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Effects of global liquidity and commodity market shocks in a commodity-exporting developing economy

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Abstract

This paper assesses the effects and transmission mechanisms of global liquidity and commodity market shocks in Mongolia, a commodity-exporting developing economy, using a structural vector autoregression (SVAR) model. Results show that boom and bust cycles in commodity and international financial markets lead to business and financial cycles in the economy as these shocks account for 30, 45, and 60 percent of domestic output, real exchange rate, and lending rate fluctuations, respectively. Commodity demand shocks have more persistent and robust effects on domestic cycles than commodity supply shocks. Trade and financial (resource export revenues, lending rate, and exchange rate) channels play an essential role in transmitting the shocks. Buoyant commodity demand and global liquidity shocks lead to a significant fall in the domestic lending rate, while positive commodity supply and global liquidity shocks appreciate the real exchange rate.

JEL classification: C51, E32, F41, F62.

Keywords: Commodity demand shocks, Commodity supply shocks, Global liquidity shocks, Business cycle, Structural VAR, Mongolia.

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1. Introduction

The global economy has become increasingly interconnected, leading to growing spillovers through trade (real) and financial channels. While developing countries have not fully recovered from the consequences of the COVID-19 epidemic, new risks shaping their external conditions arise from three main international developments. First, shocks to Chinese investment or growth, reflecting a structural slowdown, zero-COVID policy, and financial stress, can affect developing and commodity-exporting economies through trade ties (i.e., weakening export demand). Second, shocks to monetary policy or financial markets in the United States (US), owing to policy makers' reactions to increasing inflation, could spill over to other countries through tightening global financial conditions. Third, shocks originating from the war in Ukraine and the related sanctions could affect other economies by disrupting the supply of commodities, increasing financial stress, and reducing global confidence. The war and sanctions are likely to increase international food and fuel prices, and rising investor risk aversion could lead to capital outflows and, hence, exchange rate depreciation (World Bank 2022). Macroeconomic spillover effects on countries differ in their trade exposure and vulnerability to tighter global financing conditions. Moreover, disentangling shocks to commodity markets and global liquidity has been essential to assessing the potential impacts on developing economies of these international developments.

In this context, the paper examines the effects and transmission mechanisms of commodity demand, commodity supply, and global liquidity shocks on the commodity-exporting and developing economy of Mongolia using a SVAR approach. Commodity exports and exports to China account for 95 percent and 90 percent of its total exports, respectively. Currently, Mongolia imports 100 percent of its demand for refined petroleum products, accounting for about 20 percent of total imports. Moreover, as of 2021, the external debt to GDP ratio is 240 percent, and the short-term external debt to GDP ratio is 115 percent. These facts show how the economy is vulnerable to adverse shocks to commodity markets and global liquidity. Therefore, evidence from the Mongolian case study would be highly relevant in estimating the impacts of the international developments on other developing economies.

This paper extends the literature in two ways. First, it is one of the first attempts to provide empirical evidence on the effects of tightening in global financial conditions, disrupting commodity supply, and weakening commodity demand in developing and commodity-exporting countries like Mongolia. Second, examining the transmission mechanism of the external shocks passing through trade and financial channels is a novelty in the literature, and it helps design policies to stabilize macroeconomic and financial fluctuations.

Many empirical works have been done to identify sources of business cycle fluctuations in emerging and developing countries. Though scholars have no consensus, the existing literature has found various drivers. Aguiar and Gopinath (2007) find the primary source of business cycles in emerging markets can be non-stationary total factor productivity (i.e., shocks to trend growth). However, García-Cicco et al. (2010) show that non-stationary productivity shocks play a minor role in accounting for business cycles in emerging markets. Several papers (i.e., Neumeyer and Perri 2005, Uribe and Yue 2006) highlight that foreign and domestic interest rates are key drivers of business cycles in emerging economies. Another set of papers (i.e., Mendoza 1995 and Kose 2002) emphasize the importance of terms of trade shocks to account for economic fluctuations in

developing economies using calibrated business-cycle models, while Schmitt-Grohé and Uribe (2017) argue that the view that emerges from country-specific SVAR models is strikingly different.

Many papers argue that multiple commodity prices are an essential driver of the business cycle in emerging market economies. For example, recent articles (i.e., Fernández et al. 2017, Fernández et al. 2018, and Drechsel and Tenreyro 2018) show that commodity prices account for a significant fraction of economic fluctuations. Fernández et al. (2018) find evidence of an amplification mechanism owing to a "spillover" effect from commodity prices to interest rates. Shousha (2016) points out that commodity price shocks are a vital source of business cycle fluctuations for small open commodity exporters, and the main channel accounting for the different effects among emerging and advanced economies is the response of the country's interest rate to these shocks. Moreover, commodity price shocks significantly impact output and investment dynamics, particularly for economies with less developed financial markets and less flexible exchange rate regimes (Céspedes and Velasco 2012). In addition to commodity price shocks, recent papers have also focused on examining the effects of shocks on Chinese resource demand and international liquidity. For example, Dungey et al. (2014) provide empirical evidence that shocks to Chinese demand and commodity prices result in a sustained increase in commodity prices and mining investment and a positive impact on the resource sector in Australia. Charnavoki and Dolado (2014) identify global demand, commodity-specific and global non-commodity supply shocks, and find that negative commodity-specific shock, which result in increasing commodity price prices, leads to Dutch disease and spending effects in the case of Canada. Fry-McKibbin and Souza (2018) show that Chinese resource demand shocks increase Brazilian resource exports, the non-tradeable primary commodity sector, and other domestic activity, and commodity price shocks are less favorable than shocks to Chinese demand. They also highlight two results such as i) the interest rate plays an essential role in amplifying the effects of commodity price shocks, and ii) incorporating Chinese resource demand in addition to commodity prices reduces the role of commodity prices in explaining the variance of domestic output. Souza and Fry-McKibbin (2021) show that including commodity demand and international liquidity in a SVAR model reduces the impact of commodity price shocks on the interest rate made available to Brazil in global capital markets.

Studies on the effects of international liquidity shocks on small open economies passing through commodity markets have revived recently. Ratti and Vespignani (2015) find that unanticipated increases in the BRIC countries' Liquidity (M2 money) are associated with significant and persistent increases in commodity prices, a boom in global industrial production, and global warming tightening in monetary policy. Several papers (i.e., Kang et al., 2016 and Choi et al., 2017) find that global liquidity affects commodity prices, financial markets, and currencies of emerging market economies. Souza and Fry-McKibbin (2021) present empirical evidence that positive international liquidity shocks increase real commodity prices, thereby appreciating the exchange rate and lowering interest rates in Brazil. However, further case studies would help scholars and policymakers understand how and why the effects of global liquidity shocks on the domestic financial markets differentiate between developing and emerging economies.

As the Mongolian economy is dependent on mining exports, many papers have studied the effects of commodity prices and their transmission mechanism. Using a sign-restricted SVAR,

Luvsannyam (2014) shows that i) export price shocks account for about 50 percent of fluctuations in the consumer price index (CPI), and ii) fiscal policy has been pro-cyclical during commodity booms. Using a large Bayesian vector autoregression (BVAR), Doojav and Luvsannyam (2019) provide empirical evidence that external shocks (i.e., coal, copper prices, China GDP, China CPI, and FDI) account for 40-50 percent of the Mongolian business cycles (i.e., real GDP and CPI fluctuations). They also find that i) a 1 percent increase in China's growth leads to a 0.5 percent rise in real GDP, and ii) the positive shocks to Chinese demand and copper prices lead to an appreciation of the exchange rate and a decrease in interest rates. Doojav and Batmunkh (2018) show similar results with a Bayesian structural model-based analysis and more focus on the optimal combination of monetary and macroprudential policies for Mongolia. Using a Bayesian New Keynesian model, Doojav and Gantumur (2020) find that external shocks are the primary sources of equilibrium real interest rate movements. For example, commodity prices, Chinese demand, and FDI shocks account for about 40 percent of real equilibrium interest rate fluctuations. Doojav (2022) presents that China's growth and copper price shocks have played an essential role in explaining domestic output's fall at the beginning of the COVID-19 pandemic. However, no specific study has been conducted on global liquidity shocks' effects and transmission mechanism (i.e., tightening of monetary policy in developed economies) in the case of Mongolia.

