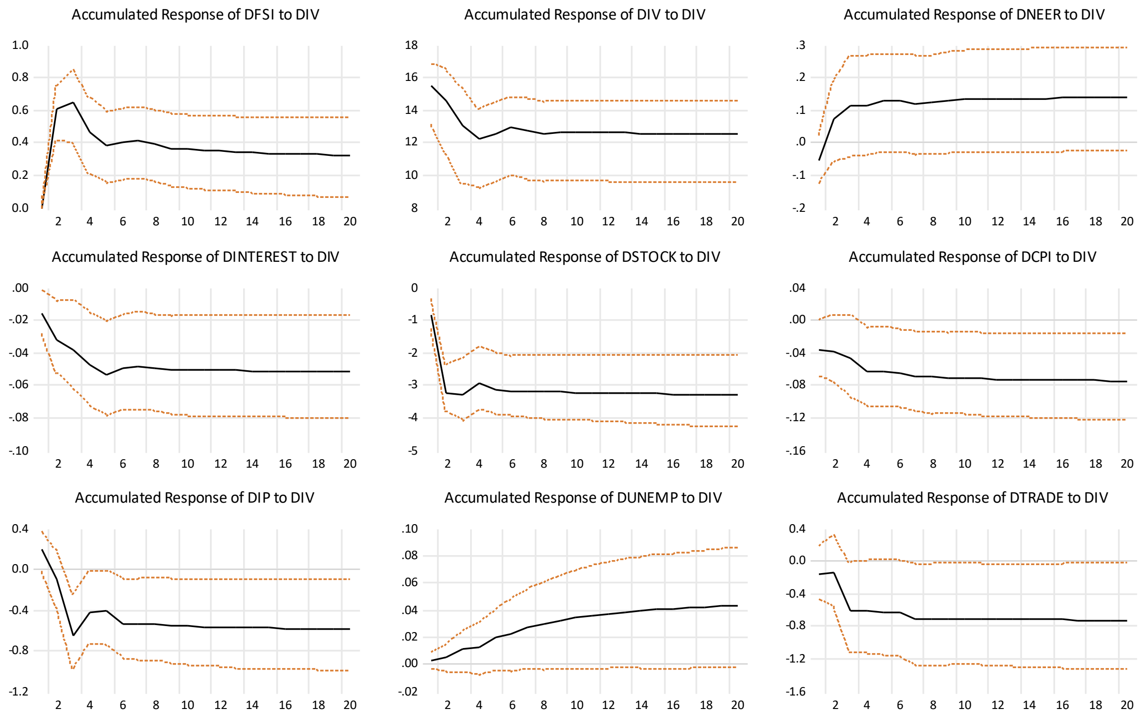
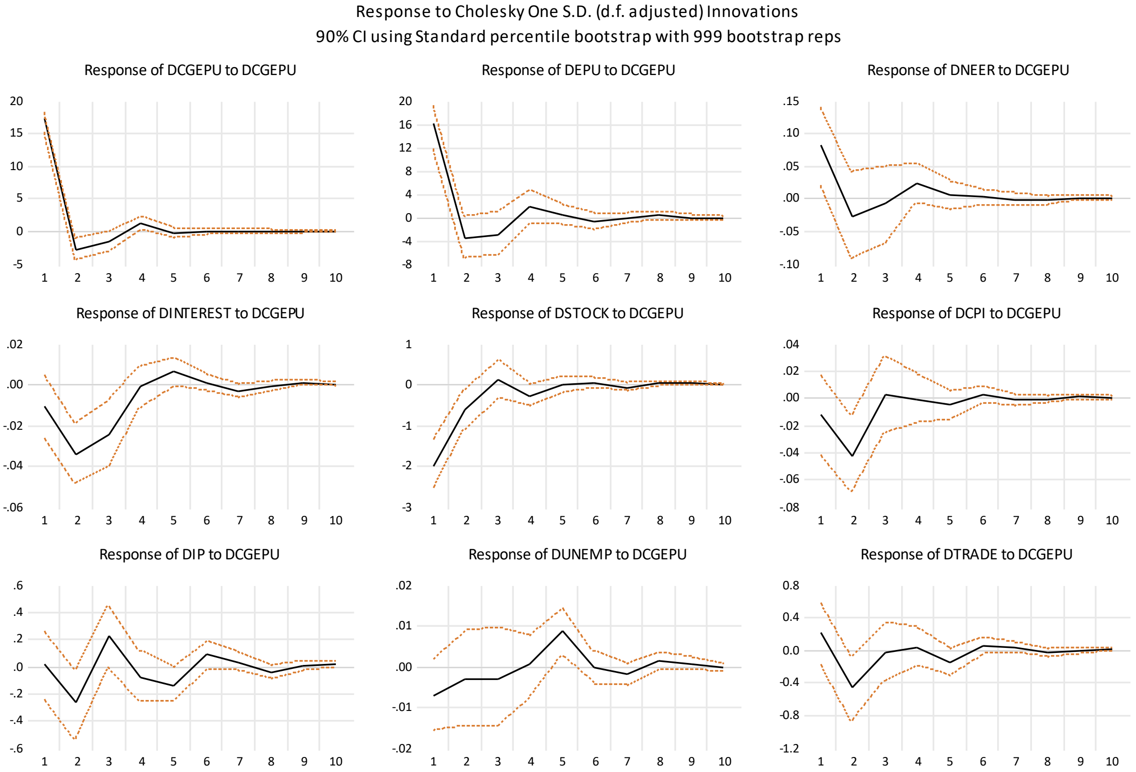
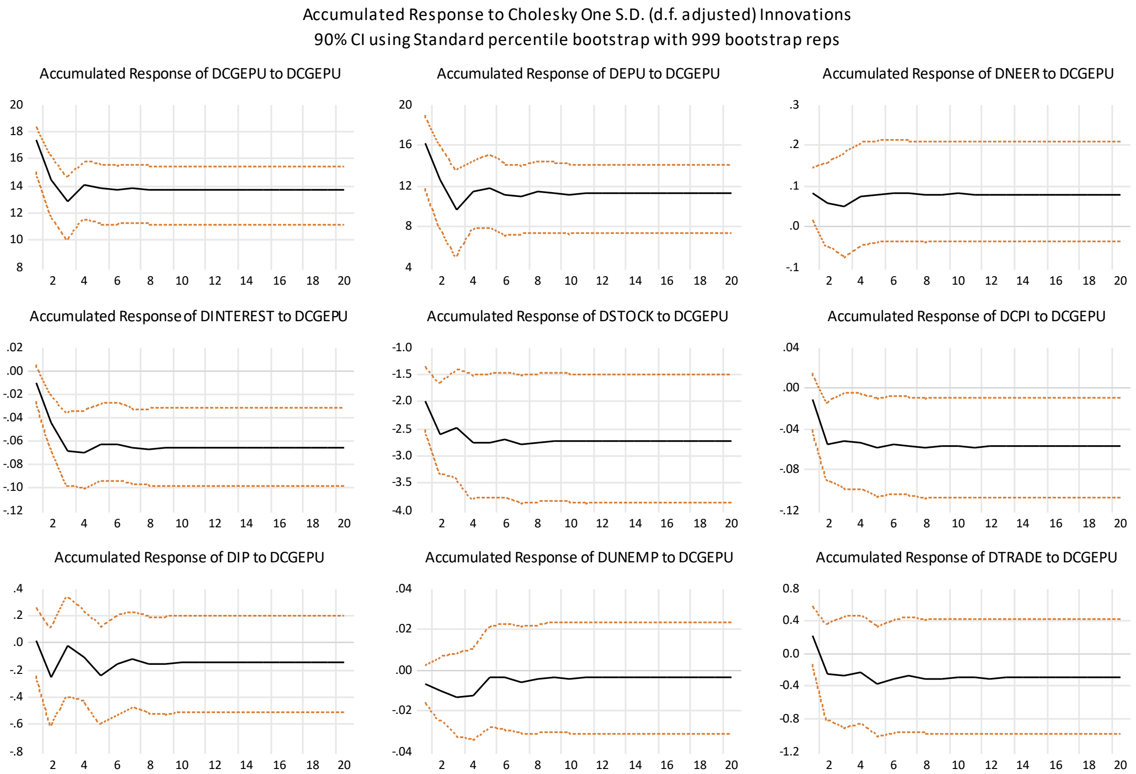


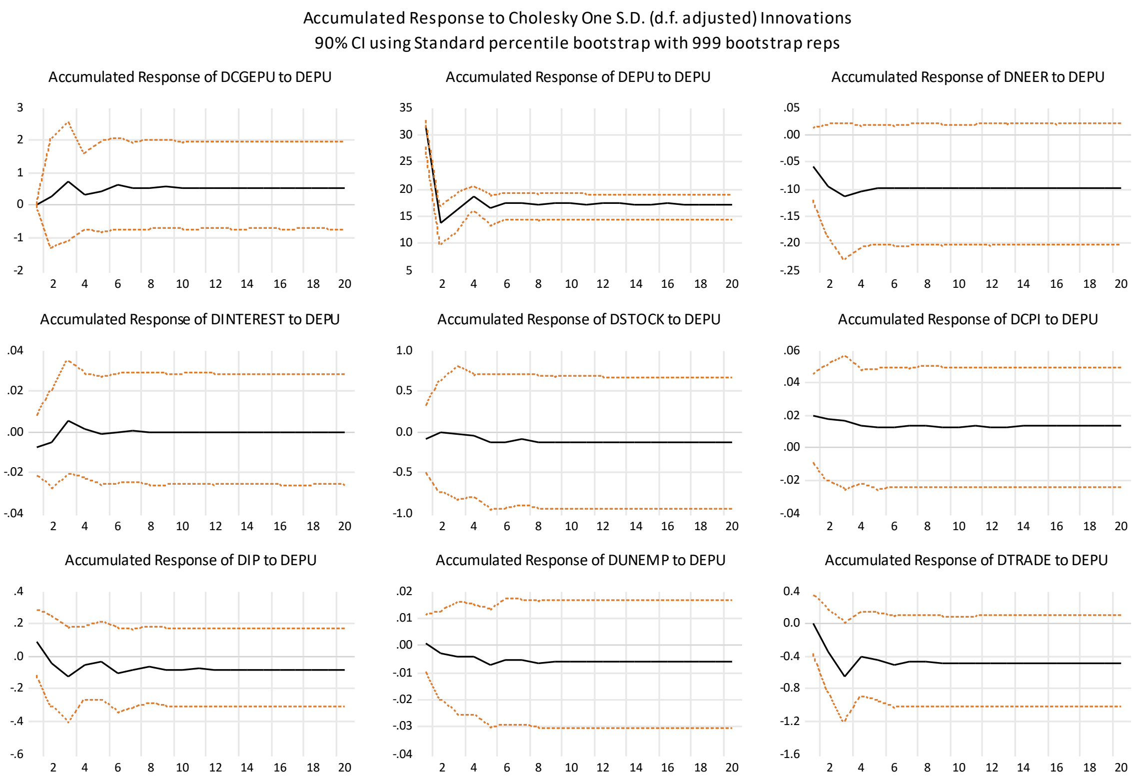
Fig 2-4. France

(a) IRFs and CIRFs to one SD cGEPU shock: Model A

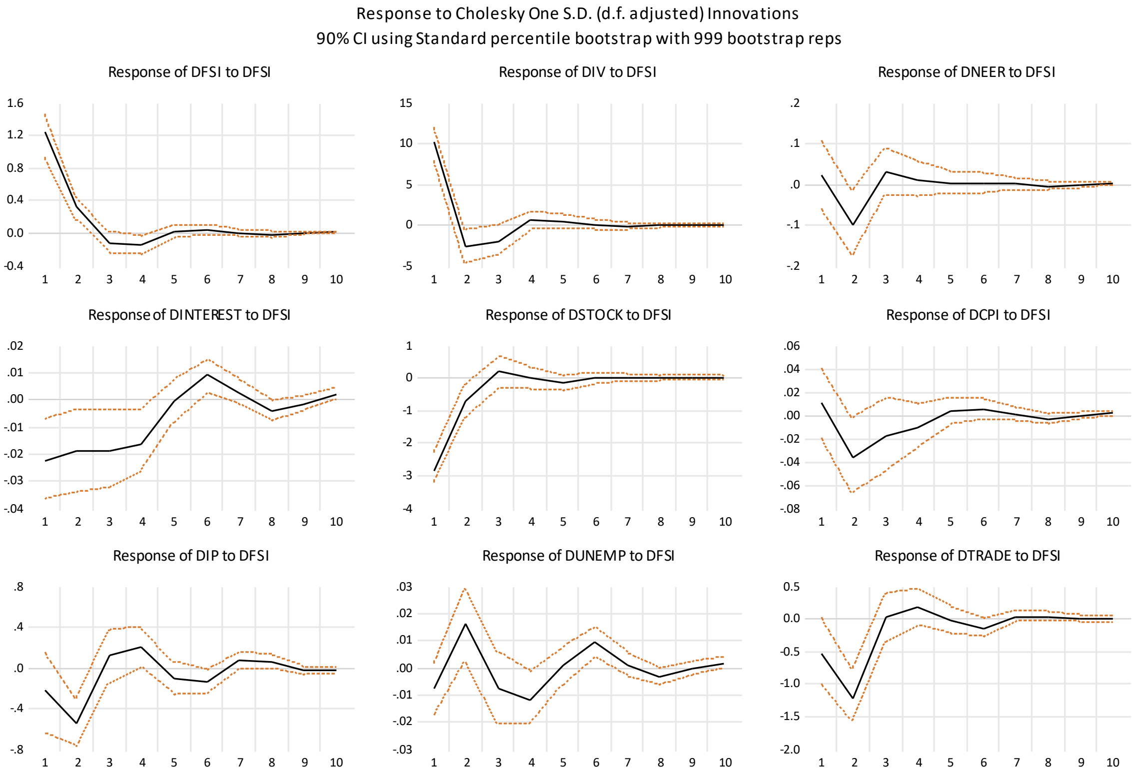


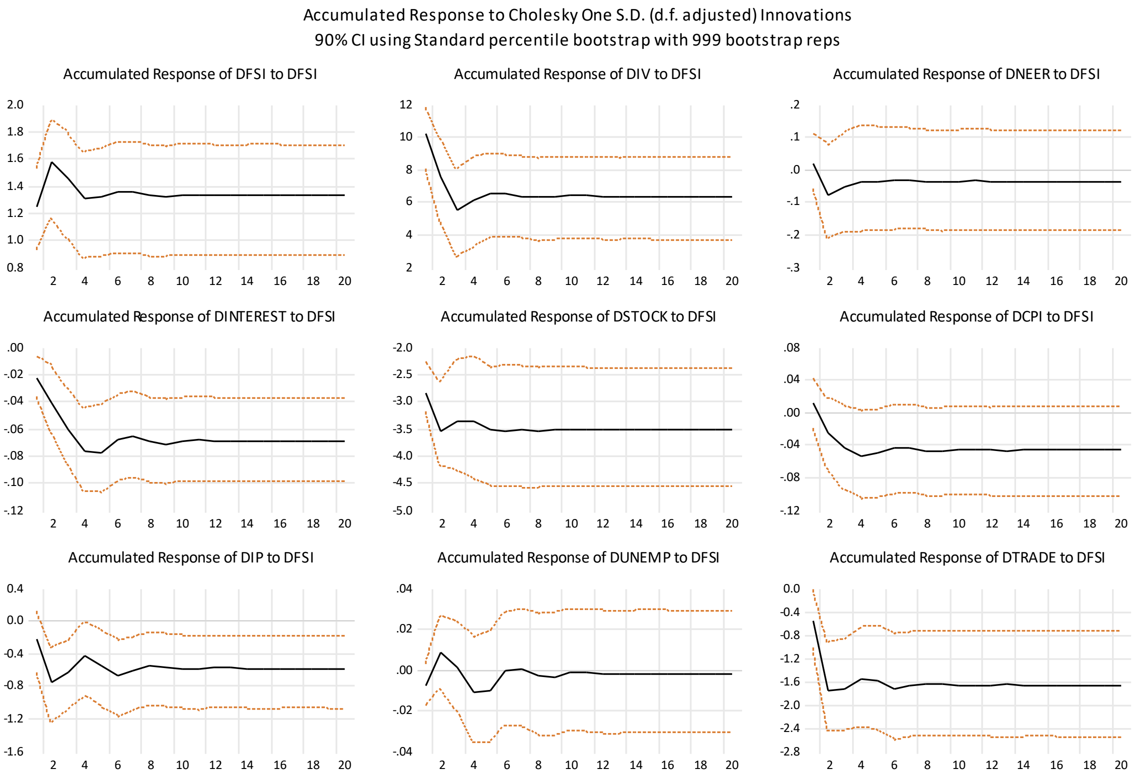


(b) IRFs and CIRFs to one SD EPU shock: Model A



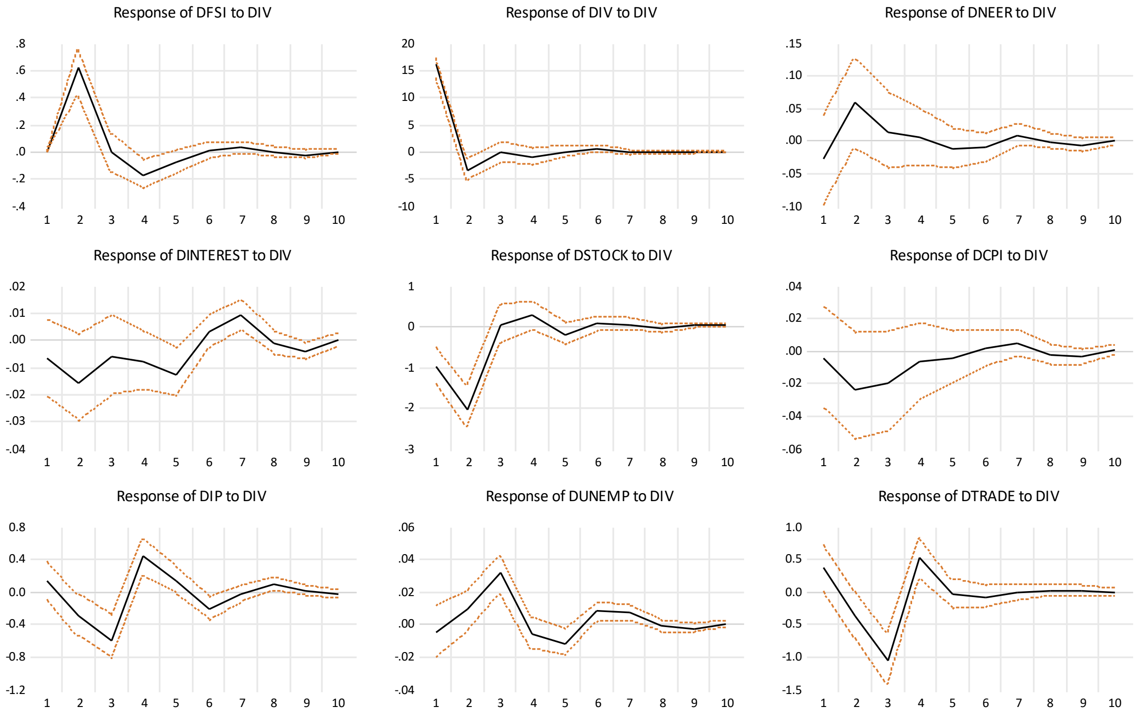
(c) IRFs and CIRFs to one SD FSI shock: Model B