The rest of the paper is structured as follows. Section 2 analyzes the relationship between commodity price, global liquidity, and domestic macroeconomic variables. Section 3 presents a SVAR model for the Mongolian economy, including restrictions used to identify structural shocks and reflect the assumption of a small open economy. Section 4 describes the data and reports the main findings and robustness checks. Finally, Section 5 concludes the paper with policy implications.

2. The relationship between commodity prices, global liquidity, and the Mongolian economy

A simple correlation analysis was performed to identify the links between external factors and the domestic economy, supporting selecting variables to be included in the model. In the paper, international developments shaping external conditions for the Mongolian economy are proxied by three variables: i) Chinese resource demand (Chinese steel production) is selected to reflect the impact of shocks to commodity demand; ii) global Liquidity (M2 money) is taken to reflect shocks from monetary policy tightening in advanced economies (i.e., the US); and iii) real commodity price is chosen to reflect shocks to commodity supply, for example, resulting from the war in Ukraine and related sanctions. However, domestic economy variables are selected as resource exports, consumption, real GDP, production in key sectors, lending rate, and real exchange rate.

On the average statistics for the period 2000-2020, the mining sector, agriculture sector, and other sectors account for 22.1 percent, 13.3 percent, and 64.7 percent of the real GDP, respectively. Table 1 shows the simple correlation between external factors (Chinese resource demand, real commodity prices, and global liquidity, proxied by the sum of M2 money of Brazil, Russia, India, China, and the US) and domestic variables. As shown in Table 1, correlations between these external factors and domestic mining production are high, while the correlation with agricultural production is relatively weak. The correlation between other sector production and real commodity price is weak compared to mining sector production. There is a strong positive association between

Chinese resource demand and other industries. The relationship reflects the fact that the growth of the mining sector increases demands for other sectors, in which transport, financial, and service sectors account for a larger share.

All three external factors positively and strongly correlate with domestic consumption, real GDP, and resource exports in the Mongolian economy. However, these factors are negatively related to the real exchange rate and lending rate, implying that an increase in the factors leads to an appreciation in the real exchange rate and a decrease in the lending rate. It is a preliminary finding for the counter-cyclical nature of the lending rate (i.e., as an economy improves, the lending rate falls).

Table 1. Correlation between foreign and domestic variables, 2000.01-2020.12

Sector / Variable	Contribution in GDP	Correlation		
		Chinese resource demand	Real commodity prices	Global liquidity
Domestic sectors				
Mining sector	0.221	0.805	0.798	0.832
Agricultural sector	0.133	0.219	0.505	0.371
Other industries	0.647	0.923	0.689	0.837
Key variables				
Real commodity prices		0.869	1.000	0.947
Resource exports		0.801	0.821	0.842
Consumption		0.896	0.807	0.934
Real GDP		0.893	0.769	0.862
Lending rate		-0.849	-0.795	-0.848
Real exchange rate		-0.609	-0.416	-0.566

Source: The researchers calculated a simple correlation for the monthly data.
Note: See Table 2 for explanations and sources of the data used.

These results also raise the following question: What is the relationship among the three external factors? There is also a strong positive correlation between real commodity prices and the other two external factors. In particular, the correlation between global liquidity and real commodity prices is estimated at 0.95, consistent with Belke et al. (2012). Figure 1 shows the dynamics of these two factors to see whether they move together over time.

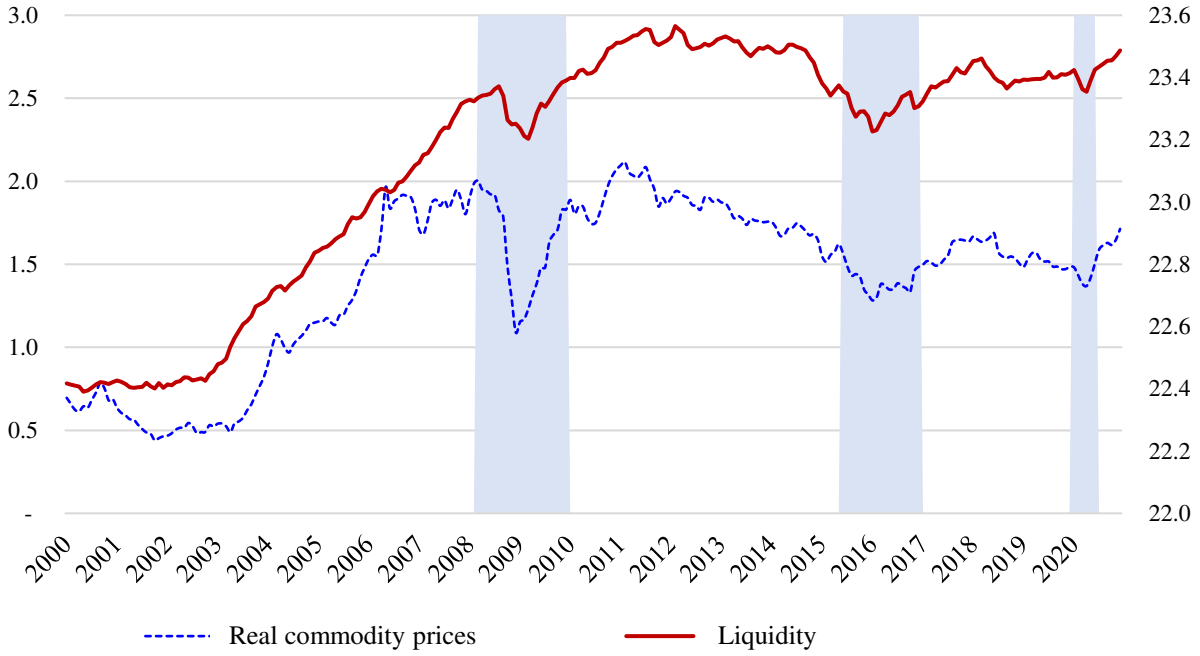
Figure 1 clearly shows that the global liquidity (right axis) and real commodity prices have strong co-movements, notably overlapped cycles of the two variables. Kang et al. (2016) point out that the impact of global liquidity on commodity prices has become more pronounced since the GFC. It is also the case in our analysis. For example, declines in global liquidity and real commodity prices coincided during the periods of the GFC, the end of the commodity supercycle in 2015, and the COVID-19 pandemic in 2020.

During the years over the shaded area in Figure 1, the Mongolian economy experienced recessions (i.e., a sharp decline in GDP growth)[2], and at the same time, global liquidity declined, and commodity prices fell. It implies that the Mongolian business cycle is highly dependent on external

[2] The GFC of 2008 led to a decline in commodity prices, thereby a recession in the domestic economy. As commodity prices raised, a rapid recovery of the Mongolian economy has occurred since the late 2009, the domestic economic recovery has been sustained until 2012 due to the implementation of major mining projects (i.e., Oyu Tolgoi and Tavan Tolgoi projects). However, the economy was again in trouble in 2015-2016 as a result of too expansionary macroeconomic policies aimed at mitigating the effects of external shocks. The Extended Fund Facility (EFF) of the IMF began in May 2017, the economy recovered during the program. However, the real GDP shrank by 5.3 percent in 2020 due to the COVID-19 pandemic (i.e., falling commodity prices, domestic quarantine, and China-Mongolia border closures).

shocks in the global financial and commodity markets. In the case of Mongolia, the trade channel of external shocks was strong during the GFC. However, the Mongolian economy has become increasingly connected with the global financial market as Development Bank and the Government of Mongolia have issued sovereign bonds since 2012. Consequently, spillovers of external shocks passing through financial channels have grown, and it has been evident in the recent two recessions.

Figure 1. Real commodity prices and liquidity, 2000Q1-2020Q4



Notes: The data are expressed in log form, and the scale is normalized. The real commodity price is on the left axis, and the liquidity (represented by the sum of the M2 money of Brazil, Russia, India, China, and the US) is on the right axis. The shaded area represents the recession periods in the Mongolian economy. For details on data construction and sources, see Section 4.1.

The observations from the simple correlation analysis also raise two interesting questions: i) Do the global liquidity shocks affect commodity demand and commodity prices, or in the opposite direction, or both directions?, and ii) How do shocks to global commodity and financial markets affect the domestic economy and financial markets through trade and financial channels? To answer these questions using Mongolia as a representative case study, we need a dynamic and stochastic model with country-specific characteristics discussed in the next section.

3. A SVAR model for the Mongolian economy

The SVAR approach is used to examine the effects of global liquidity, commodity supply, and commodity demand shocks on international financial and commodity markets and the domestic economy. The SVAR model for the set of variables, X_t is

$$B_0 X_t = B_1 X_{t-1} + \cdots + B_j X_{t-j} + \epsilon_t \quad (1)$$

where B_0 represents the contemporaneous relationship between the variables and is non-singular and normalized to have unit values on the diagonal. B_1, …, and B_j are the structural parameters on

the lagged endogenous variables for a lag length of j. $\epsilon_t$is a 10×1 vector of normally distributed structural shocks with $E(\epsilon_t \epsilon_t') = D$ of for and $E(\epsilon_t \epsilon_{t+s}') = 0$, for all $s \neq 0$. The diagonal matrix D contains the variances used to calculate the structural shocks.

The dataset (X_t) consists of four foreign and six domestic variables, selected in line with Souza and Fry-McKibbin (2021). Foreign variables are China's steel production (csp_t), global liquidity using M2 of the BRIC (Brazil, Russia, India, China) and the US (liq_t), real commodity prices (pc_t), and real foreign output (yw_t). The first three foreign variables are included in the system as they are essential to identify commodity demand, global liquidity, and commodity supply shocks. Analysis in Section 2 shows that these variables are highly correlated with each other and domestic variables. yw_t is not only a key variable in determining foreign demand but also essential to capture the impacts of the global business cycle. Moreover, the inclusion of pc_t helps to reflect the effects of the commodity price cycle in the model. The domestic variables are real Mongolian mineral exports ($resx_t$), real mining production ($comm_t$), domestic output (yd_t), CPI (pd_t), lending rate (rd_t), and real exchange rates (q_t). The choice of these domestic variables is based on relationships in small open and commodity-exporting economy models. For instance, including the lending rate and real exchange rate is vital to examine the transmission of external shocks and influences on the financial markets.

The structural shocks in the SVAR are identified using the restrictions employed by Souza and Fry-McKibbin (2021)[3].

The contemporaneous identification restrictions are summarized by

$$B_0 X_t = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{2,1} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{3.1} & b_{3,2} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{4,1} & b_{4,2} & b_{4,3} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{5,1} & b_{5,2} & b_{5,3} & b_{5,4} & 1 & 0 & 0 & 0 & 0 & 0 \\ b_{6,1} & b_{6,2} & b_{6,3} & b_{6,4} & b_{6,5} & 1 & 0 & 0 & 0 & 0 \\ b_{7,1} & b_{7,2} & b_{7,3} & b_{7,4} & b_{7,5} & b_{7,6} & 1 & 0 & 0 & 0 \\ 0 & b_{8,2} & b_{8,3} & 0 & 0 & b_{8,6} & b_{8,7} & 1 & 0 & 0 \\ 0 & b_{9,2} & b_{9,3} & 0 & 0 & b_{9,6} & b_{9,7} & b_{9,8} & 1 & 0 \\ b_{10,1} & b_{10,2} & b_{10,3} & b_{10,4} & b_{10,5} & b_{10,6} & b_{10,7} & b_{10,8} & b_{10,9} & 1 \end{bmatrix} \begin{bmatrix} csp_t \\ liq_t \\ pc_t \\ yw_t \\ resx_t \\ comm_t \\ yd_t \\ pd_t \\ rd_t \\ q_t \end{bmatrix} \quad (2)$$

and the identification restrictions through the lags for j are by

[3] Their restrictions are based on the identification assumptions discussed by Dungey et al. (2014) and Dungey et al. (2020).

$$B_j X_{t-j} = \begin{bmatrix} b^j_{1,1} & b^j_{1,2} & b^j_{1,3} & b^j_{1,4} & 0 & 0 & 0 & 0 & 0 & 0 \\ b^j_{2,1} & b^j_{2,2} & b^j_{2,3} & b^j_{2,4} & 0 & 0 & 0 & 0 & 0 & 0 \\ b^j_{3,1} & b^j_{3,2} & b^j_{3,3} & b^j_{3,4} & 0 & 0 & 0 & 0 & 0 & 0 \\ b^j_{4,1} & b^j_{4,2} & b^j_{4,3} & b^j_{4,4} & 0 & 0 & 0 & 0 & 0 & 0 \\ b^j_{5,1} & b^j_{5,2} & b^j_{5,3} & b^j_{5,4} & b^j_{5,5} & 0 & 0 & 0 & 0 & b^j_{5,10} \\ b^j_{6,1} & b^j_{6,2} & b^j_{6,3} & b^j_{6,4} & b^j_{6,5} & b^j_{6,6} & b^j_{6,7} & b^j_{6,8} & b^j_{6,9} & b^j_{6,10} \\ b^j_{7,1} & b^j_{7,2} & b^j_{7,3} & b^j_{7,4} & b^j_{7,5} & b^j_{7,6} & b^j_{7,7} & b^j_{7,8} & b^j_{7,9} & b^j_{7,10} \\ b^j_{8,1} & b^j_{8,2} & b^j_{8,3} & b^j_{8,4} & b^j_{8,5} & b^j_{8,6} & b^j_{8,7} & b^j_{8,8} & b^j_{8,9} & b^j_{8,10} \\ b^j_{9,1} & b^j_{9,2} & b^j_{9,3} & b^j_{9,4} & b^j_{9,5} & b^j_{9,6} & b^j_{9,7} & b^j_{9,8} & b^j_{9,9} & b^j_{9,10} \\ b^j_{10,1} & b^j_{10,2} & b^j_{10,3} & b^j_{10,4} & b^j_{10,5} & b^j_{10,6} & b^j_{10,7} & b^j_{10,8} & b^j_{10,9} & b^j_{10,10} \end{bmatrix} \begin{bmatrix} csp_{t-j} \\ liq_{t-j} \\ pc_{t-j} \\ yw_{t-j} \\ resx_{t-j} \\ comm_{t-j} \\ yd_{t-j} \\ pd_{t-j} \\ rd_{t-j} \\ q_{t-j} \end{bmatrix} \quad (3)$$

Lower triangular restrictions on the contemporaneous impact matrix B_0 is set as shown in Equation (2), and parameter matrices of the lags B_1 and B_j are restricted according to Equation (3).

The general ordering of the variables in the system is selected as $X_t = [csp_t\ liq_t\ pc_t\ yw_t\ resx_t\ comm_t\ yd_t\ pd_t\ rd_t\ q_t]'$. Chinese resource demand comes first, given that Chinese demand was domestically generated and less dependent on the international economy than other foreign variables. Global liquidity comes before world commodity prices and foreign output. Ratti and Vespignani (2015) also order global liquidity before commodity prices by assuming that liquidity can affect demand and supply in the commodity markets. Commodity prices respond to Chinese resource demand and global liquidity contemporaneously. The foreign output is believed to be the most endogenous and affected by world commodity and financial market changes among the foreign variables. Foreign variables are considered to influence each other through the lags.

As Mongolia is a small open economy with no capacity to affect the global economy, the foreign variables in X_t affect all domestic variables contemporaneously or through the lags. However, the domestic variables do not affect the foreign variables contemporaneously or through the lags. Domestic resource exports and the commodity sector react to the external sector contemporaneously. In line with standard New Keynesian structural models, the identification of the remaining macroeconomic variables generally follows the lower triangular ordering with exceptions for inflation rate and interest rate, where there are zero restrictions on Chinese steel production, foreign output, and resource exports contemporaneously, which are in line with Berkelmans (2005) and Dungey et al. (2014)[4]. The only foreign variables that affect inflation and the interest rate are global Liquidity and commodity prices, allowing for reflection on the financial channel of international developments. The domestic variables affect each other through the lags except for resource exports, where there are zero restrictions on the commodity sector, domestic output, inflation, and interest rate. It implies that only the real exchange rate affects resource exports among the domestic variables. The assumption that the interest rate influences the domestic variables with lags and shocks to the domestic macroeconomic variables affect the

[4] The rationale for this assumption is that the foreign variables will affect through the lags: first affects domestic output followed by the inflation rate and the interest rate.

financial market variables (i.e., the interest rate and the exchange rate) contemporaneously is standard with existing models specified for emerging markets.