(d) IRFs and CIRFs to one SD IV shock: Model B

Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps



Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps

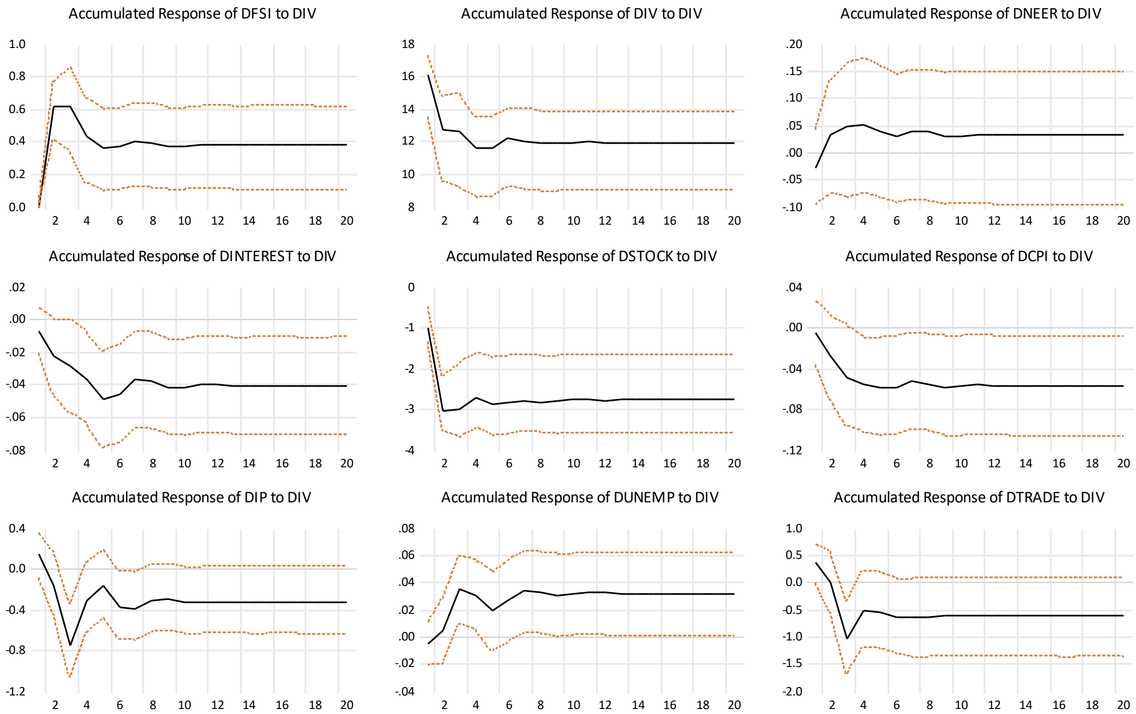
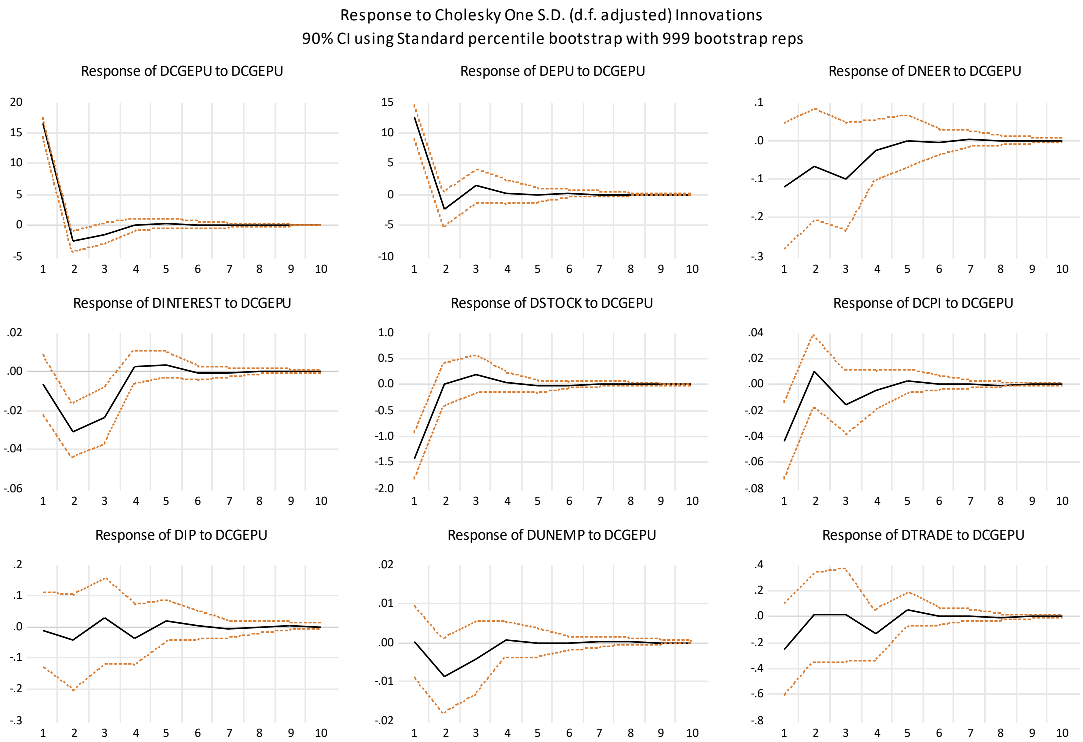
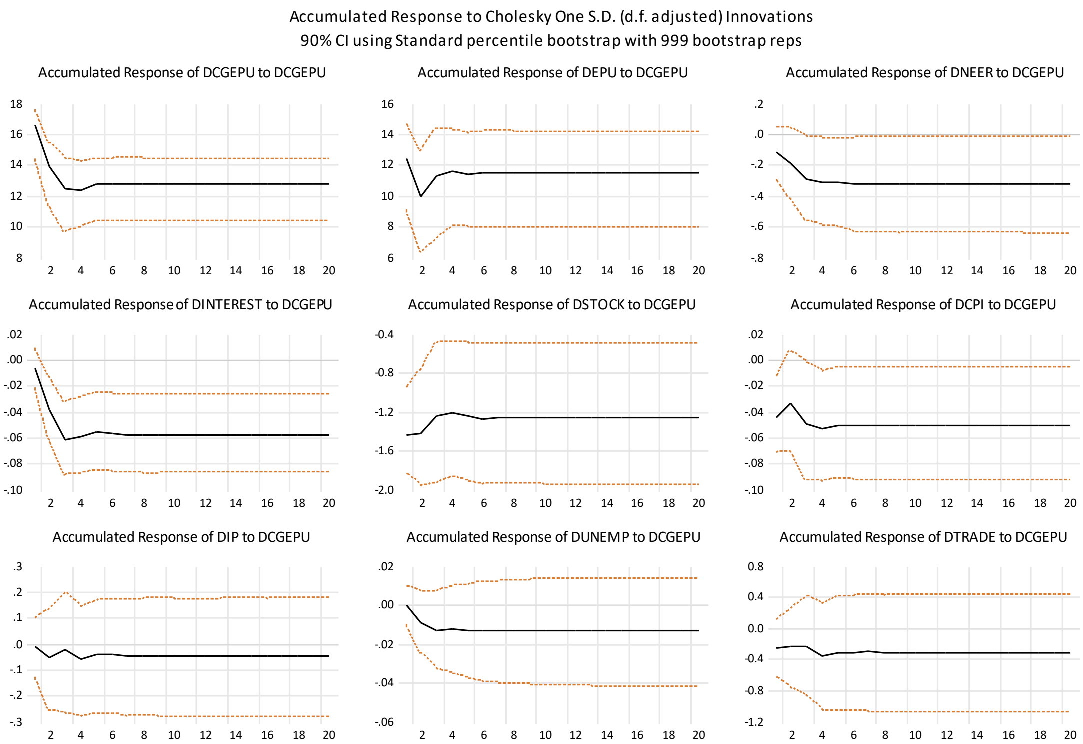


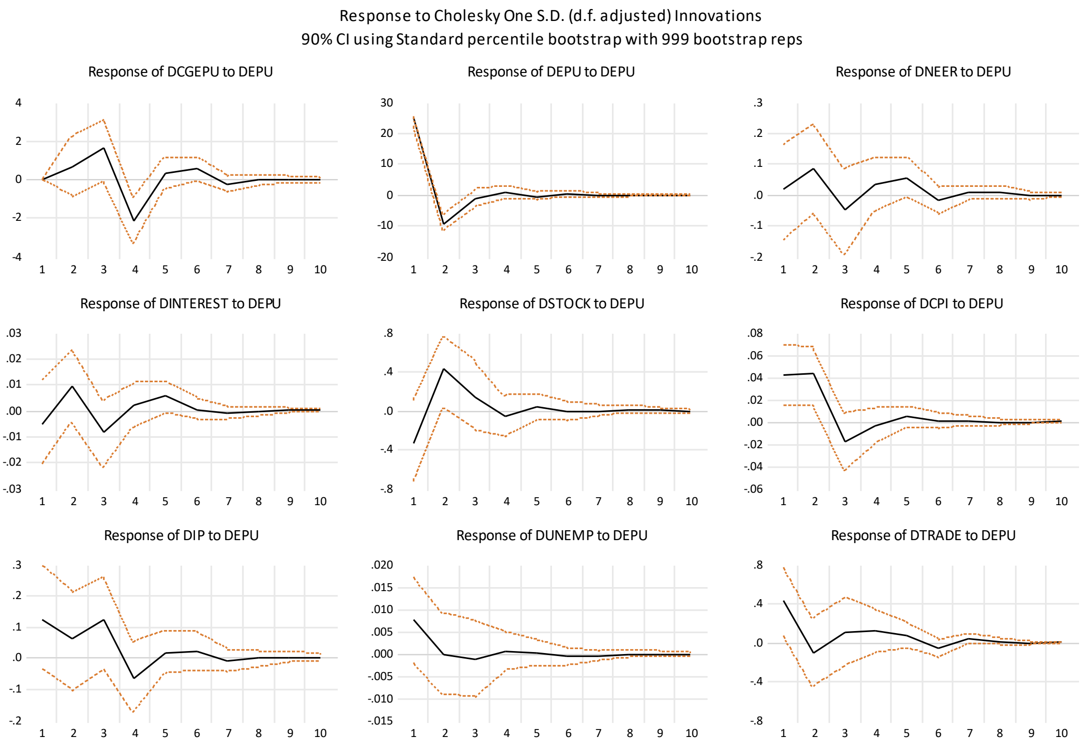
Fig 2-5. UK

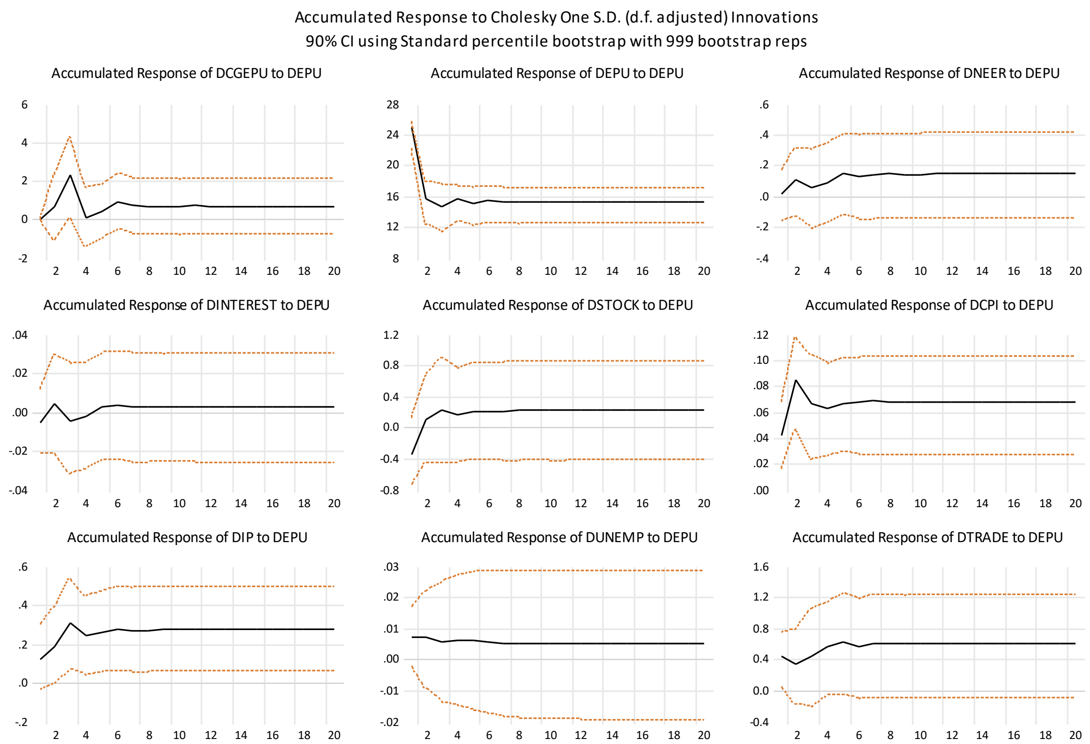
(a) IRFs and CIRFs to one SD cGEPU shock: Model A



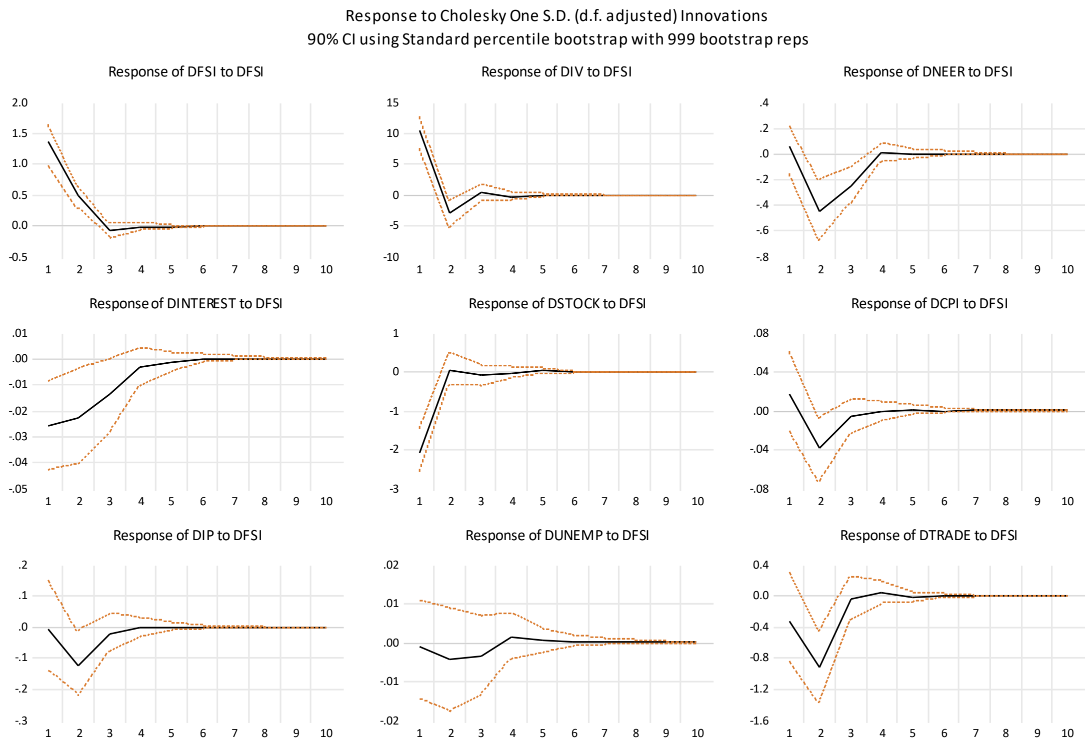


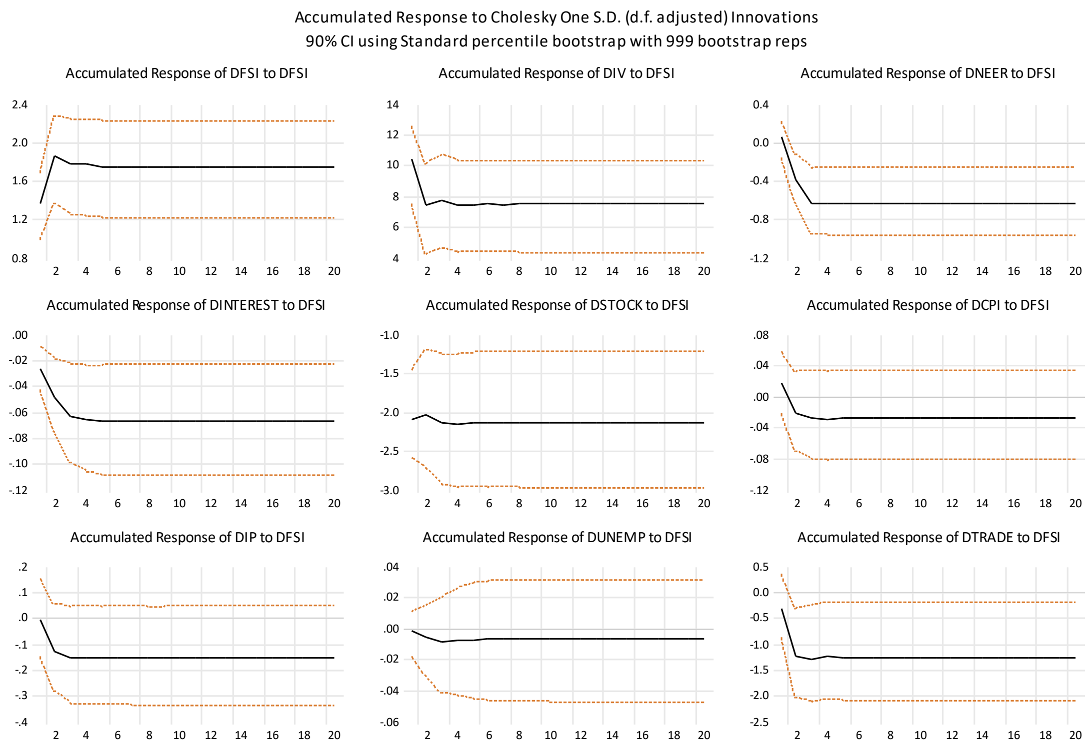
(b) IRFs and CIRFs to one SD EPU shock: Model A