Based on these restrictions, we identify ten structural shocks and effects and transmission mechanisms of the shocks empirically examined in Section 4.

4. Data and empirical results

4.1 Data

The dataset (X_t) used in the VAR estimation includes ten variables for the period 2000Q1-2020Q4. In the case of Mongolia, quarterly data on real GDP is only available from the first quarter of 2000. The start date also coincides with the end of the transition from a socialist to a market economy. The four foreign and six domestic variables used in the estimation are detailed in Table 2.

Table 2 . Descriptions of the data

	Name	Descriptions
Foreign variables	csp_t	Chinese steel production (in tons) is available at www.tradingeconomics.com .
	liq_t	The M2 data for Brazil, China, and the US is from the Federal Reserve Bank of St. Louis. M2 of Russia and L2 of India are available from the corresponding central bank's website. CPI and exchange rate of the BRIC (Brazil, Russia, India, and China) countries and the US are from FRED, the Federal Reserve Bank of St. Louis.
	pc_t	Nominal commodity prices in the US dollars for five major export products (copper concentrate, coal, crude gold, crude oil, and iron ore) are observed. We deflate the data using the US CPI. Commodity prices are obtained from the World Bank Pink Sheet, and the US CPI is taken from FRED. Mongolian exports in US dollars were used to derive the weights to construct the real commodity price index. Export data comes from the Mongolian Customs General Administration.
	yw_t	Thirteen countries' real GDP in real-time, seasonally adjusted, and constant US dollars are obtained from the World Bank (Global Economic Monitor). Export data are used to calculate the weights. The source is the Mongolian Customs General Administration.
Domestic variables	$resx_t$	Mongolian exports of crude gold, crude oil, iron ore, copper concentrate, and coal, denominated in US dollars, are taken from the Mongolian Customs General Administration. To calculate actual resource export, the sum of the exports is deflated by the US CPI and seasonally adjusted using ARIMA X13.
	$comm_t$	The production of the mining sector, expressed in 2010 prices, is taken from the National Statistical Office (NSO) of Mongolia. The data are seasonally adjusted using ARIMA X13.
	yd_t	Real GDP, expressed in 2010 prices, is obtained from the NSO database. The data are seasonally adjusted using ARIMA X13.
	pd_t	Ulaanbaatar's annual inflation data are obtained from the Monthly Statistical Bulletin of the Bank of Mongolia.
	rd_t	The weighted average lending rate of banks for each month is taken from the Monthly Statistical Bulletin of the Bank of Mongolia.
	q_t	The monthly real effective exchange rate is obtained from the Bank of Mongolia.

Following Dungey et al. (2014, 2020), Chinese steel production (csp_t) serves as a proxy of Chinese resource demand as there is no direct measure of Chinese resource demand. The sum of the real M2 of BRIC (Brazil, Russia, India, China) and the US (liq_t)[5]. The monetary aggregates are deflated by the corresponding domestic CPI and transformed into the US dollars by the nominal

[5] In empirical studies, global liquidity is proxied by M2 of G7 (Canada, France, Germany, Italy, Japan, USA, UK), OECD countries, G3 (USA, Eurozone, Japan), G5 (USA, Eurozone, Japan, UK, Canada) and the BRIC (Brazil, Russia, India, and China).

exchange rate. Foreign output (yw_t) is the real GDP of Mongolia's thirteen largest trading partners weighted in terms of the average value of Mongolian exports to each country.

We use a constructed commodity price index (pc_t) for the principal commodities that Mongolia exports, namely copper concentrate, coal, crude gold, crude oil, and iron ore. The value of the exports of each commodity is divided by the value of Mongolia's total commodity exports to calculate the weights for the commodities used in the price index for each month. The index is expressed in US dollars and converted to a real index by dividing the nominal commodity price index by the CPI of the US. As the average weights of copper concentrate and coal are high, the prices of the commodities mainly drive movements in the index. The quarterly values are the average over the quarter. The real resource export variable ($resx_t$) for Mongolia consists of the same products included in the commodity price index.

The measure of the commodity sector ($comm_t$) is proxied by mining production, and the domestic output (yd_t) is Mongolian real GDP. The inflation rate (pd_t) is the headline CPI-based annual inflation, the primary indicator of the inflation target of the Bank of Mongolia. The lending rate (rd_t) is the weighted average interest rates on loans issued by banks. The real exchange rate (q_t) is the trade-weighted index expressed in real terms using CPI. The quarterly values are the average over the quarter. Inflation and lending rate are in percent. All variables except for the inflation and lending rate are in logs.

4.2 Lag order selection

Using standard information criteria (AIC, HQ, or SC), the lag length of the SVAR is chosen. HQ and SC suggest that the lag length is $j = 1$, while AIC indicates lag length is 4. Since many variables are included in the system estimated by classical econometrics, we choose $j = 1$, which ensures no serial correlation, and the VAR satisfies the stability condition. The model with one lag also meets the overidentification test of the restrictions shown in equations (2) and (3). The model with 2 lags is also estimated as a robustness check, and the results have been robust.

4.3 Impulse responses: How does the domestic economy respond to commodity demand, commodity supply, and global liquidity shocks?

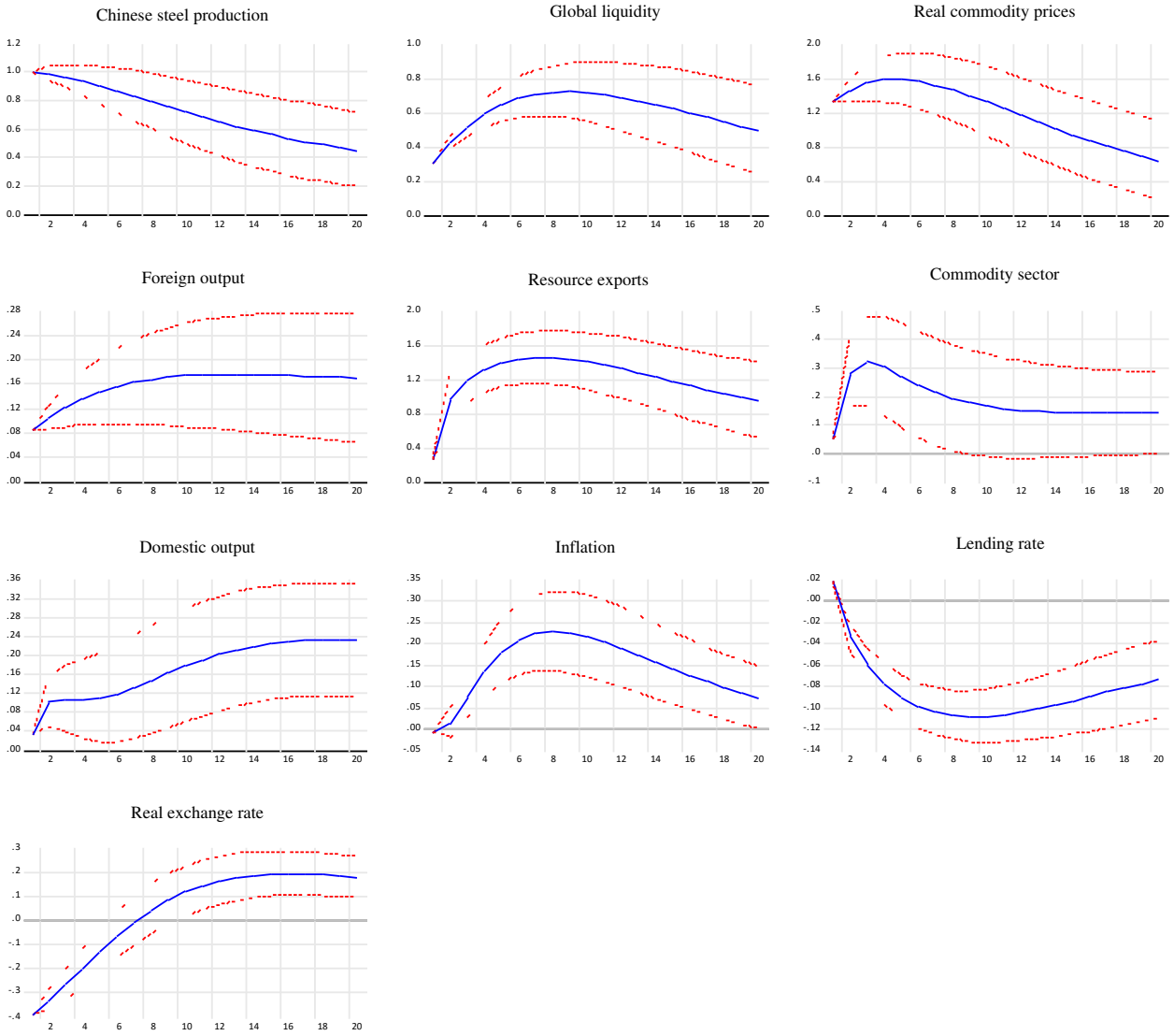
Impulse response functions show how the variables respond to a structural shock for each period. The 68 percent confidence intervals of impulse response functions are calculated.