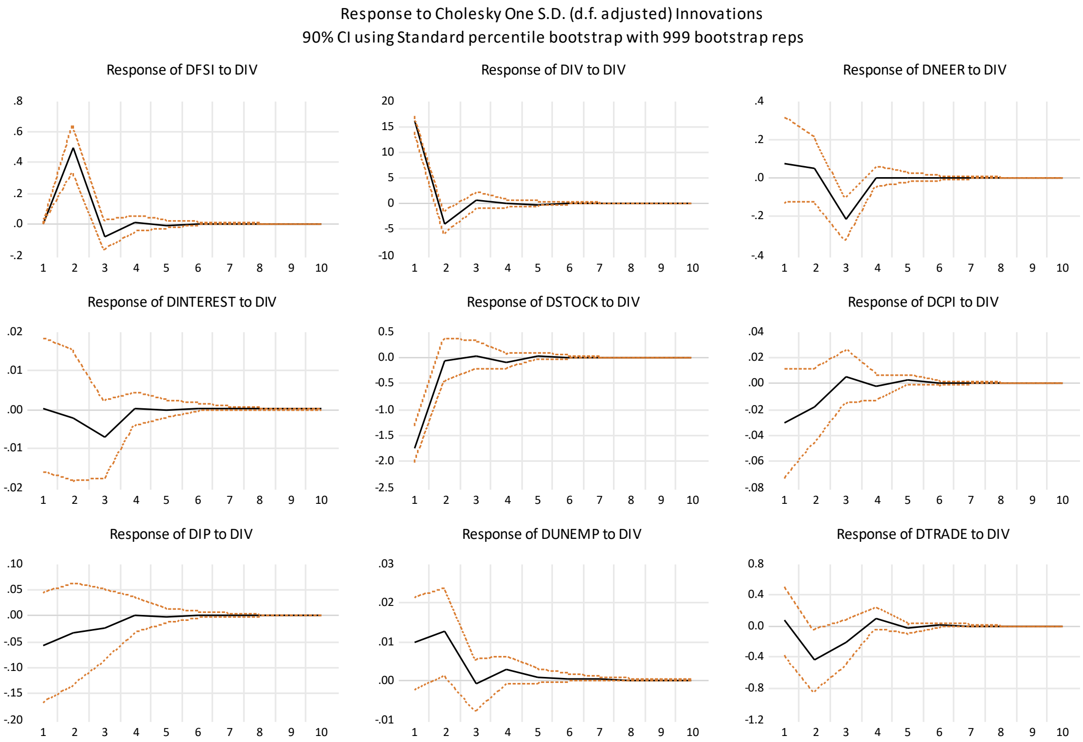


(c) IRFs and CIRFs to one SD FSI shock: Model B





(d) IRFs and CIRFs to one SD IV shock: Model B



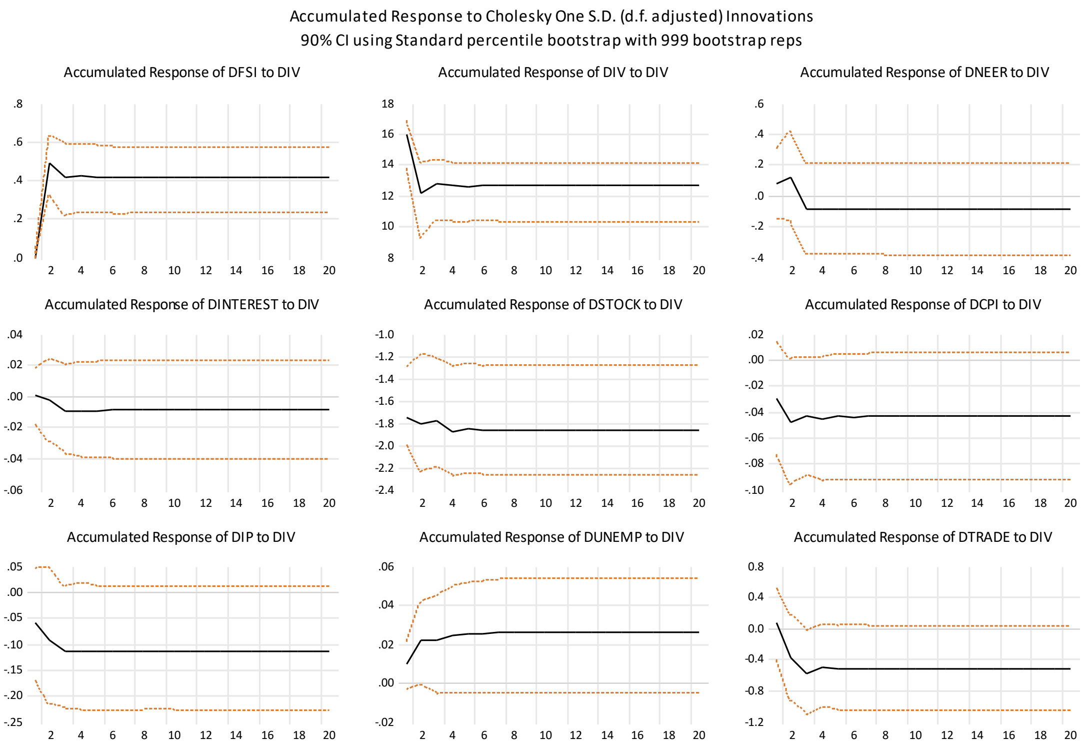
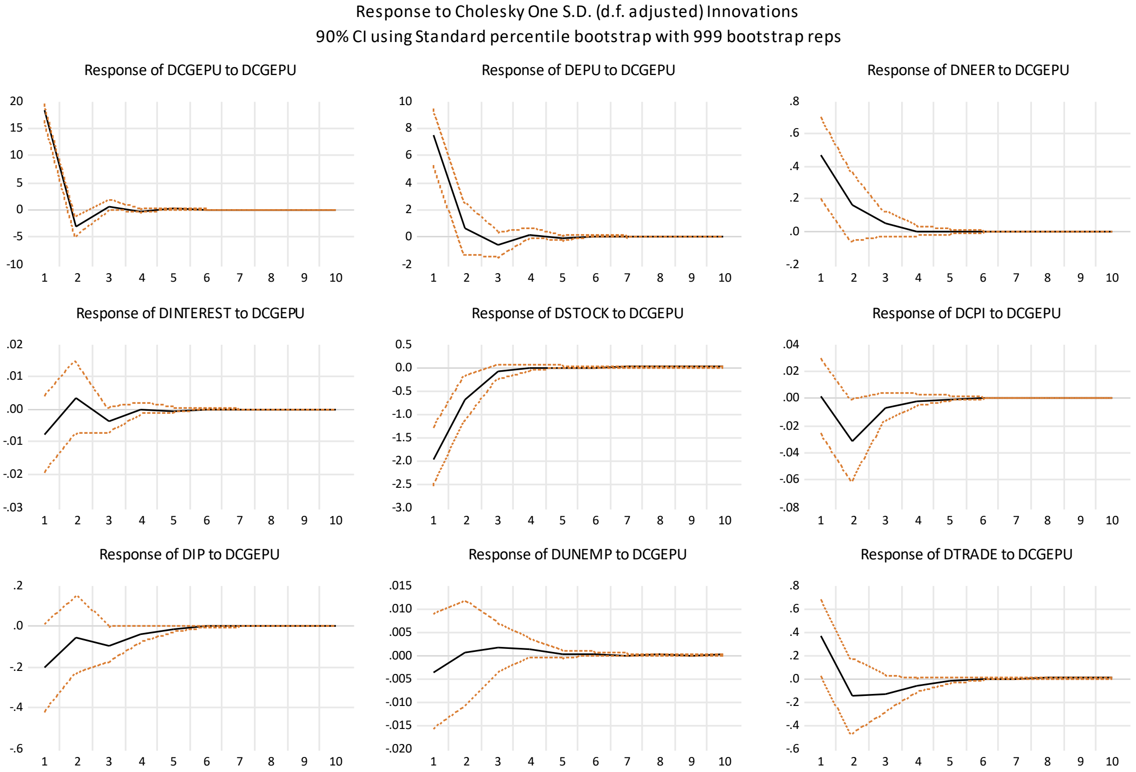
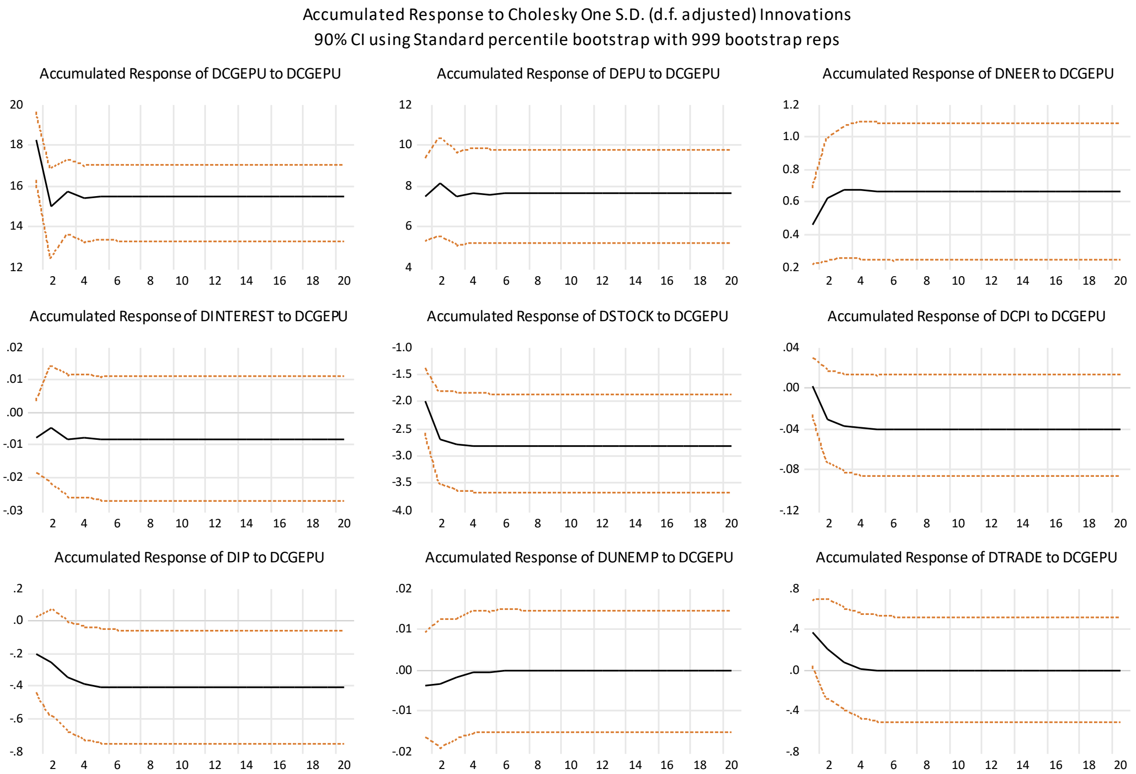


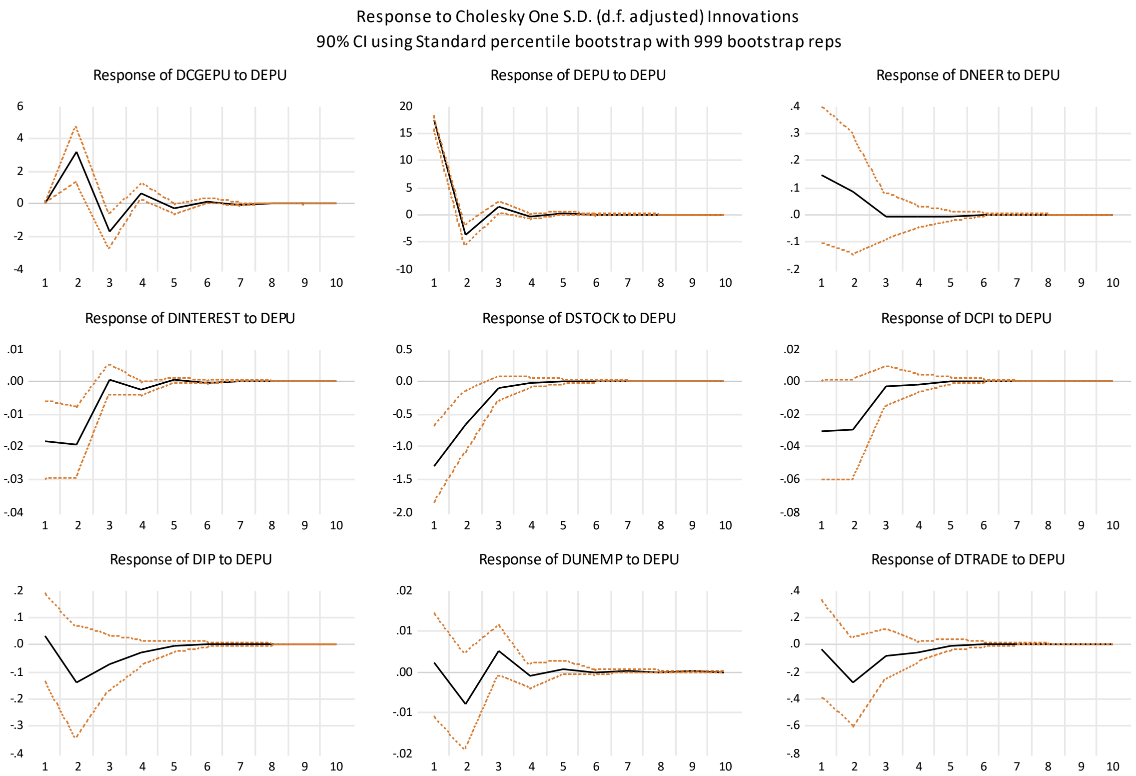
Fig 2-6. Japan

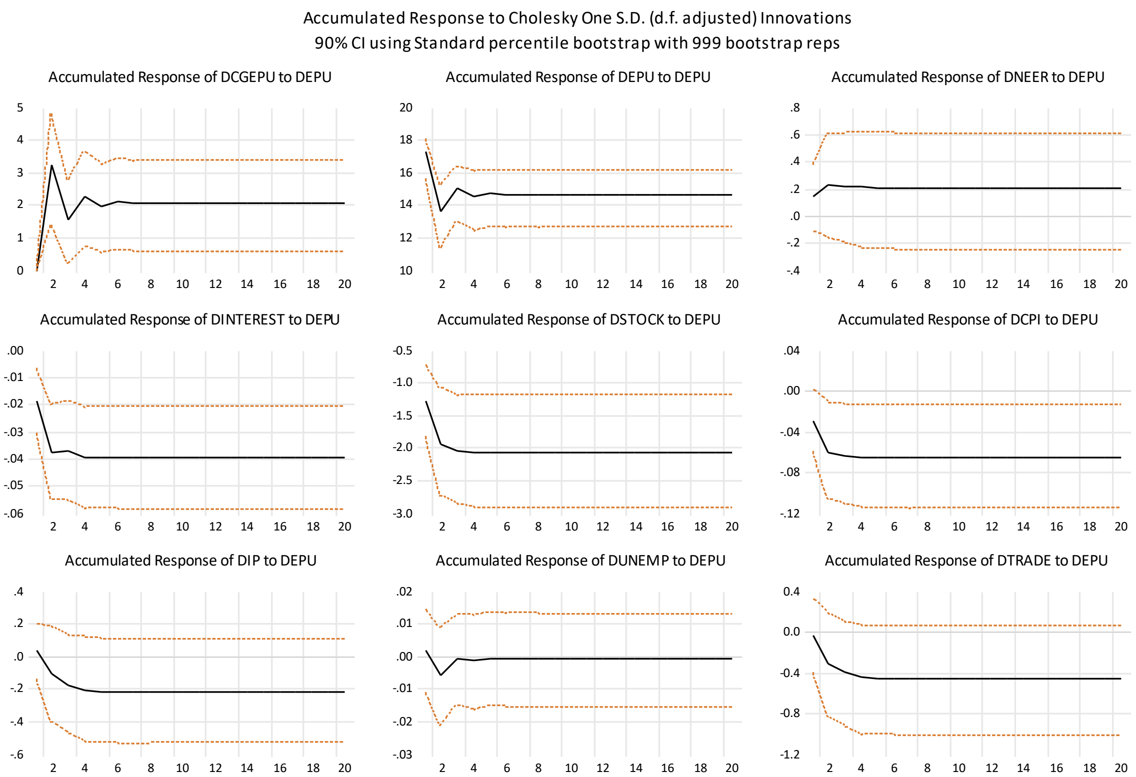
(a) IRFs and CIRFs to one SD cGEPU shock: Model A



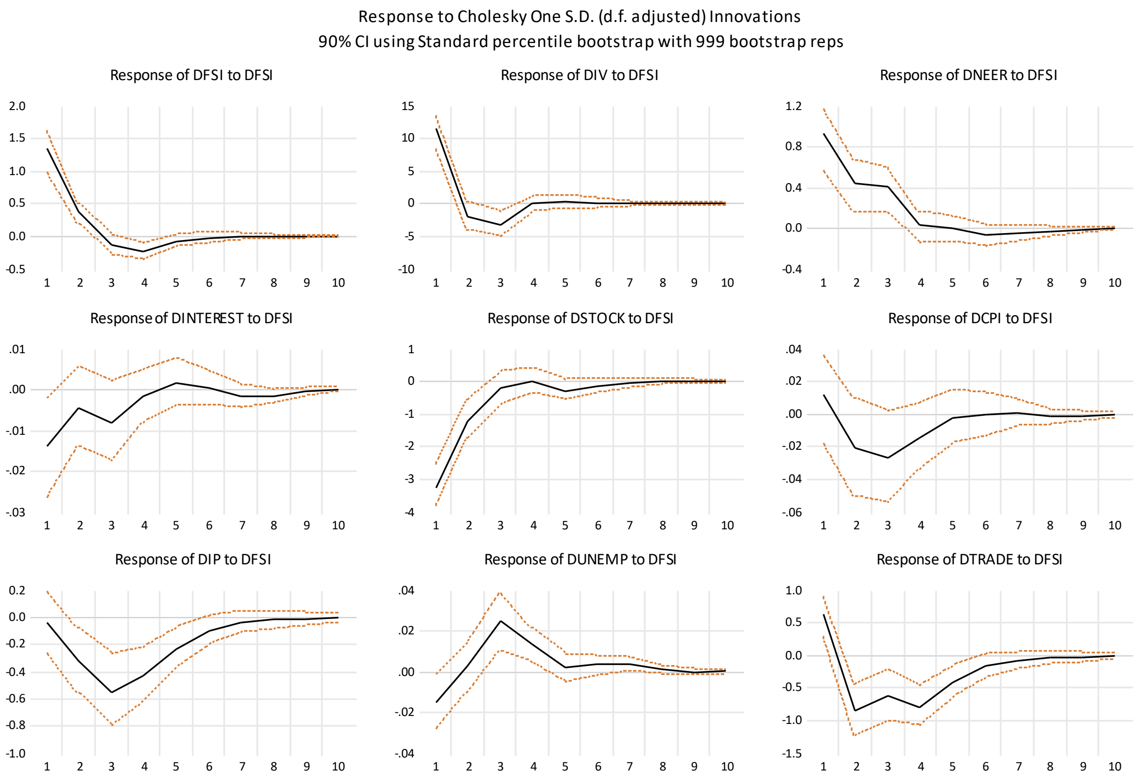


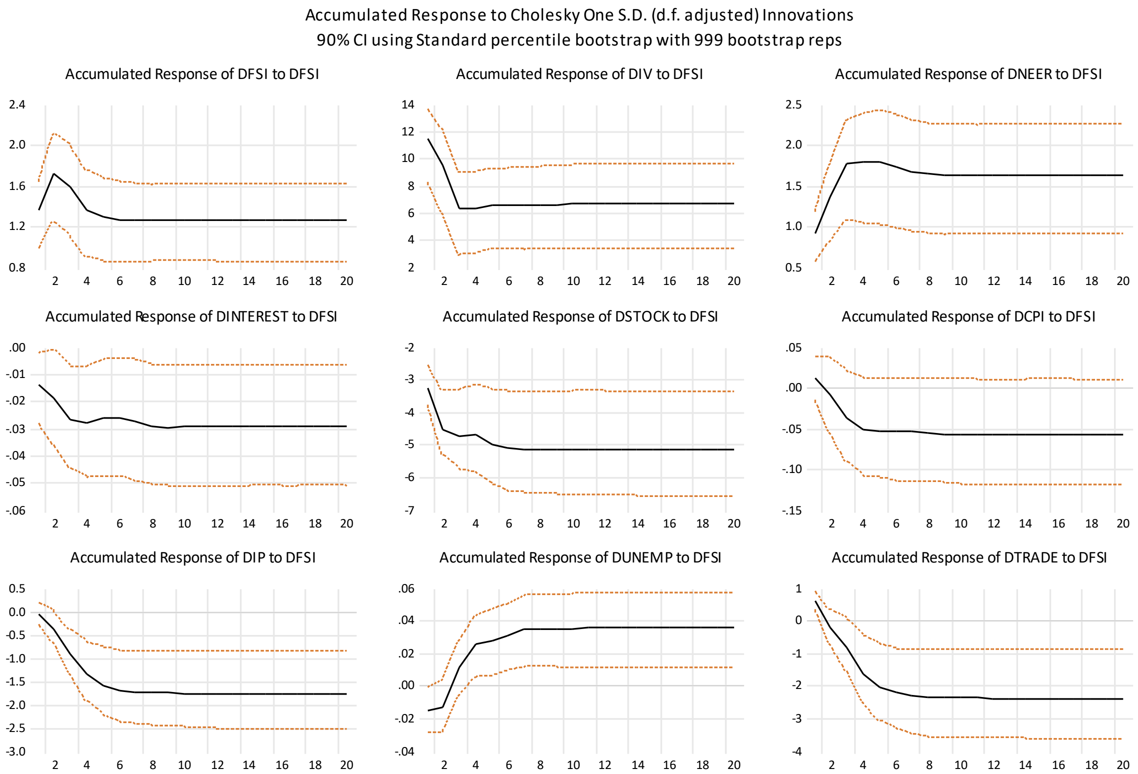
(b) IRFs and CIRFs to one SD EPU shock: Model A



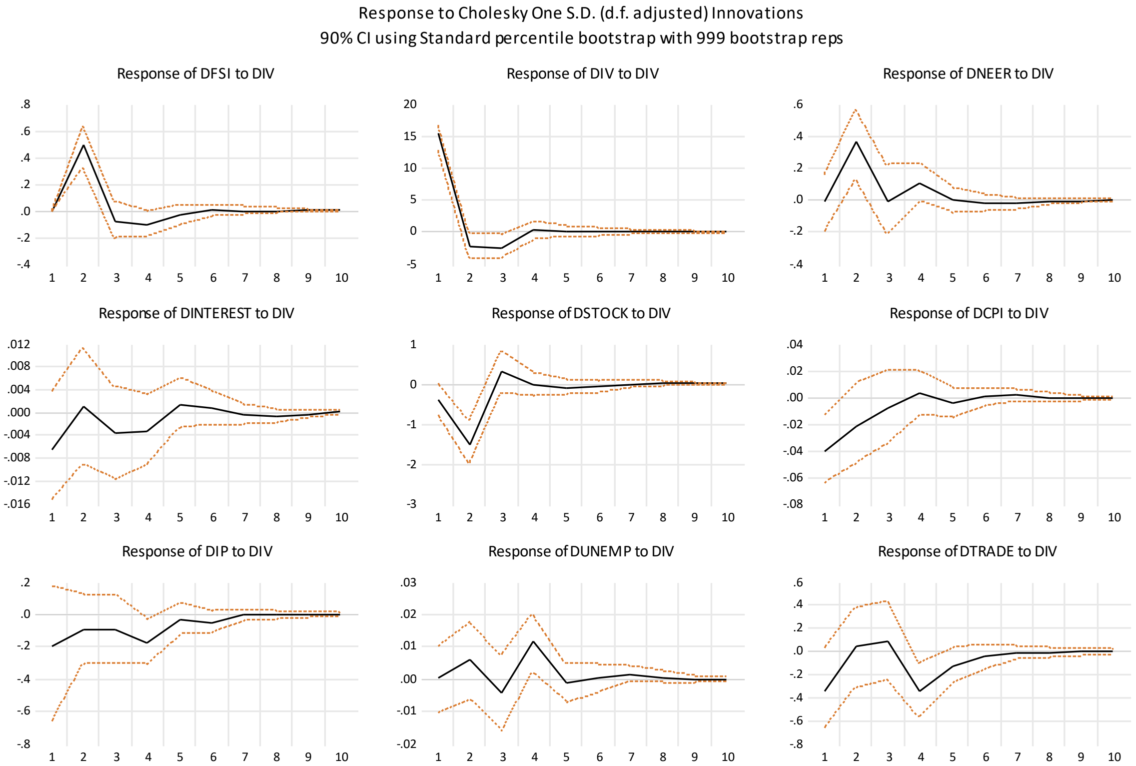


(c) IRFs and CIRFs to one SD FSI shock: Model B





(d) IRFs and CIRFs to one SD IV shock: Model B



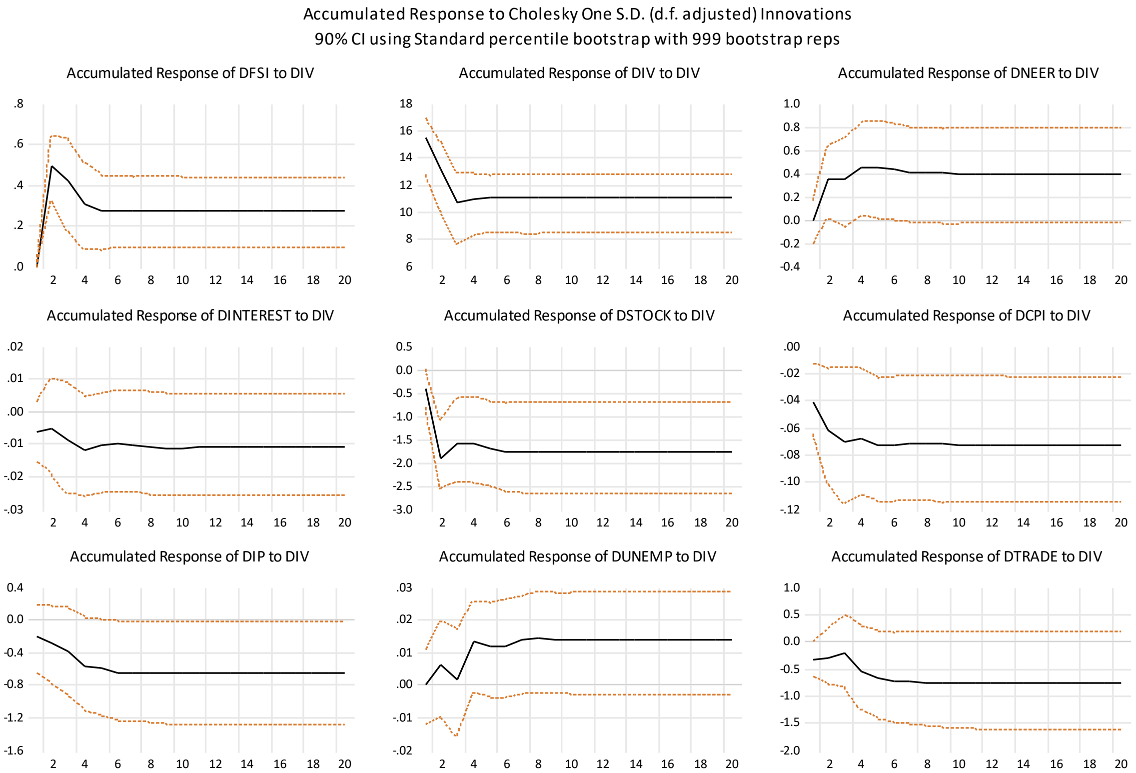
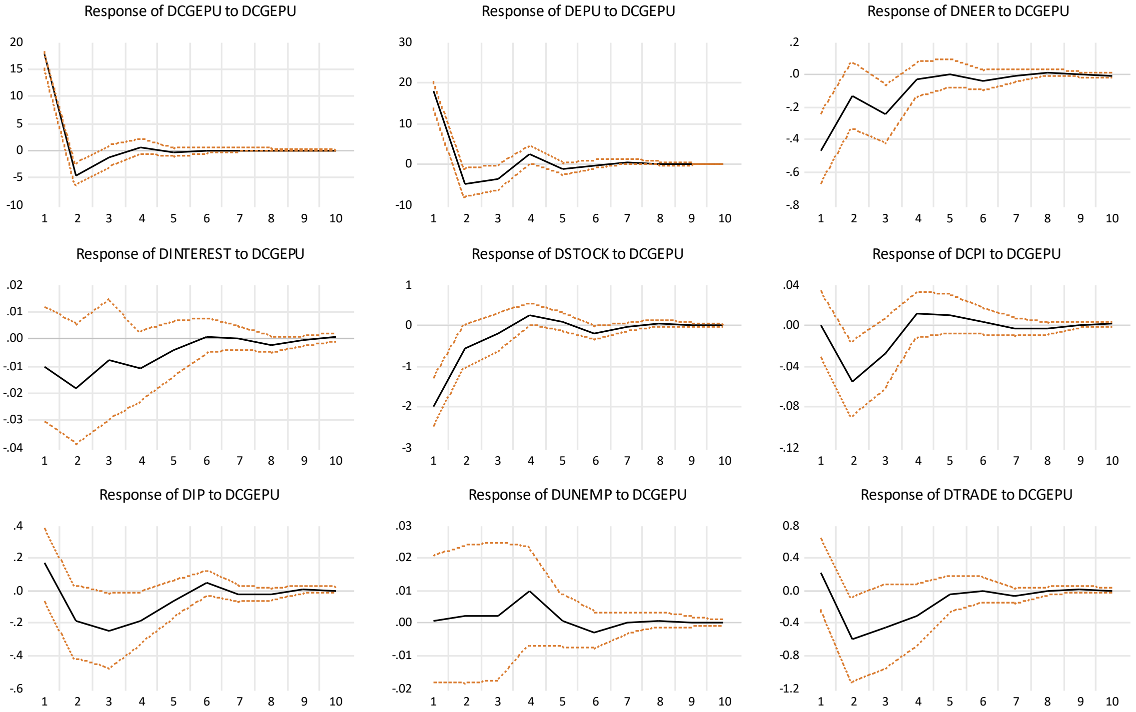


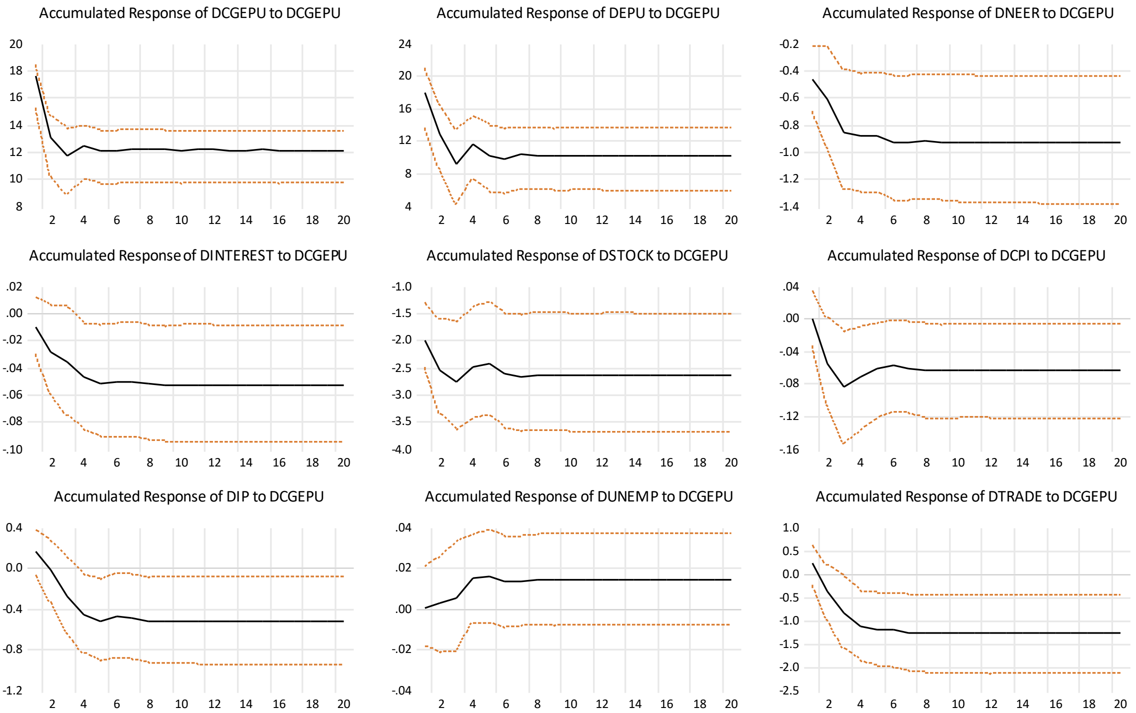
Fig 2-7. Japan

(a) IRFs and CIRFs to one SD cGEPU shock: Model A

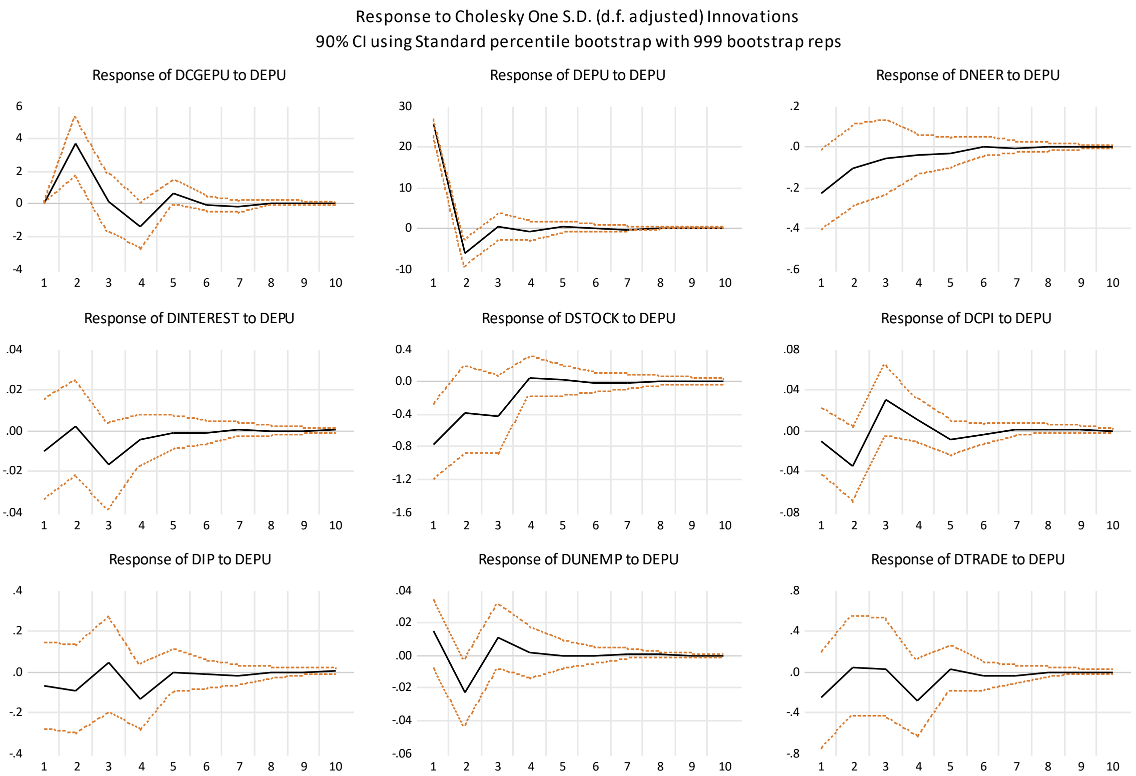
Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps

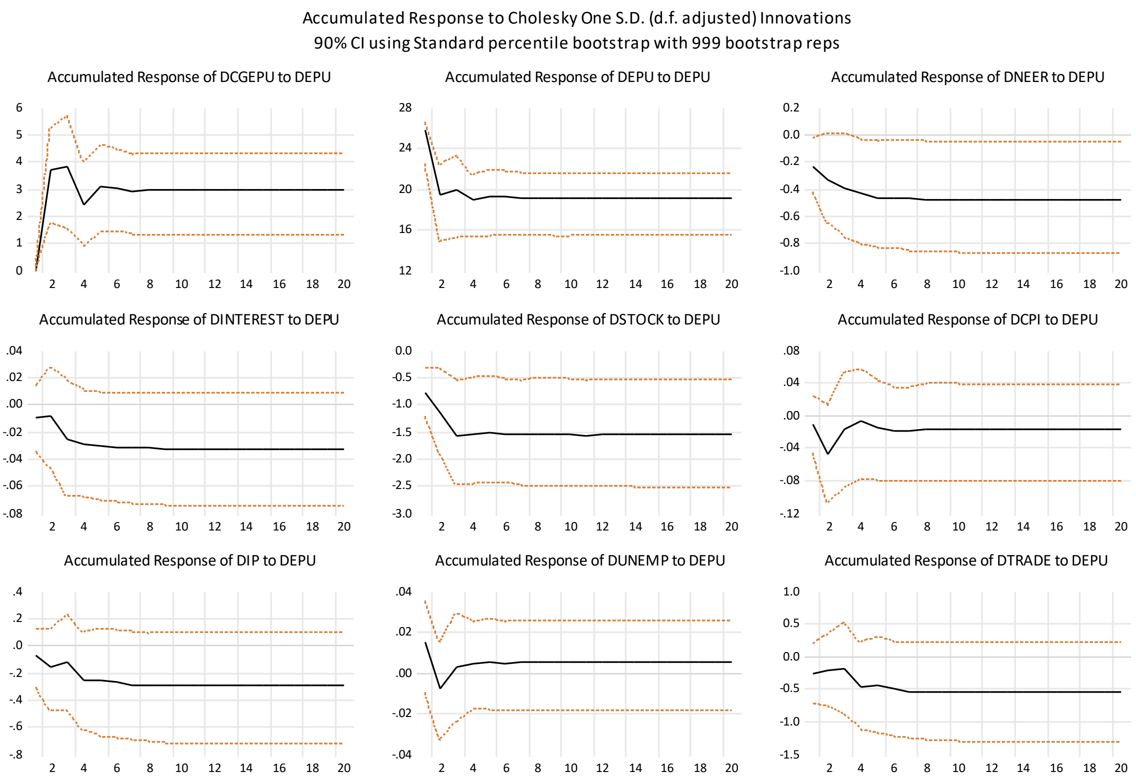


Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps



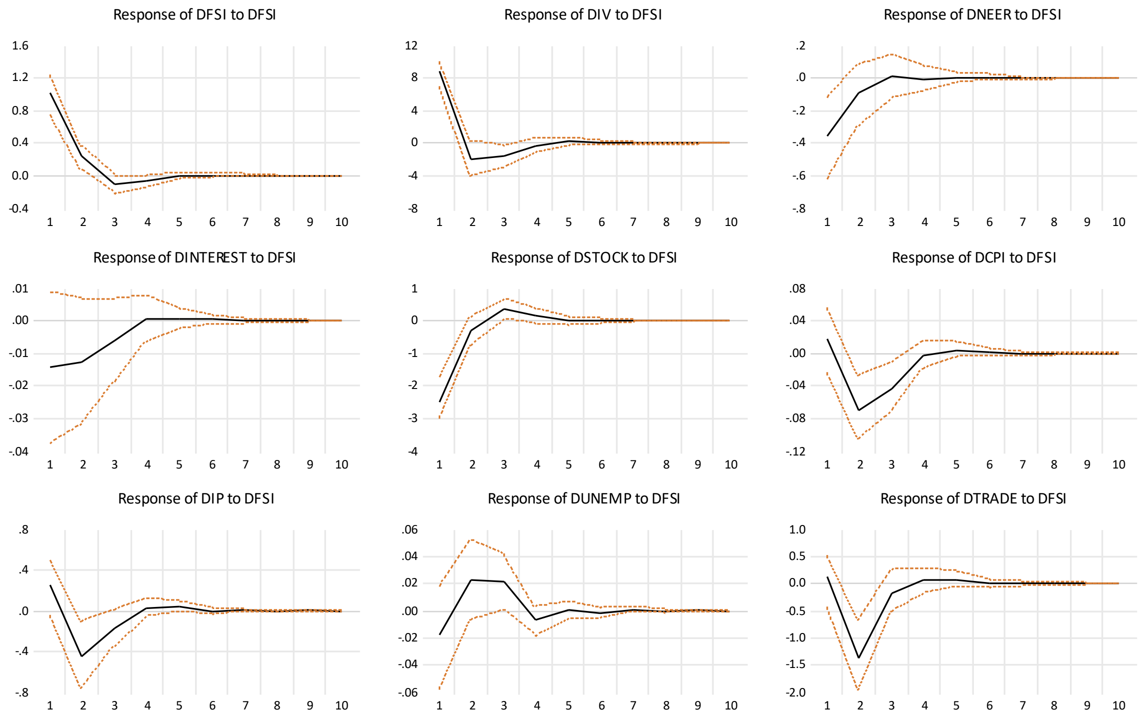
(b) IRFs and CIRFs to one SD EPU shock: Model A