Responses to commodity demand shock. As shown in Figure 2, the Chinese steel production shock of a 1 percent increase in Chinese steel production leads to rises in real commodity prices, real foreign output and liquidity in international financial markets. For example, commodity prices peak at 1.6 percent above the baseline in four quarters after the shock, while global liquidity peaks at 0.7 percent above the baseline in eight quarters after the shock. In addition, real foreign output increases steadily, reaching a stable level in about nine quarters, where it peaks at 0.17 percent above the baseline. After the shock, these effects are expected to last for more than 20 quarters. This finding suggests that the shock to Chinese resource demand strongly impacts commodity prices and global liquidity.

Real resource exports increase by 1.4 percent above baseline in six quarters after the shock. The mining sector output peaks at 0.33 percent above baseline after three quarters. Higher Chinese resource demand and the resulting rise in commodity prices expands Mongolia's real GDP.

Domestic GDP increases by 0.15 percent above the baseline in eight quarters and by 0.23 percent in twelve quarters after the shock. The persistent effect on the domestic output indicates that the demand shock has positive spillover impacts on other sectors. The expansion of other sectors, together with the no appreciation in the real exchange rate in response to the shock, implies that Dutch disease is not evident in the case of Mongolia.

Figure 2. Impulse responses to a commodity demand shock ($\epsilon_{csp,t}$)



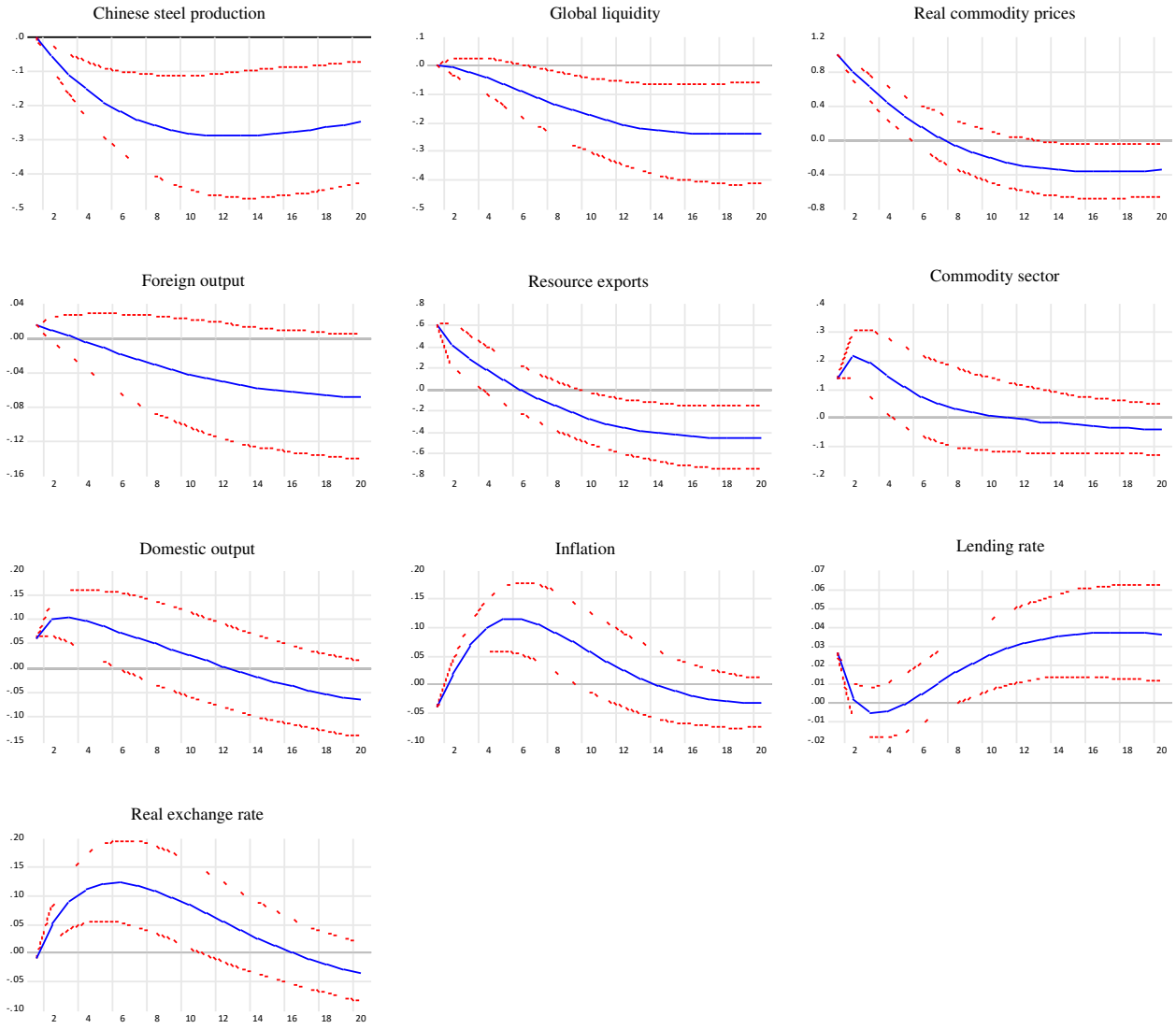
Except for the first period, the commodity demand shock leads to a decline in the domestic lending rate. A little positive response of the lending rate in the first quarter can be explained by an increase in the credit demand due to the domestic output expansion. The shock also leads to a rise in global liquidity. As advocated by Shousha (2016), investors may expect optimistic economic outlook since the export demand and the terms of trade change favorably. These factors contribute to domestic monetary and credit expansions, which reduces the lending rate. This finding supports the view that a counter-cyclical relationship between interest rates and the business cycle exists in commodity-exporting economies. Moreover, the decline in interest rates is one of the channels to support non-mining GDP growth, leading to a further expansion during a resource boom. The responses of domestic output and lending rate are in line with the existing findings that commodity

market shocks are key sources of business cycles in emerging market economies (i.e., Zeev et al. 2017, Drechsel and Tenreyro 2018, Fernández et al. 2018).

In responding to the shock, inflation is expected to rise steadily and peak at 0.2 percentage points above the baseline in nine quarters after the shock. Lower lending rates and higher domestic demand are the main drivers of higher inflation. In addition, the higher imports fueled by the domestic expansion led to the real exchange rate depreciation in the impact period. The depreciation has a somewhat positive impact on the output of non-mining exporters. However, the real exchange rate appreciates starting from the first quarter, converging to initial values in ten quarters after the shock.

Responses to commodity supply shock. The commodity supply shock, equivalent to a 1 percent increase in real commodity price, reduces Chinese steel production with the most substantial impact at 0.3 percent below the baseline in twelve quarters after the shock (Figure 3).