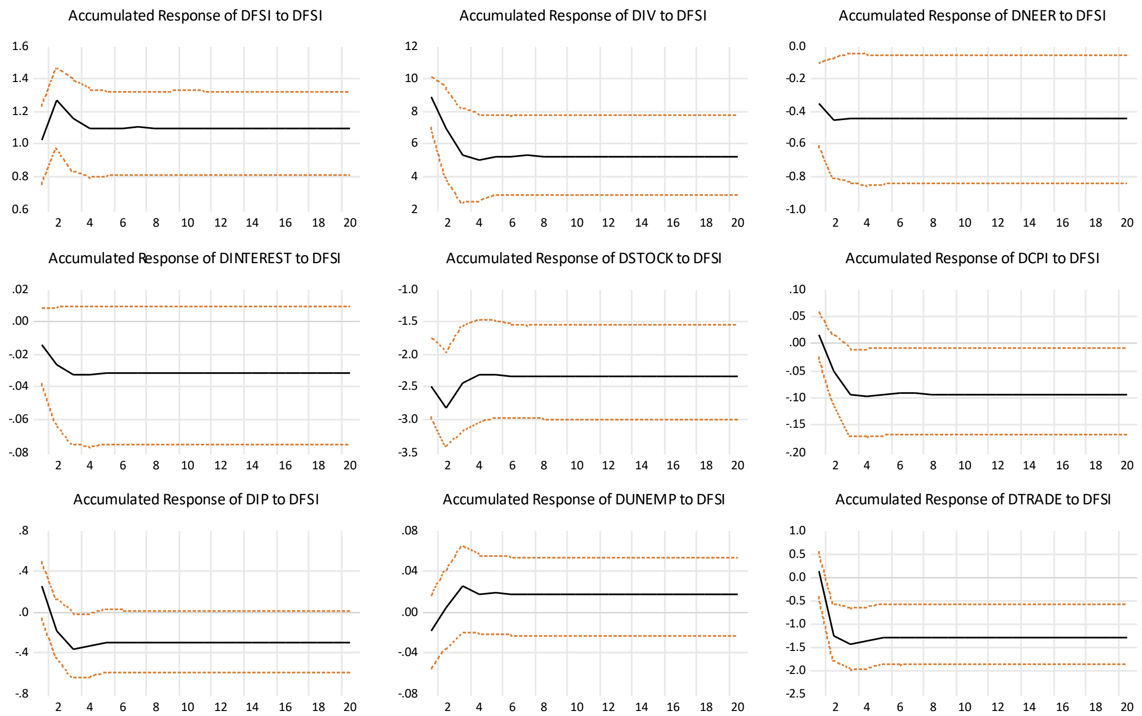


(c) IRFs and CIRFs to one SD FSI shock: Model B

Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps

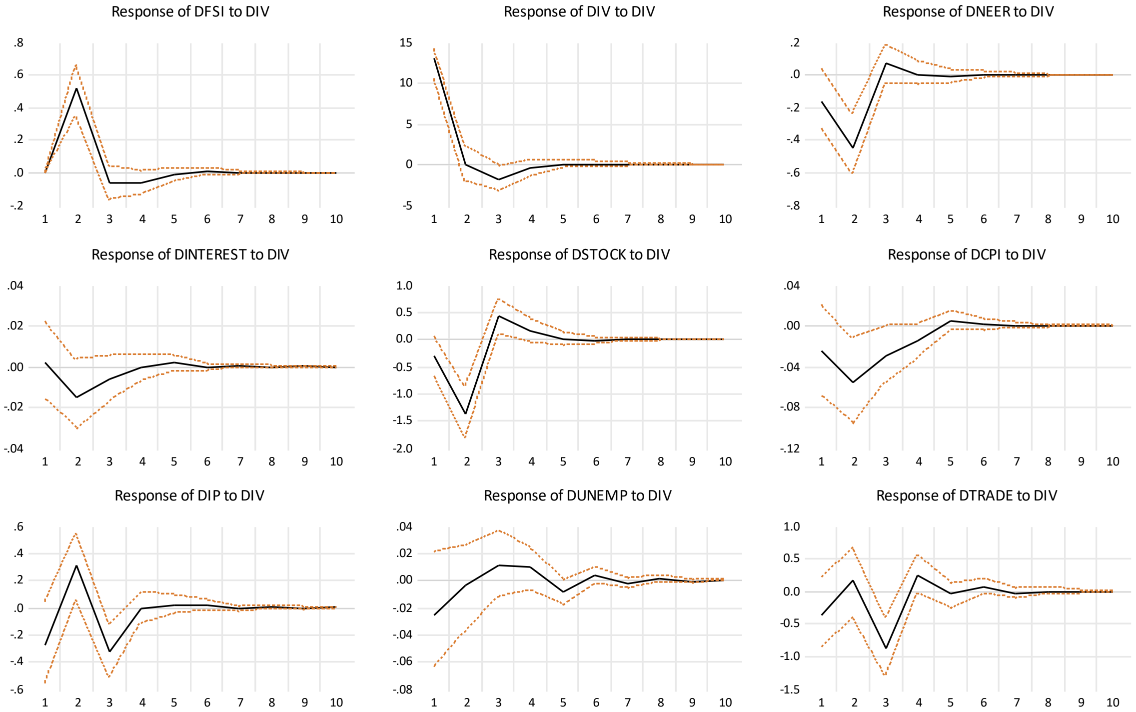


Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps



(d) IRFs and CIRFs to one SD IV shock: Model B

Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps



Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps

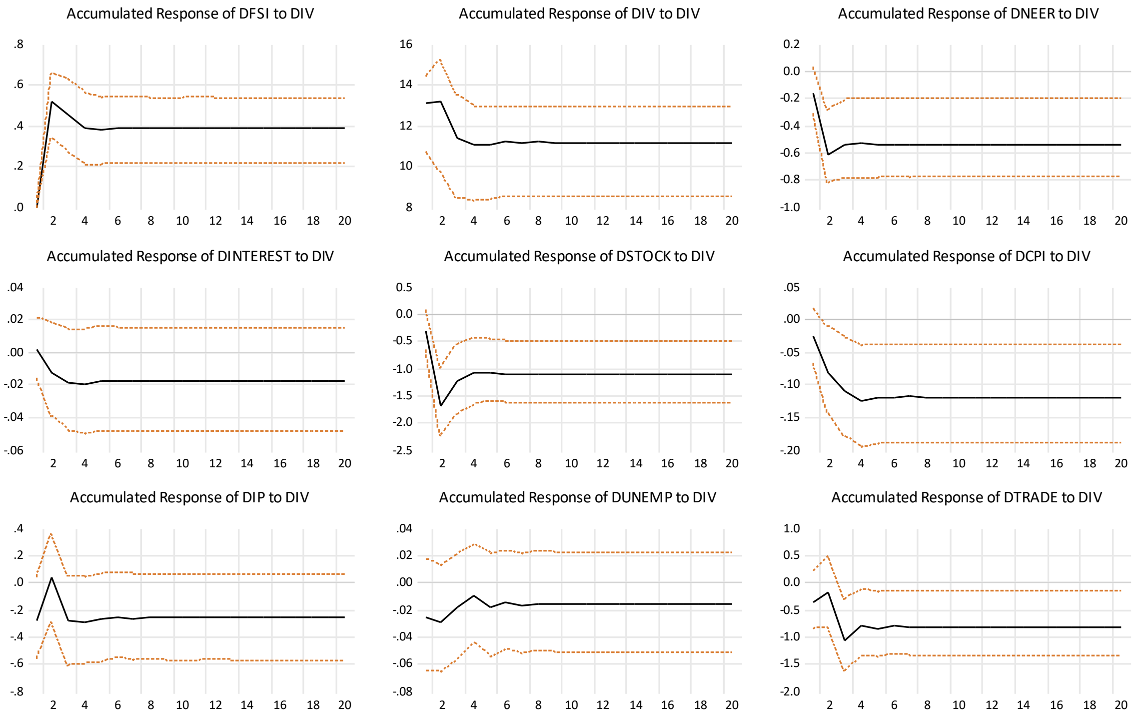
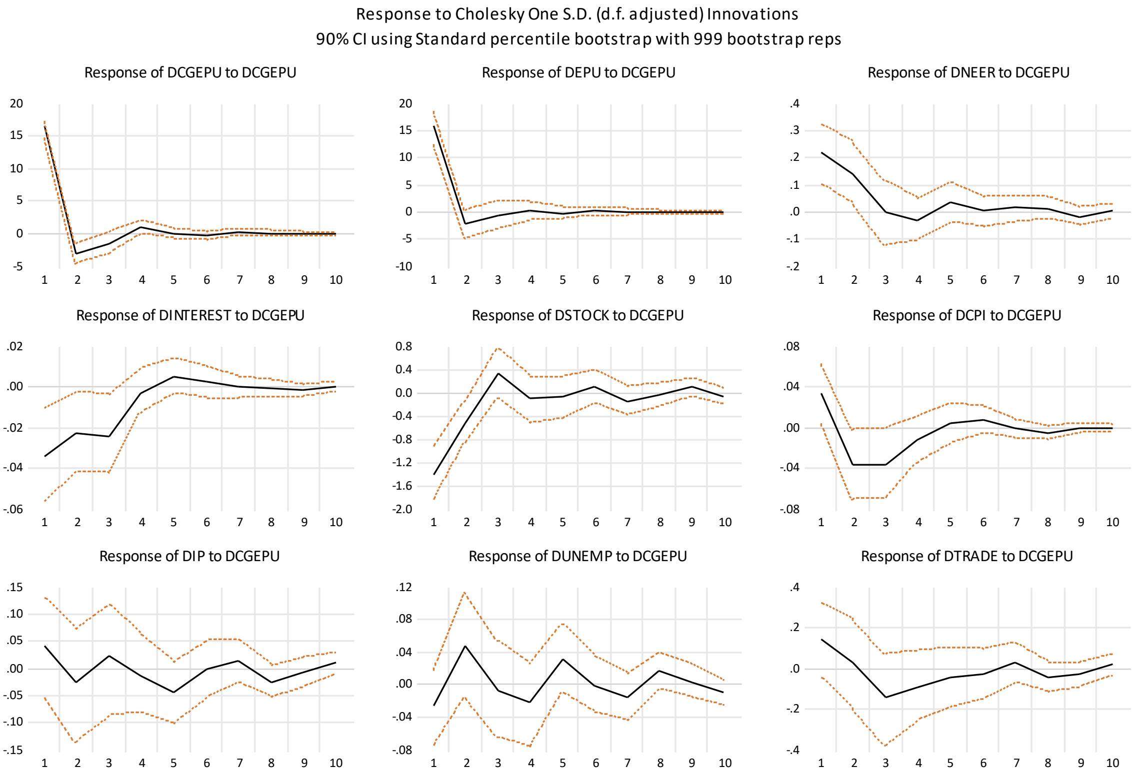
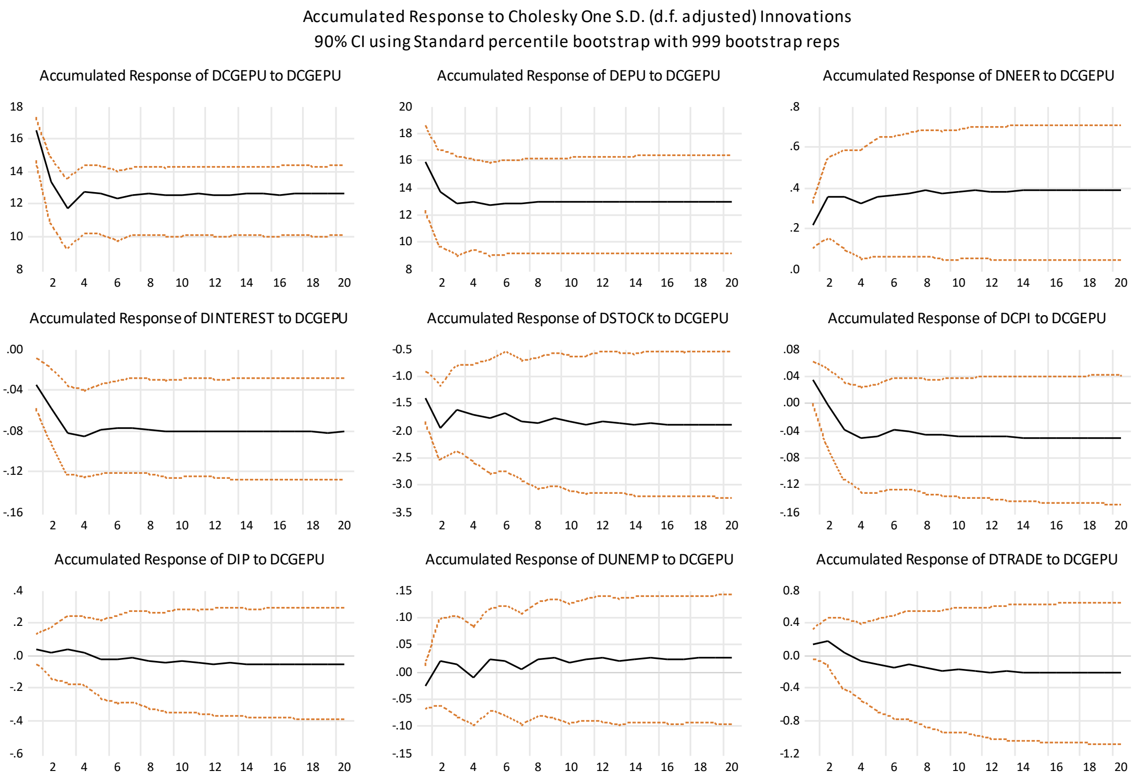


Fig 2-8. US

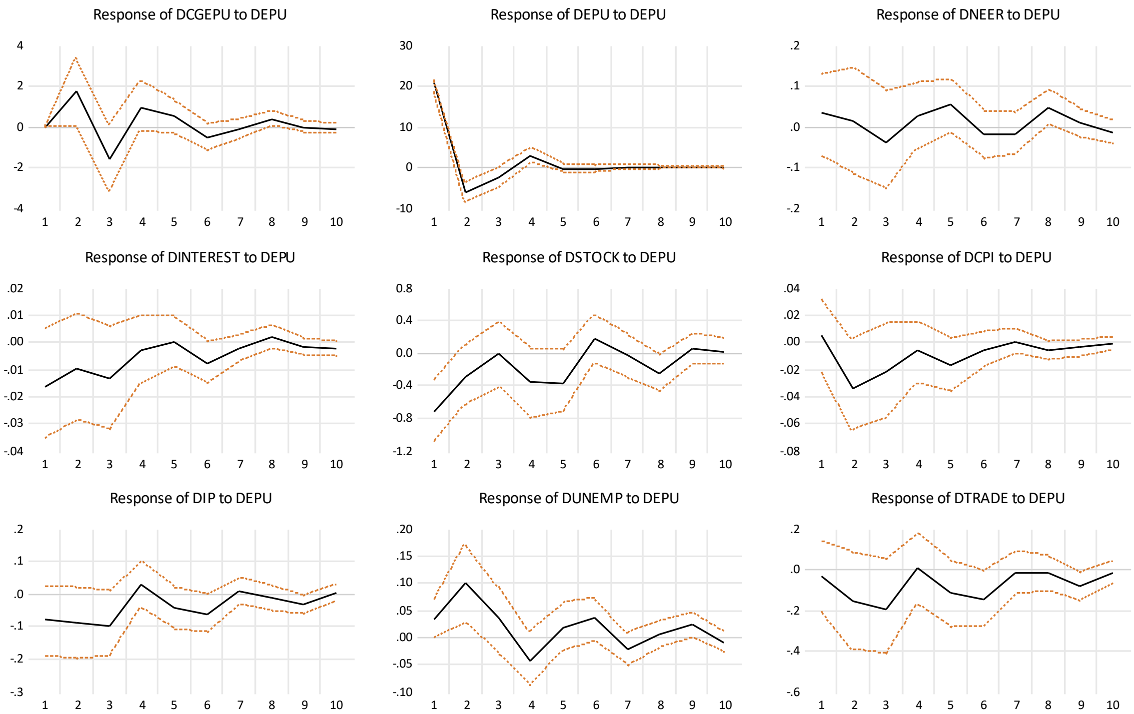
(a) IRFs and CIRFs to one SD cGEPU shock: Model A



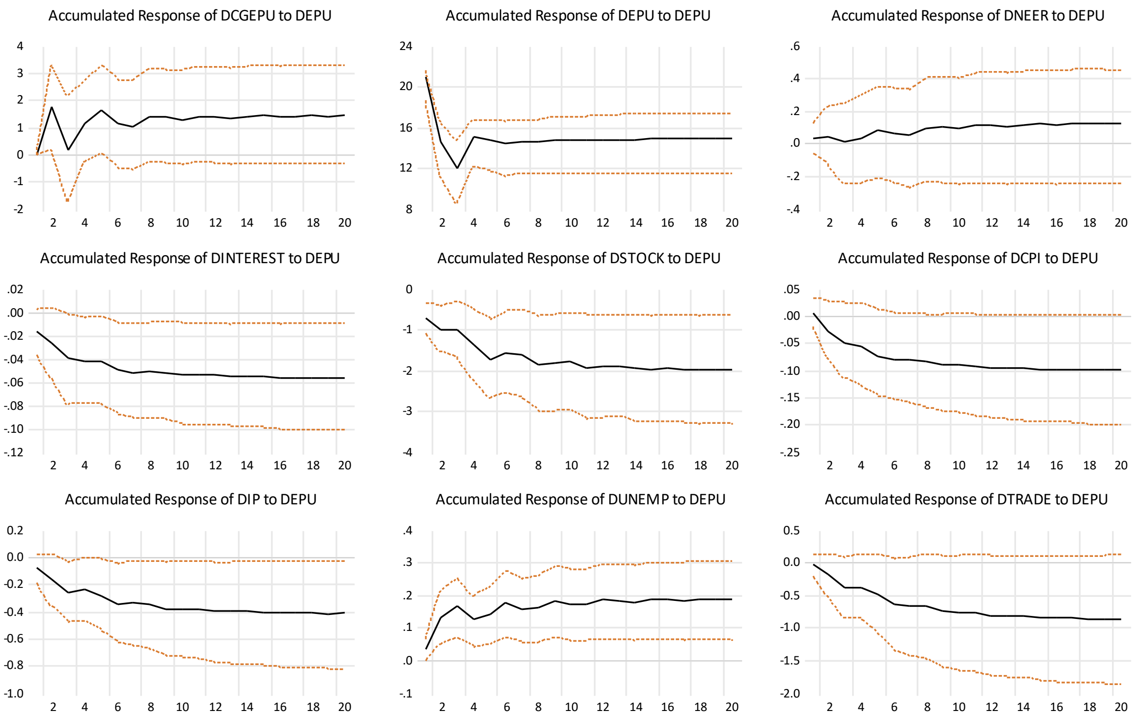


(b) IRFs and CIRFs to one SD EPU shock: Model A

Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps

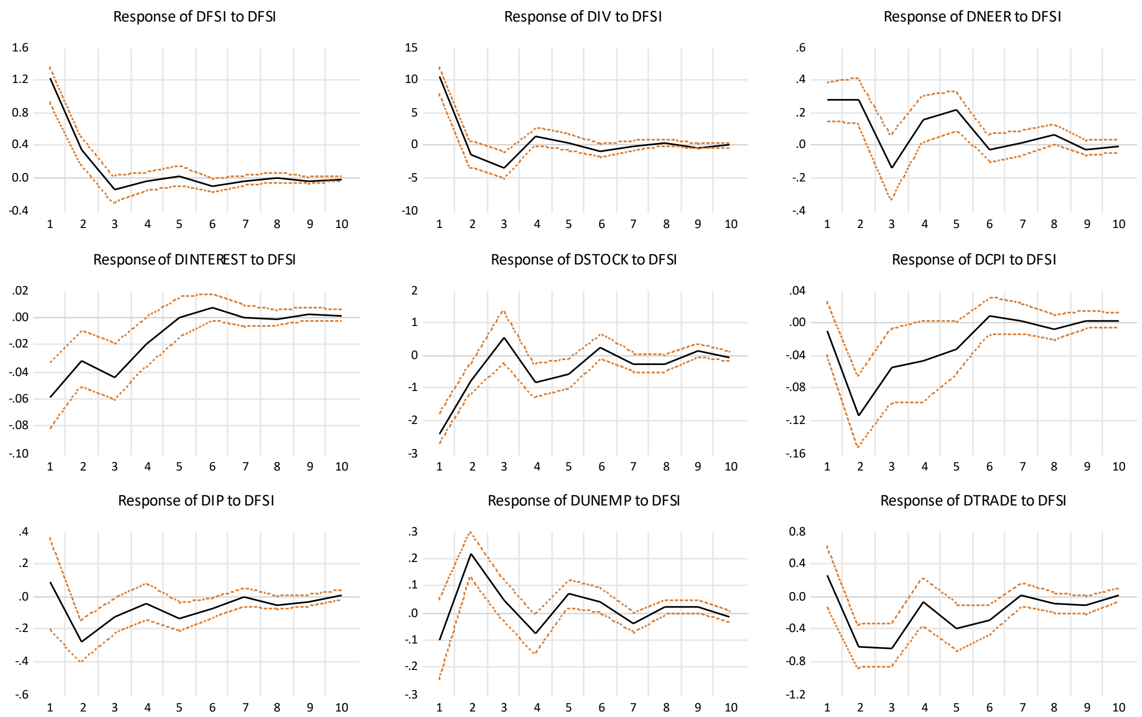


Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps

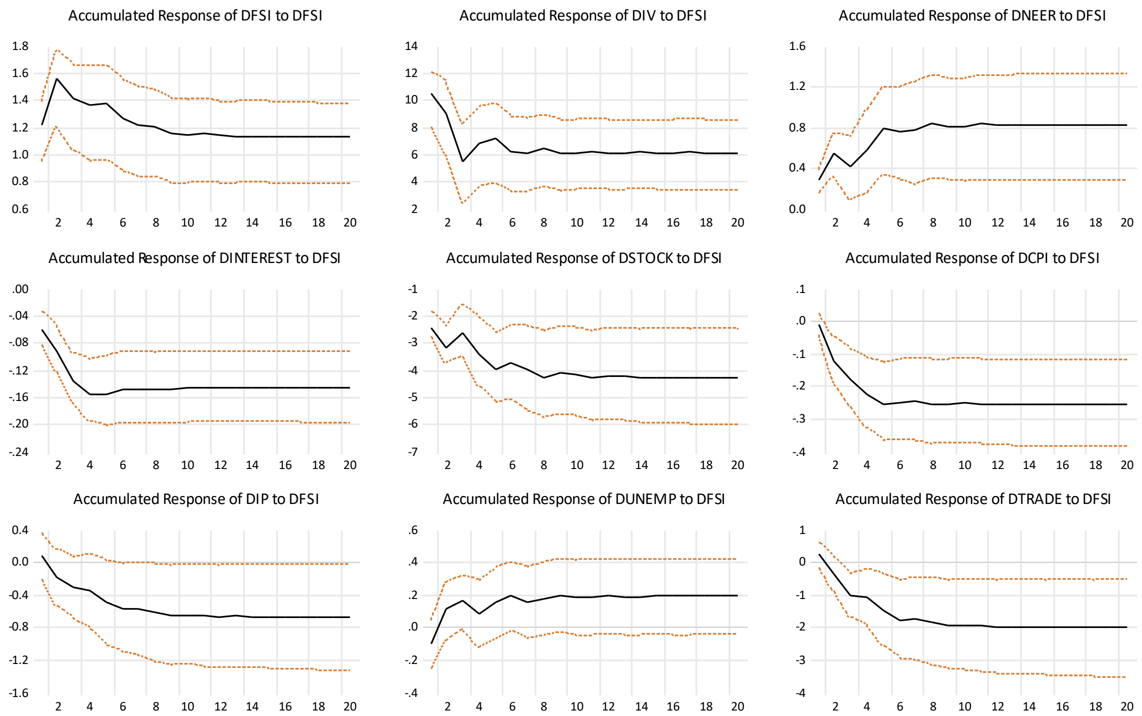


(c) IRFs and CIRFs to one SD FSI shock: Model B

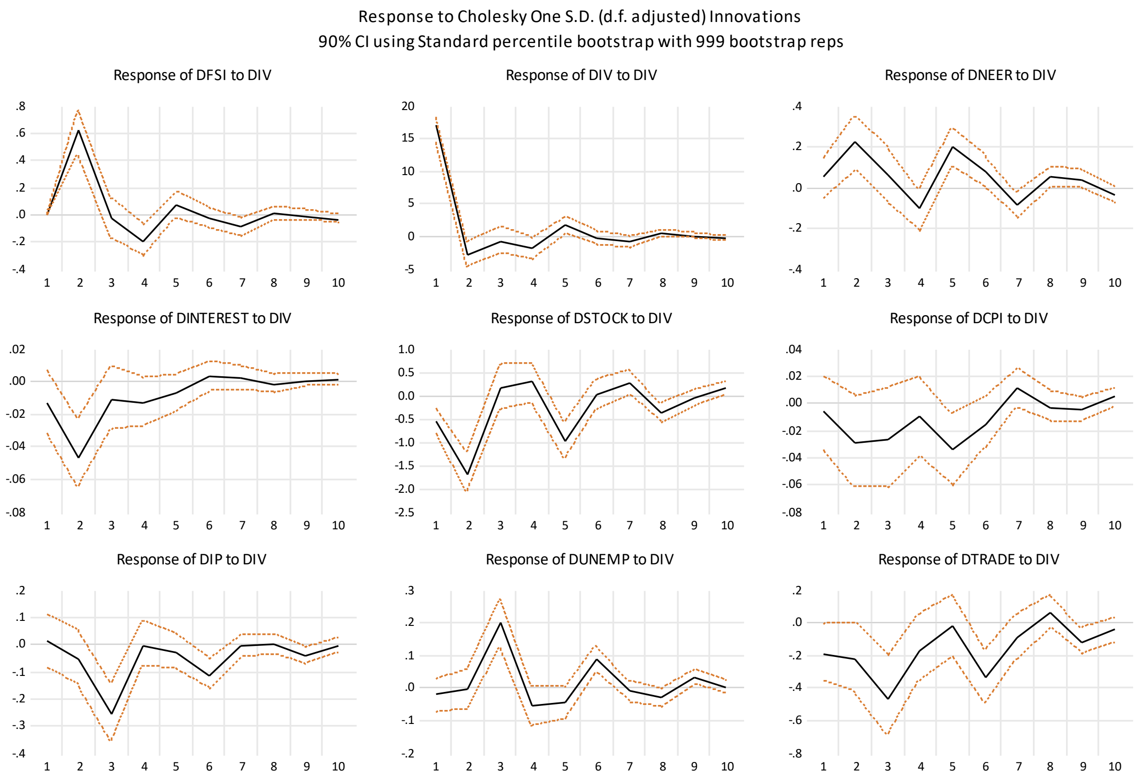
Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps



Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps



(d) IRFs and CIRFs to one SD IV shock: Model B



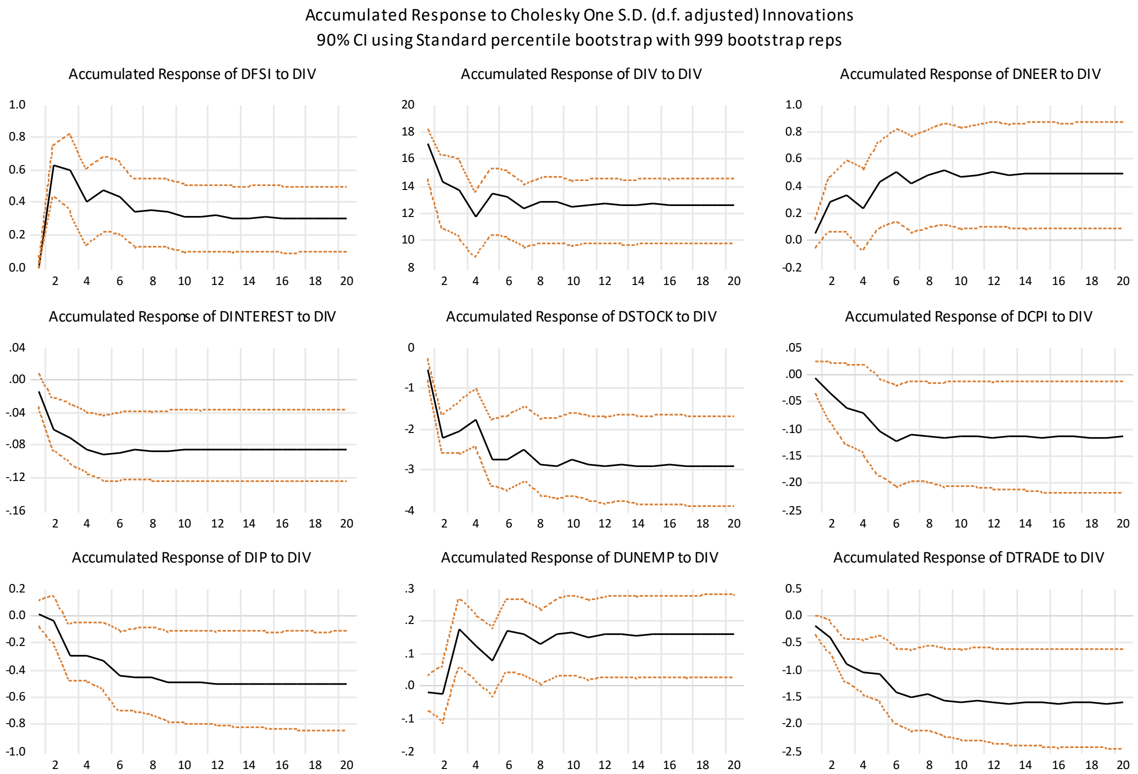
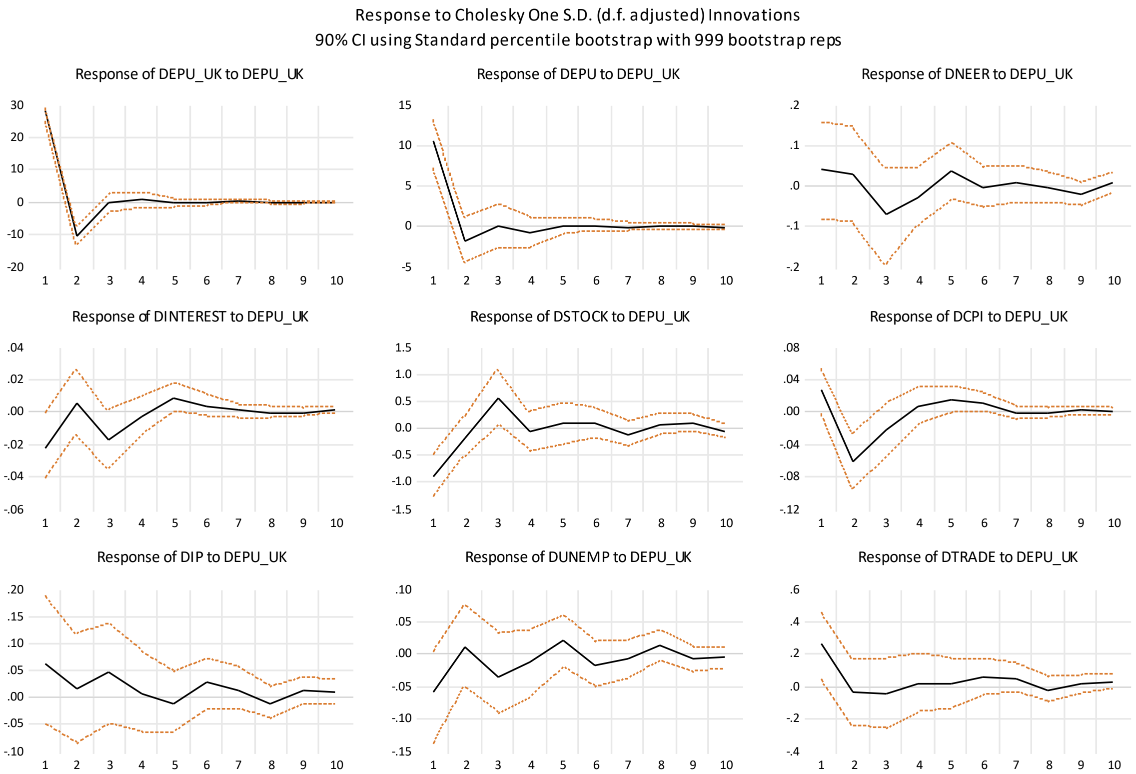


Fig 3. Impulse Responses Functions (IRFs) and Cumulative Impulse Responses Functions (CIRFs) for Robustness Check 1



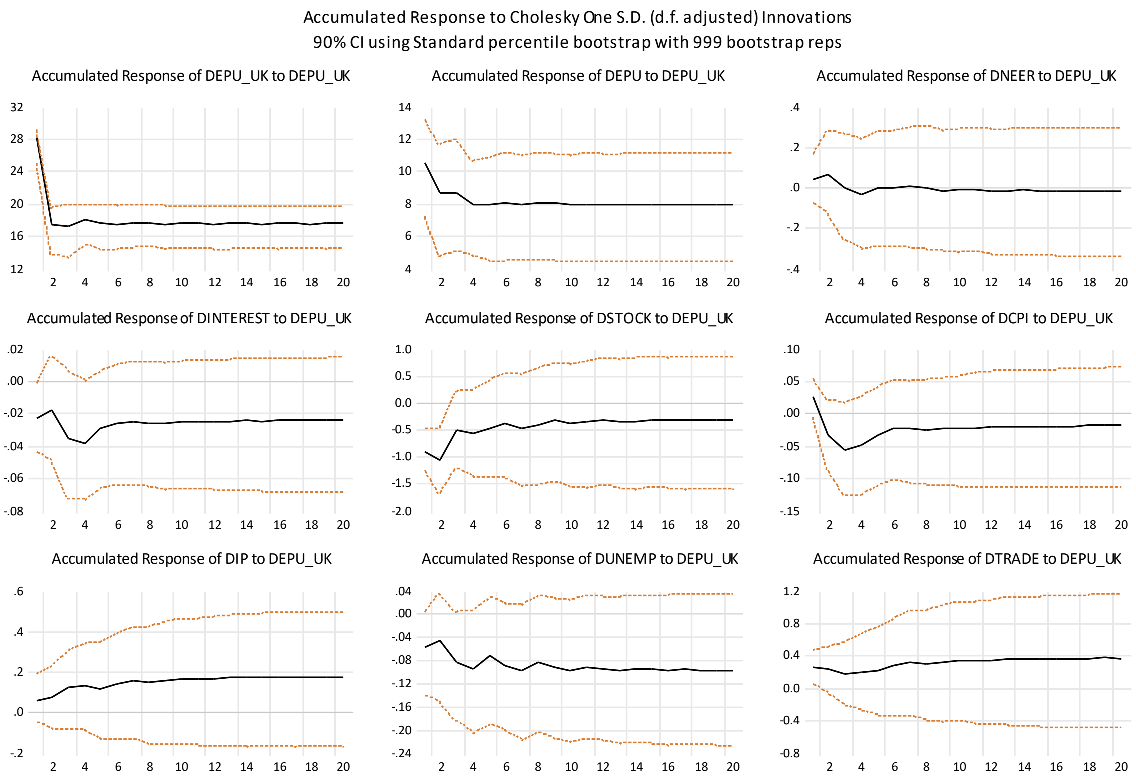
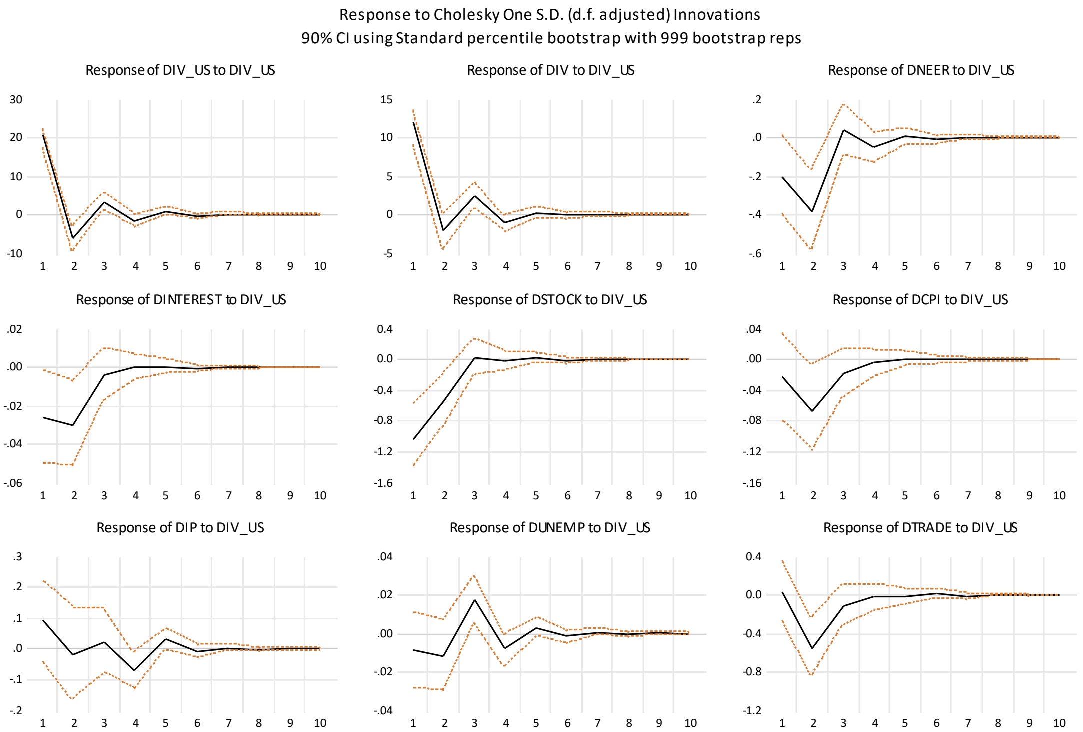