Figure 3. Impulse responses to a commodity supply shock ($\epsilon_{pc,t}$)



Foreign output initially increases but falls[6] starting from the third quarter, and the confidence interval includes zero except for the impact period. Global liquidity does not respond to the commodity supply shock for the first six quarters. However, the fall in Chinese steel production leads to a decrease in liquidity starting from the seventh quarter.

As expected, the effect on real resource exports is strong and reflects the pattern of the commodity prices. Real resource exports increase by 0.6 percent in the impact period. Domestic and commodity sector output peak at 0.1 percent and 0.2 percent above baseline in the third quarter following the shock. The effects on resource exports, commodity sector, and domestic output are statistically significant only for four quarters, which is "short-lived" compared to the case of the commodity demand shock. As the supply shock mainly enters the domestic economy through the real sector, the effect on inflation takes time, peaking at 0.12 percentage points above the baseline in six quarters after the shock. Due to the rise in demand for credit in the real sector, the lending rate significantly increases in the impact period. Since then, the lending rate temporarily falls in line with previous studies (i.e., Shousha 2016 and Souza and Fry-McKibbin 2021). As inflation rises, the lending rate responds positively from the sixth quarter.

The real exchange rate appreciates in response to the higher global commodity prices. The exchange rate closely follows the path of higher resource exports and higher inflation. Rising lending rates and appreciation lead to a decline in domestic output from the fifth quarter.

Responses to liquidity shock. The shock, equivalent to a 1 percent increase in global liquidity, leads to a significant rise in real commodity prices, however, does not impact foreign output (Figure 4). As a result of the shock, Chinese steel production fell steadily for the first eight quarters, peaking at 0.4 percent below the baseline. The real resource exports positively respond, but commodity sector output declines. The findings imply that the financial shock does not affect the volume of resource export and the commodity sector output, but only influences the commodity prices, thereby the value of exports.

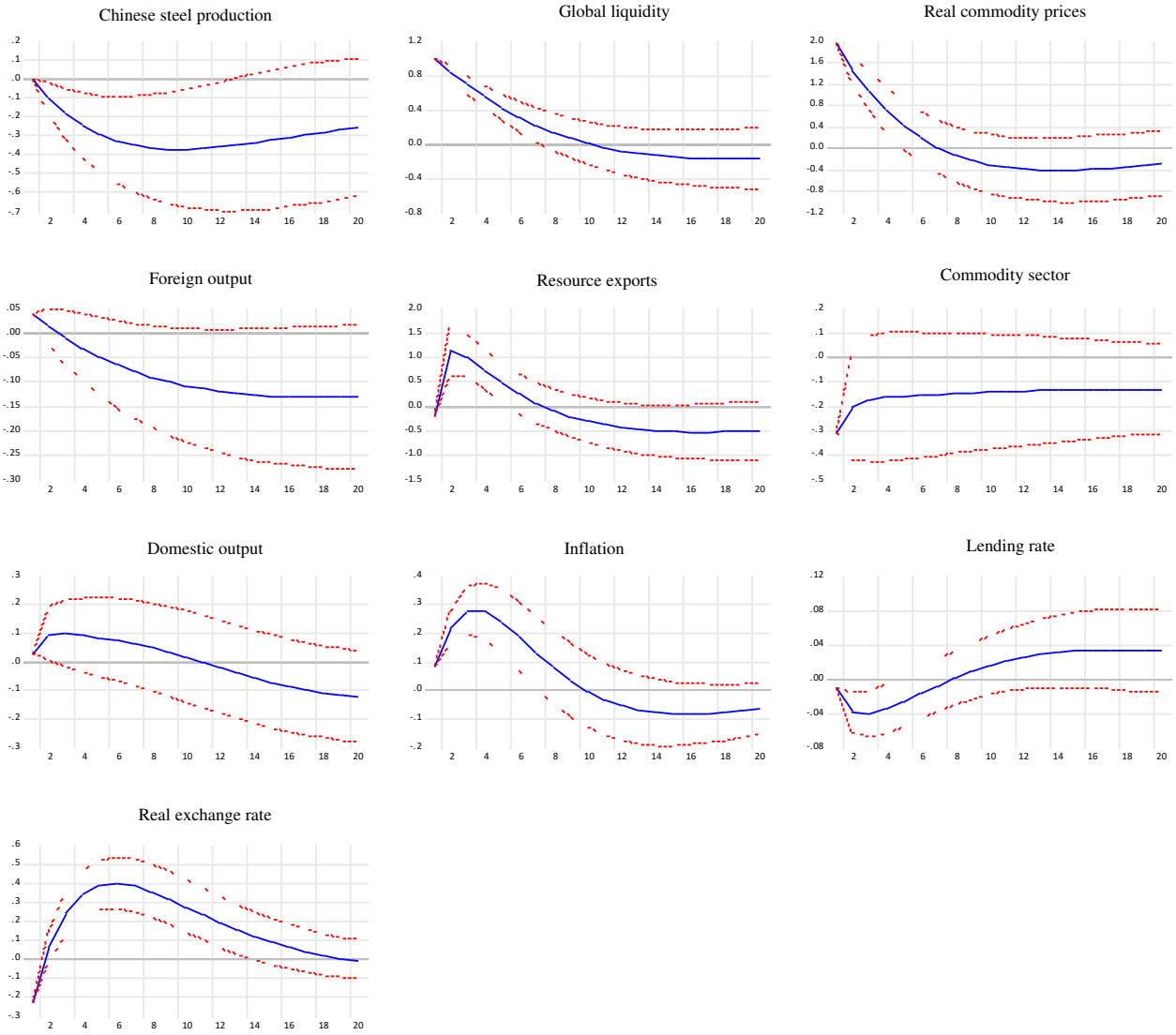
Reflecting the expectation of increased revenue from exports and higher growth, the domestic lending rate falls, and the real exchange rate appreciates as found by Souza and Fry-McKibben (2021) for Brazil. The lower lending rate leads to a rise in non-commodity sector output, hence the domestic GDP. These results indicate that the financial channel of the shock is strong in the economy. Higher domestic production and lower lending rate lead to a rise in inflation. The peak impact is two quarters for domestic output and four quarters for inflation.

Overall, the impulse responses to these three shocks show that i) positive external shocks lead to increases in real resource exports, domestic output, and inflation, suggesting that the global cycles in commodity and financial markets have the potential to drive the business cycle in Mongolia; ii) positive shocks to commodity supply and global liquidity appreciate the real exchange rate of domestic currency for the short term; iii) the domestic lending rate falls in responding to positive shocks to commodity demand and global liquidity, and iv) commodity demand shocks affect the domestic economy mainly passing through trade and financial channels (resource revenue exports,

[6] Higher commodity prices result in the increase in the price of inputs into production, and hence prices of final goods lead to a fall in foreign demand.

"demand spillover" and lending rate channels), while financial channel (lending rate and exchange rate channels) is more evident for global liquidity shocks. Trade and financial channels (resource revenue and lending rate channels) of commodity supply shocks exist in the economy.

Figure 4. Impulse responses to a global liquidity shock ($\epsilon_{liq,t}$)