Fig 4. Impulse Responses and Cumulative Impulse Responses for Robustness Check 2

Fig 4-1.Canada



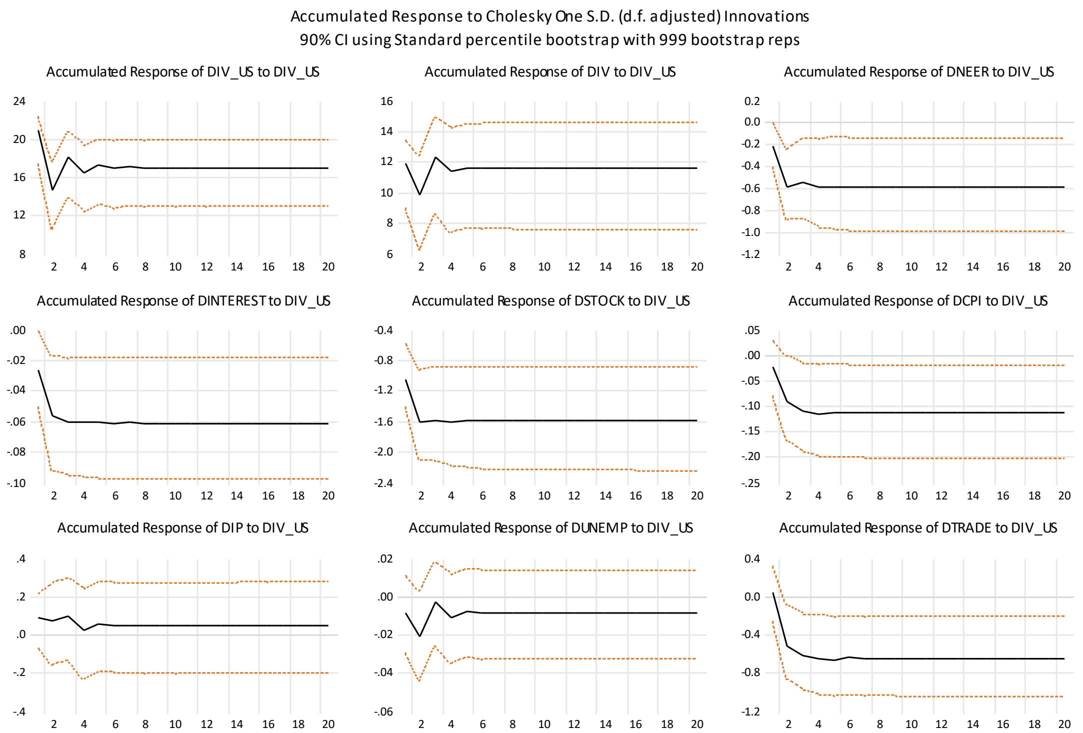
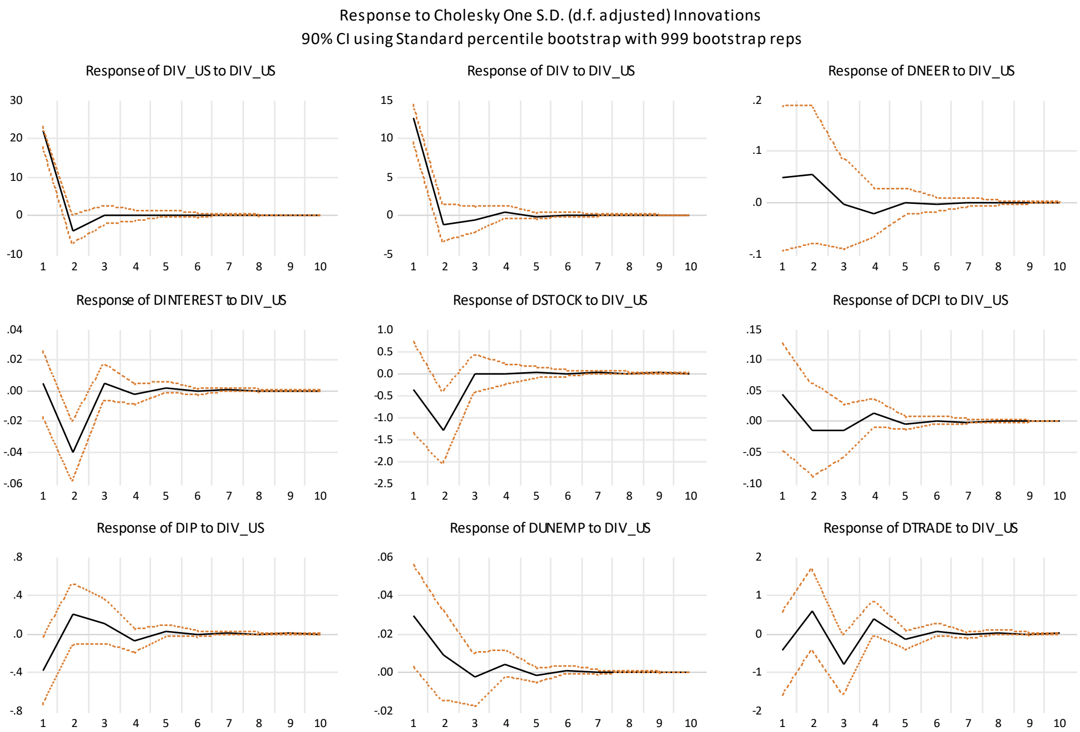


Fig 4-2. China


Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps
Response of DIV_US to DIV_US
Response of DIV to DIV_US
Response of DNEER to DIV_US
Response of DINTEREST to DIV_US
Response of DSTOCK to DIV_US
Response of DCPI to DIV_US
Response of DIP to DIV_US
Response of DUNEMP to DIV_US
Response of DTRADE to DIV_US

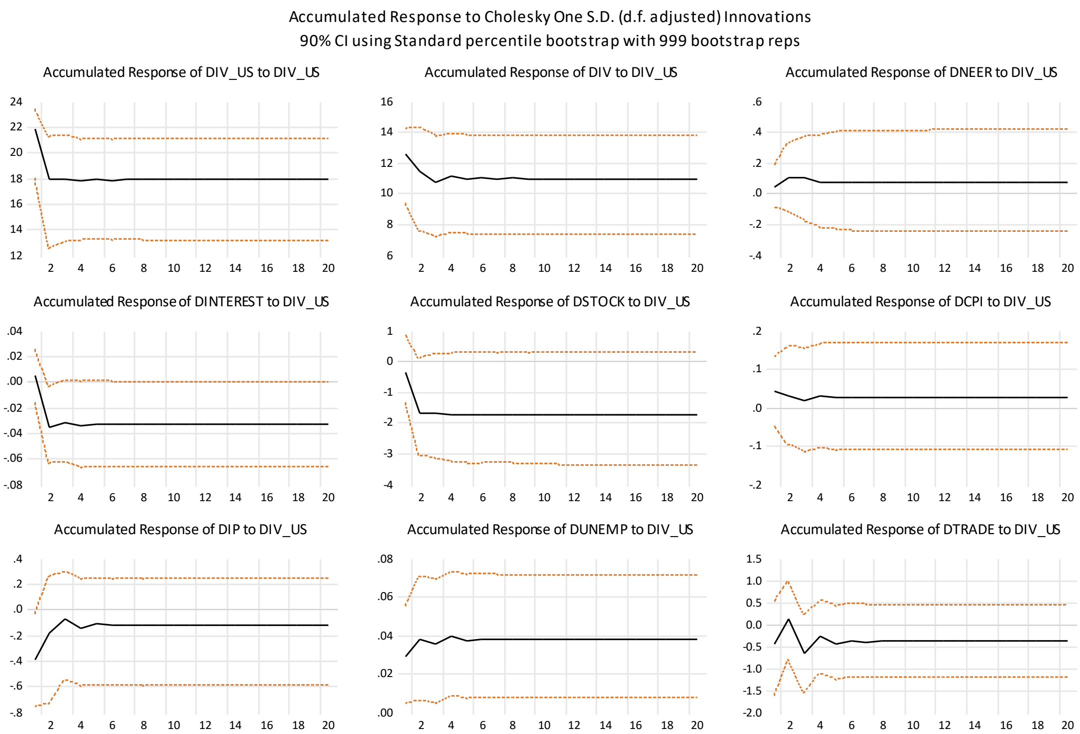
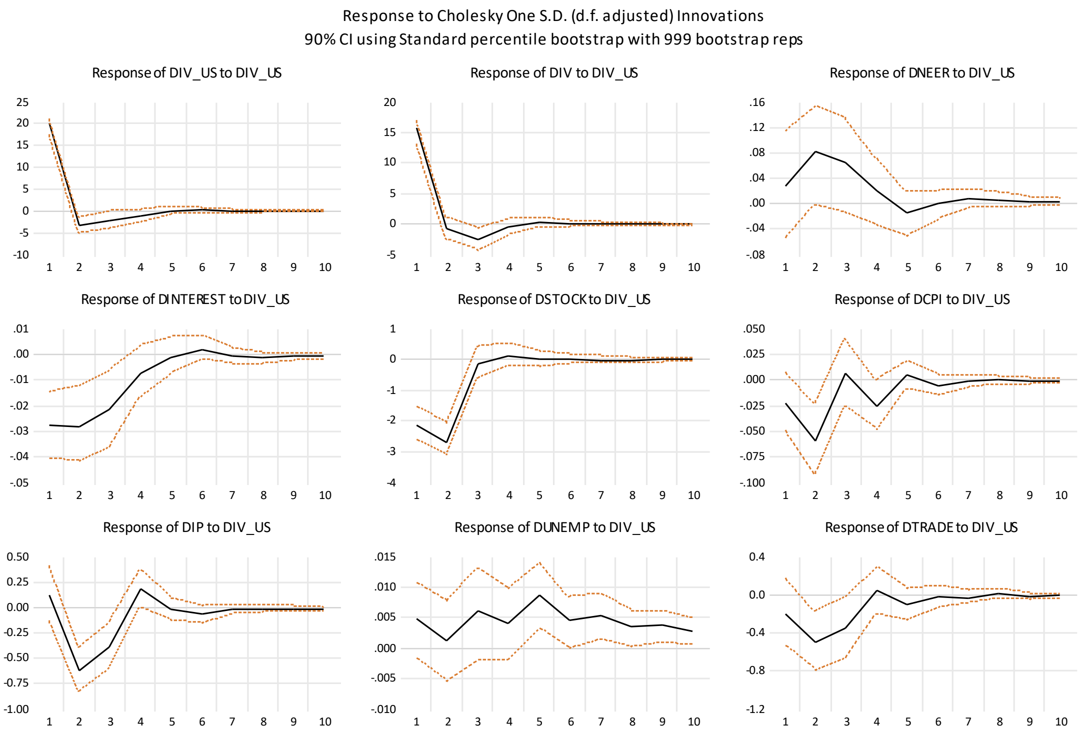

Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps
Accumulated Response of DIV_US to DIV_US
Accumulated Response of DIV to DIV_US
Accumulated Response of DNEER to DIV_US
Accumulated Response of DINTEREST to DIV_US
Accumulated Response of DSTOCK to DIV_US
Accumulated Response of DCPI to DIV_US
Accumulated Response of DIP to DIV_US
Accumulated Response of DUNEMP to DIV_US
Accumulated Response of DTRADE to DIV_US

Fig4-3. Germany



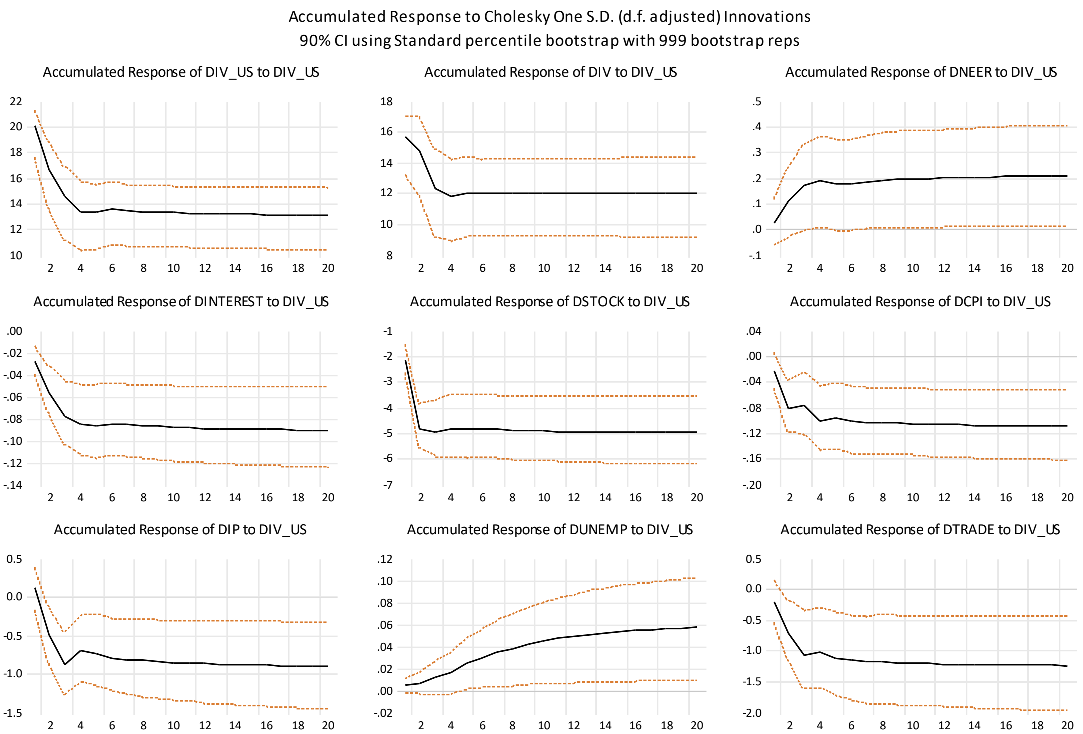
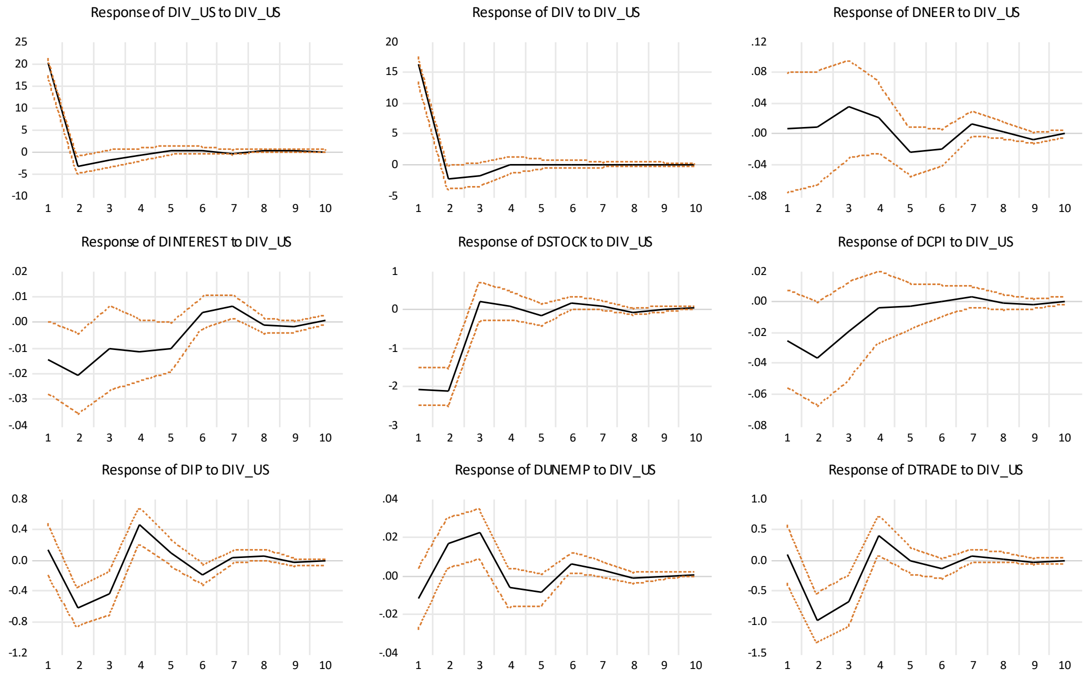


Fig 4-4. France

Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps



Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps

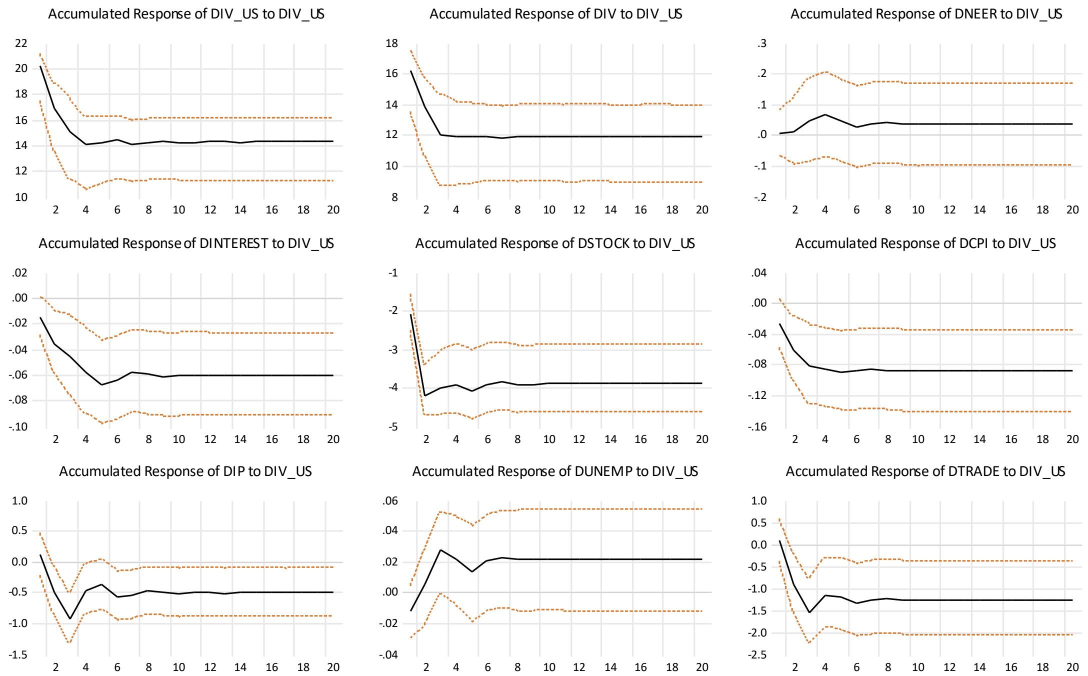
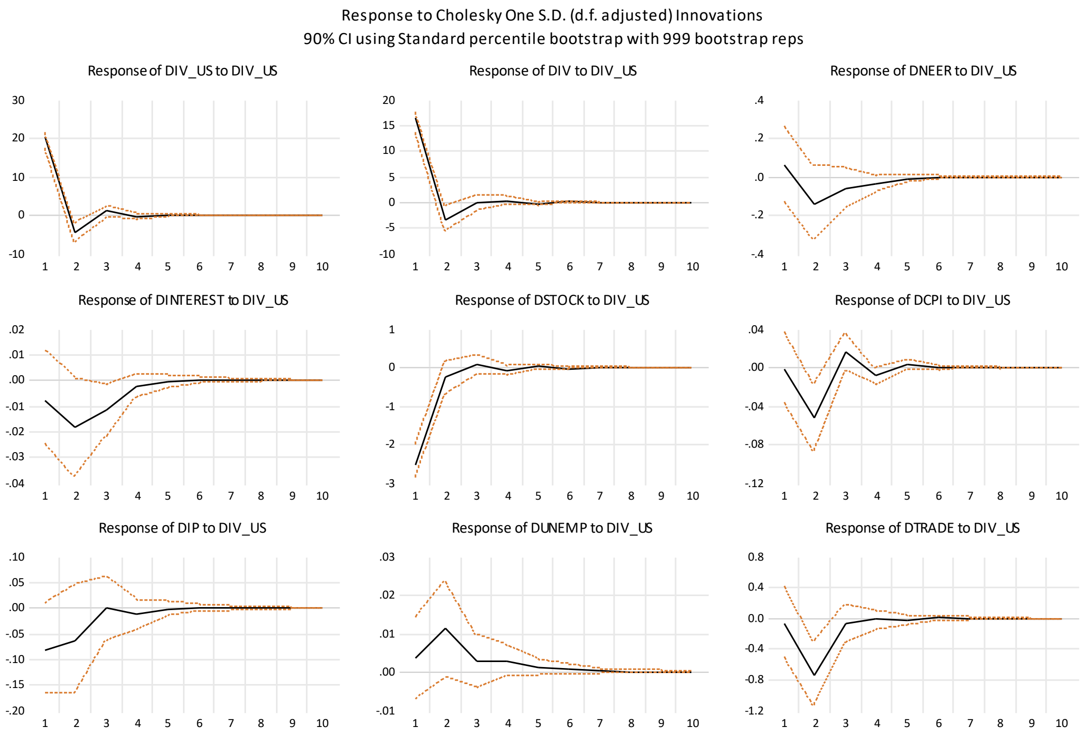


Fig 4-5. UK


Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps
Response of DIV_US to DIV_US
Response of DIV to DIV_US
Response of DNEER to DIV_US
Response of DINTEREST to DIV_US
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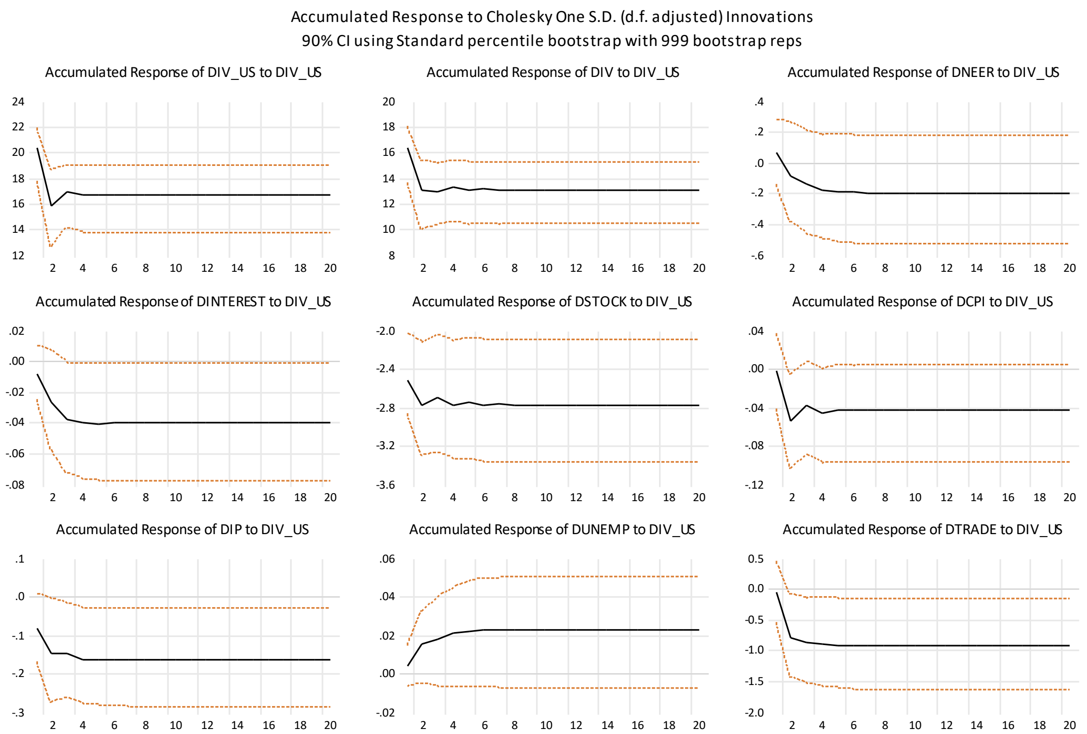
Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps
Accumulated Response of DIV_US to DIV_US
Accumulated Response of DIV to DIV_US
Accumulated Response of DNEER to DIV_US
Accumulated Response of DINTEREST to DIV_US
Accumulated Response of DSTOCK to DIV_US
Accumulated Response of DCPI to DIV_US
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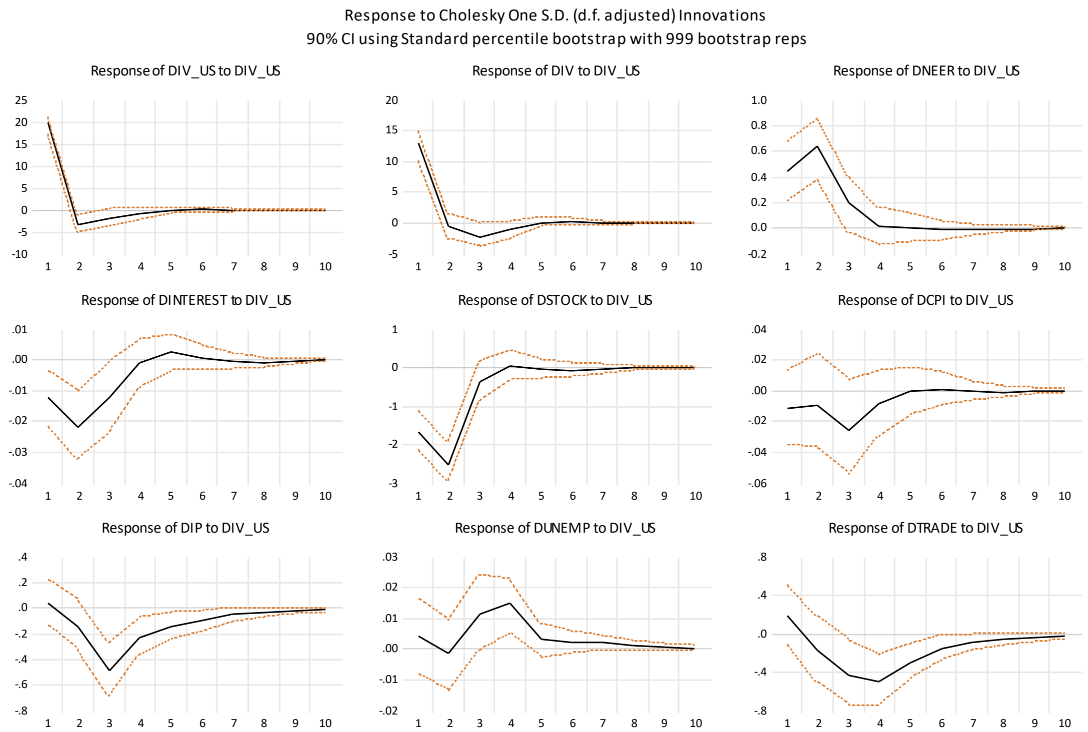
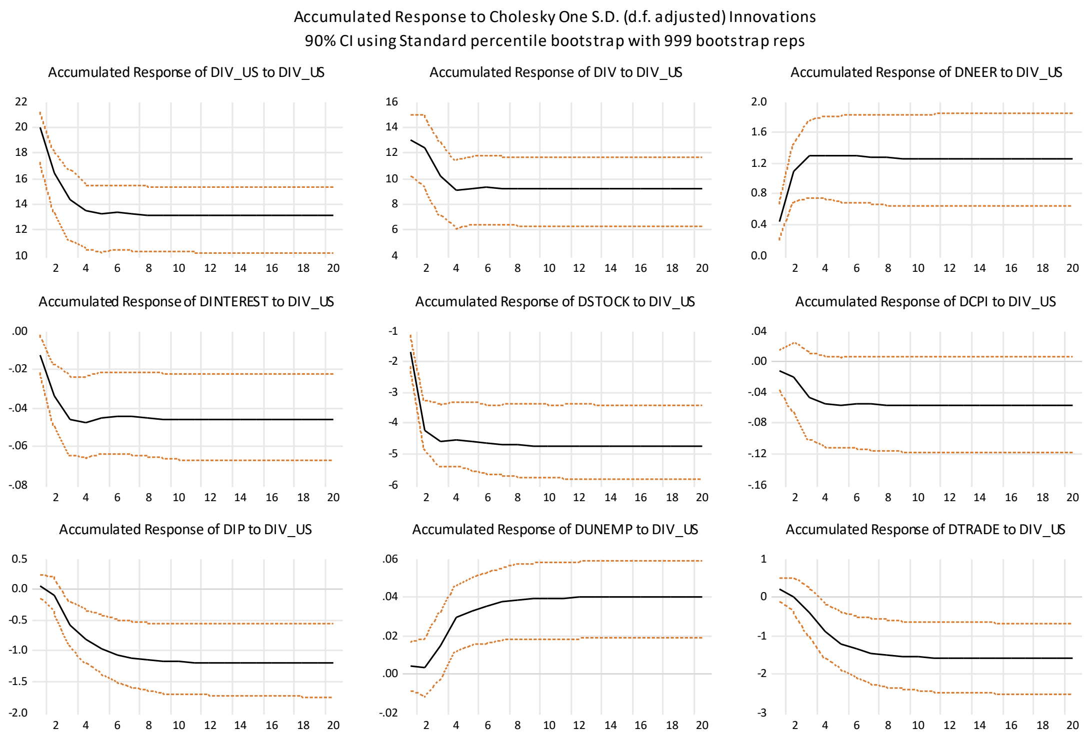
Accumulated Response of DTRADE to DIV_US

Fig 4-6. Japan



Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps
Response of DIV_US to DIV_US
Response of DIV to DIV_US
Response of DNEER to DIV_US
Response of DINTEREST to DIV_US
Response of DSTOCK to DIV_US
Response of DCPI to DIV_US
Response of DIP to DIV_US
Response of DUNEMP to DIV_US
Response of DTRADE to DIV_US



Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps
Accumulated Response of DIV_US to DIV_US
Accumulated Response of DIV to DIV_US
Accumulated Response of DNEER to DIV_US
Accumulated Response of DINTEREST to DIV_US
Accumulated Response of DSTOCK to DIV_US
Accumulated Response of DCPI to DIV_US
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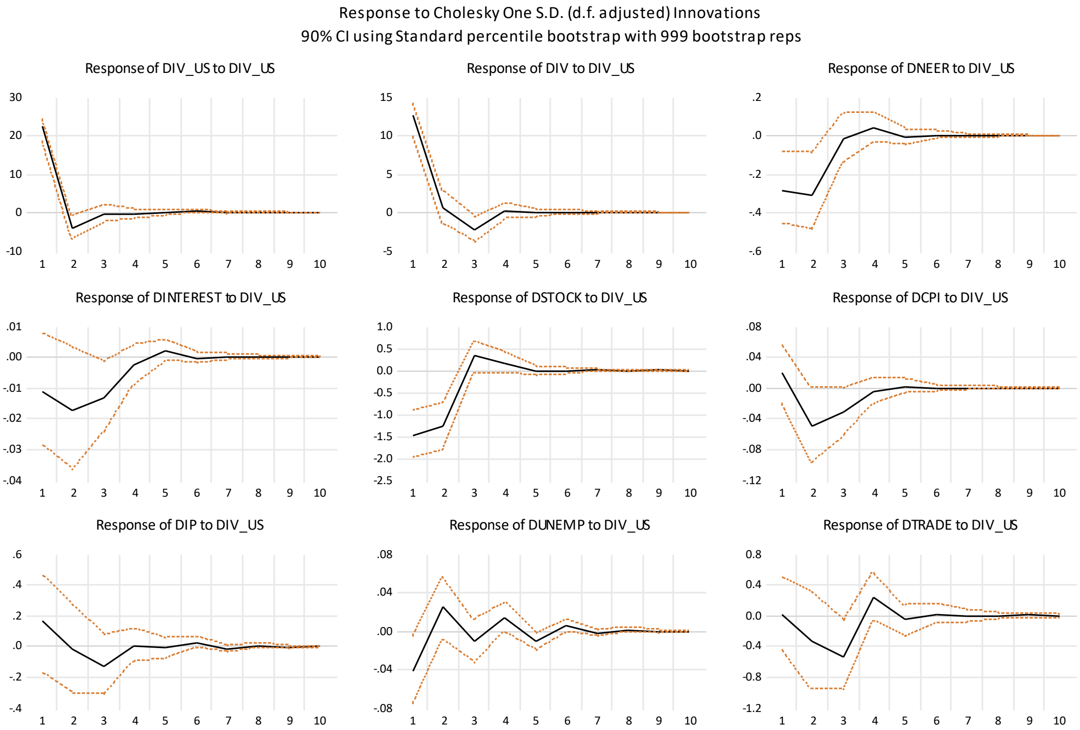
Accumulated Response of DUNEMP to DIV_US
Accumulated Response of DTRADE to DIV_US

Fig 4-7. Korea


Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps
Response of DIV_US to DIV_US
Response of DIV to DIV_US
Response of DNEER to DIV_US
Response of DINTEREST to DIV_US
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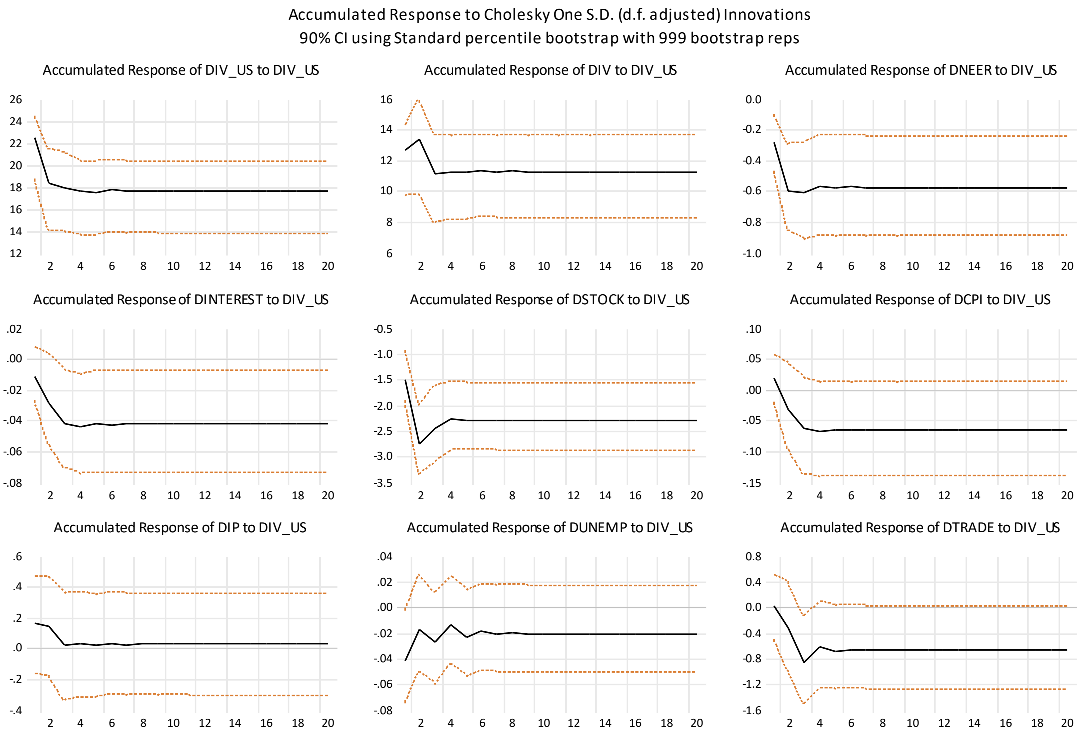
Response of DTRADE to DIV_US


Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations
90% CI using Standard percentile bootstrap with 999 bootstrap reps
Accumulated Response of DIV_US to DIV_US
Accumulated Response of DIV to DIV_US
Accumulated Response of DNEER to DIV_US
Accumulated Response of DINTEREST to DIV_US
Accumulated Response of DSTOCK to DIV_US
Accumulated Response of DCPI to DIV_US
Accumulated Response of DIP to DIV_US
Accumulated Response of DUNEMP to DIV_US
Accumulated Response of DTRADE to DIV_US

Reference

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