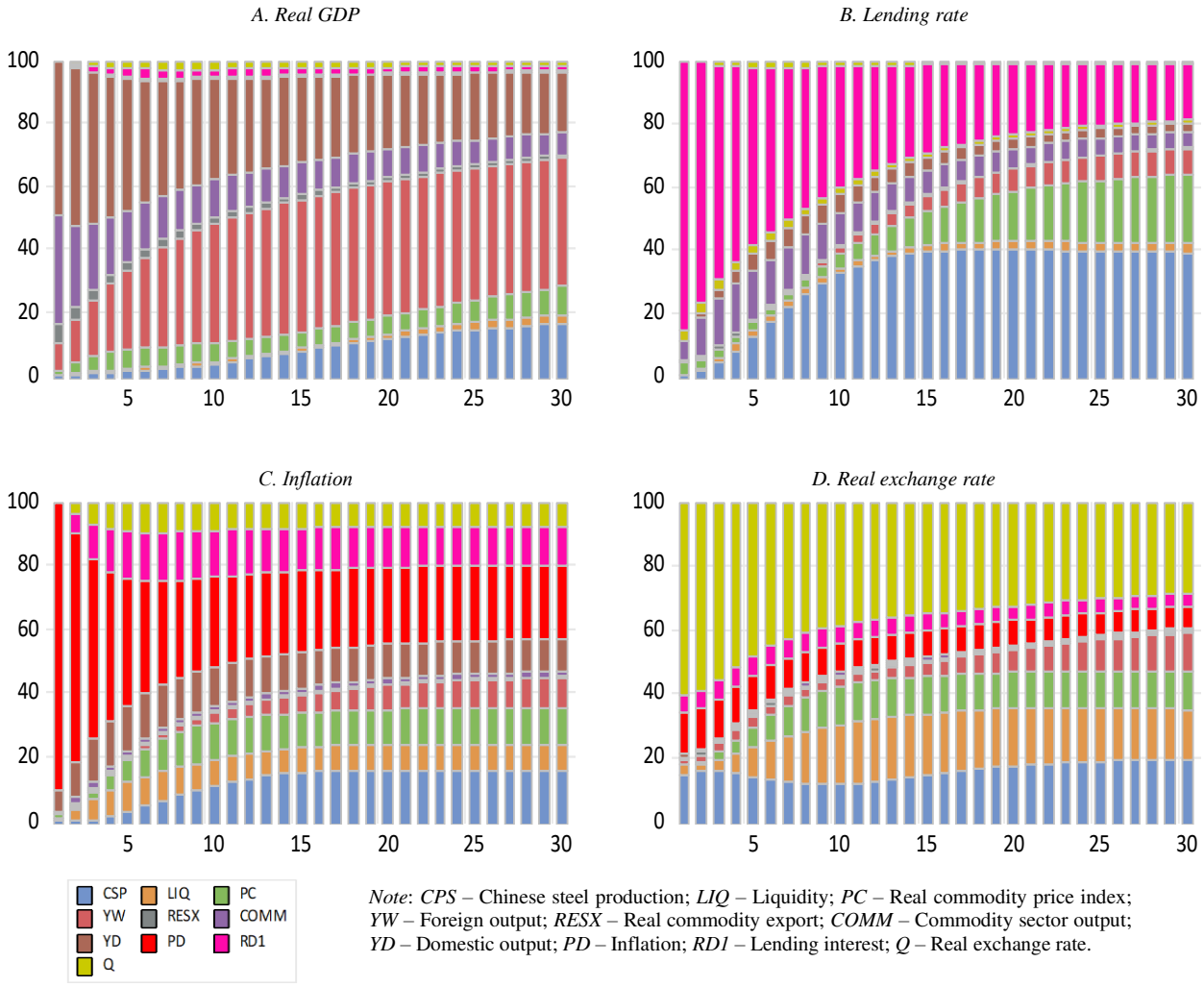
4.4 Variance decomposition: How vital are commodity demand, commodity supply, and global liquidity shocks in business and financial cycle fluctuations?

Impulse response functions are mostly used to examine the transmission and effect of the structural shocks, while they do not provide evidence on importance of the shocks in business and financial cycle fluctuations. Variance decomposition, on the other hand, shows the importance of the shocks in movements in the variables. Figure 5 shows the variance decomposition of the selected domestic variables at the point estimates.

The variance decomposition shows that external shocks play an essential role in the Mongolian business and financial fluctuations in the longer term. In the short-term, domestic influences such as domestic output and commodity sector shocks dominate the macroeconomy of Mongolia. However, shocks in commodity and international financial markets ($\epsilon_{csp,t}$, $\epsilon_{pc,t}$, $\epsilon_{liq,t}$) account

for about 30 percent of real GDP fluctuations in the thirtieth quarters[7]. In particular, the commodity demand side (i.e., Chinese resource demand) has a more vital role in the business cycle of Mongolia. All external shocks (including foreign output shocks) account for 65 percent, which is in line with the finding obtained by Doojav and Luvsannyam (2019) in the case of Mongolia. Using a large Bayesian VAR approach, they show that external shocks (copper, coal, oil prices, Chinese growth, FDI shocks) together account for almost 50 percent of real GDP fluctuations.

Figure 5. Variance decomposition of selected domestic variables



Note: *CPS* – Chinese steel production; *LIQ* – Liquidity; *PC* – Real commodity price index; *YW* – Foreign output; *RESX* – Real commodity export; *COMM* – Commodity sector output; *YD* – Domestic output; *PD* – Inflation; *RD1* – Lending interest; *Q* – Real exchange rate.

A key finding is that commodity demand and commodity supply shocks have a trivial role in lending rate fluctuations in the longer term. For instance, after 30 quarters, commodity demand and commodity supply shocks contribute 40 percent and 20 percent of lending rate fluctuations, respectively. The contribution of commodity demand shocks increases for the first 15 quarters and stabilizes since then, while the role of commodity supply shocks increases after the tenth quarter. Among domestic factors, shocks to the lending rate and commodity sector output have been the main determinants of the lending rate (i.e., explaining almost 85 percent) for the first five quarters.

[7] This result is in line with Drechsel and Tenreyro (2018) who find that commodity price shocks account for 22 percent of output growth fluctuations in in Argentina.

External shocks account for 45 percent of inflation and 60 percent of the real exchange rate after the 30 quarters. Mainly, commodity demand and commodity supply shocks play a crucial role in both inflation and real exchange rate movements. The result indicates that the exchange rate acts as a shock absorber in the economy since most of the movements in the exchange rate are driven by shocks, which also cause variations in domestic output and inflation. Another novel result here is that the contribution of global liquidity shocks is much higher for inflation and real exchange rate fluctuations than those of domestic output and lending rate. It may imply that i) international spillover of the global liquidity shocks, reflecting monetary policies in the advanced economies, mainly passes through exchange rates; and ii) exchange rate pass-through into inflation is reasonably high in the economy.

Among the domestic factors, domestic demand, domestic supply, and lending rate shocks play a crucial role in short to medium-term movements in inflation, while domestic supply, lending rate, and exchange rate shocks contribute considerably to real exchange rate movements in the short term.

4.5 Robustness checks

When working with empirical VAR models, it is necessary to examine the robustness of the results. In this paper, we perform robustness checks by changing the time lags of the SVAR and the shock identification method.

When we select the time lag of the SVAR model as $j = 2$ instead of $j = 1$, there is no significant difference from the results shown in Section 4.3 and Section 4.4. The impulse response functions and variance decompositions of the SVAR(2) model are shown in Annex 1. The comparison of impulse response functions of models with different lags indicates no qualitative differences for the impulse responses as shapes (general direction) and confidence intervals remain consistent. However, there are a few minor differences in response functions of the SVAR(2) model, such as i) the longer lag diminishes the general smoothness of the responses; ii) in responding to a commodity demand shock, the inflation initially decreases, and the commodity sector output response becomes statistically insignificant; iii) the negative response of lending rate to a commodity supply shock is now statistically significant for the first quarters, and iv) response of domestic output to a global liquidity shock becomes negative on the impact period. For the comparison of variance decompositions, the result that external shocks explain about 60 percent of real GDP and lending rate fluctuations and 40 of inflation movements remains consistent. However, contribution of external shocks in real exchange rate movements have reduced to 50 percent.

To check whether the results of the benchmark specification are robust to the shock identification methods, we use Cholesky decomposition (i.e., a simple ordering of variables) instead of restrictions imposed on B_0 matrix (equations (2)). In other words, B_0 matrix is now a lower triangular matrix, and the ordering of variables remains as $[csp_t\ liq_t\ pc_t\ yw_t\ resx_t\ comm_t\ yd_t\ pd_t\ rd_t\ q_t]$. The impulse response functions and variance decomposition based on the Cholesky decomposition method are shown in Annex 2. When comparing impulse response functions of restrictions imposed by equations (2) and the Cholesky decomposition, no significant differences in the shape and magnitude of responses are detected. However, there are minor differences such as i) inflation decreases initially in responding to a

commodity demand shock, ii) the negative response of foreign output to a commodity supply shock becomes statistically significant after seven quarters, and iii) positive response of lending rate to a liquidity shock is now statistically significant after 11 quarters. The comparison of variance decompositions remains consistent and confirms that external shocks are the main sources of real GDP and interest rate fluctuations. However, the contribution of commodity demand and supply shocks in inflation and real exchange rate movements has slightly lowered compared to the benchmark result. Overall, the comparative analysis confirms that the results are robust to the shock identification methods (i.e., restrictions on contemporaneous impact matrix).

5. Conclusion

This paper has examined the effects and transmission mechanisms of commodity demand, commodity supply, and global liquidity shocks in Mongolia, a developing and commodity-exporting economy. We estimate a SVAR model reflecting the main characteristics of the economy to identify four foreign and six domestic shocks and quantify their effects on the business and financial cycles.

Two main findings stand out. First, the Mongolian business and financial cycles follow boom and bust cycles in commodity and international financial markets. Positive shocks to commodity and global financial markets significantly lead to co-movements in domestic resource exports, real GDP, and inflation. Moreover, all external shocks account for more than 60 percent of domestic output, lending rate and real exchange rate fluctuations, and above 40 percent of inflation movements. Mainly, commodity demand, commodity supply, and global liquidity shocks contribute 30, 45, and 60 percent of domestic output, real exchange rate, and lending rate fluctuations, respectively. Commodity demand shocks have more persistent and robust effects on the domestic cycles compared to commodity supply shocks. Second, both trade and financial (resource export revenues, lending rate, and exchange rate) channels play a crucial role in the transmission mechanism of the shocks. For example, buoyant commodity demand and global liquidity shocks lead to a significant fall in the domestic lending rate, amplifying the expansion driven by booms in the commodity market. The finding supports the views such as i) the counter-cyclical nature of the cost of borrowing is a source of business cycles in emerging market economies, and ii) there is a strong amplification mechanism owing to a "spillover" effect from commodity prices to interest rates. Positive commodity supply and global liquidity shocks lead to real exchange rate appreciation, dampening the expansion. Variance decomposition analysis confirms that the lending rate acts as an amplifier of the commodity demand shocks, while the real exchange rate plays a role in absorbing commodity supply and liquidity shocks in the economy. These findings remain robust when the number of lags in the model and shock identification methods is changed.

These results have implications for successfully implementing macroeconomic policies for commodity-exporting economies, especially during global uncertainty. First, disentangling commodity demand, commodity supply, and liquidity shocks and quantifying their effects help policymakers to conduct scenario analysis of critical international developments such as monetary policy tightening in the US (liquidity shock), the war in Ukraine (commodity supply shock), and China's Zero-COVID policy (commodity demand shock or/and foreign output shock). Second,

counter-cyclical monetary (or/and macroprudential) policy would be more effective in stabilizing the domestic business and financial cycles mainly driven by commodity demand shocks, while excessive volatility in real exchange rate led by commodity price (supply) shocks can be better handled with sterilized intervention in the foreign exchange market. Finally, incorporating commodity demand, commodity supply, and global liquidity shocks into structural policy models would help study and manage policy trade-offs in the economies prone to external shocks.

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Annex 1. Impulse response functions and variance decomposition of SVAR(2)

Figure X1.1. Impulse responses to a commodity demand shock ($\epsilon_{csp,t}$)

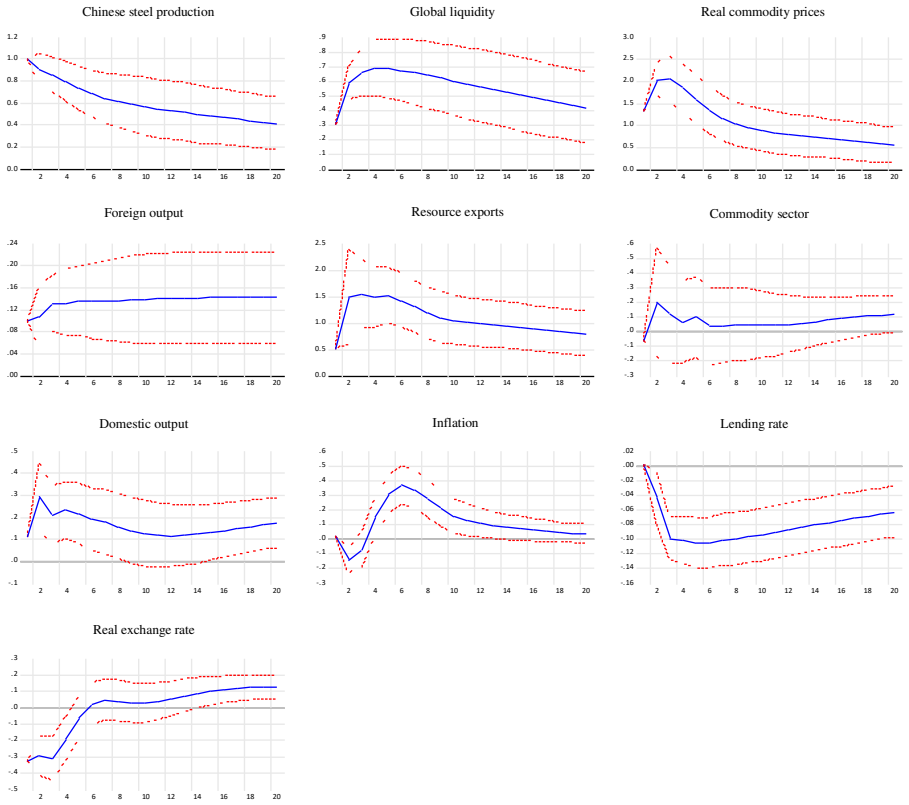


Figure X1.2. Response to a commodity supply shock ($\epsilon_{pc,t}$)

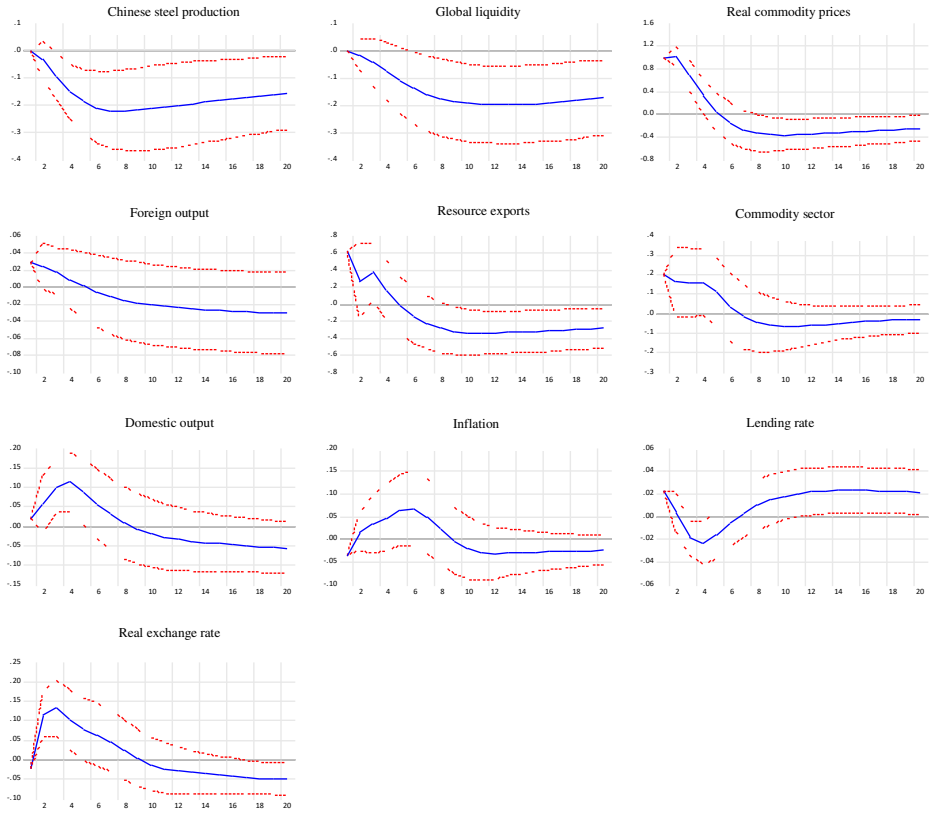


Figure X1.3. Impulse response to a global liquidity shock ($\epsilon_{liq,t}$)

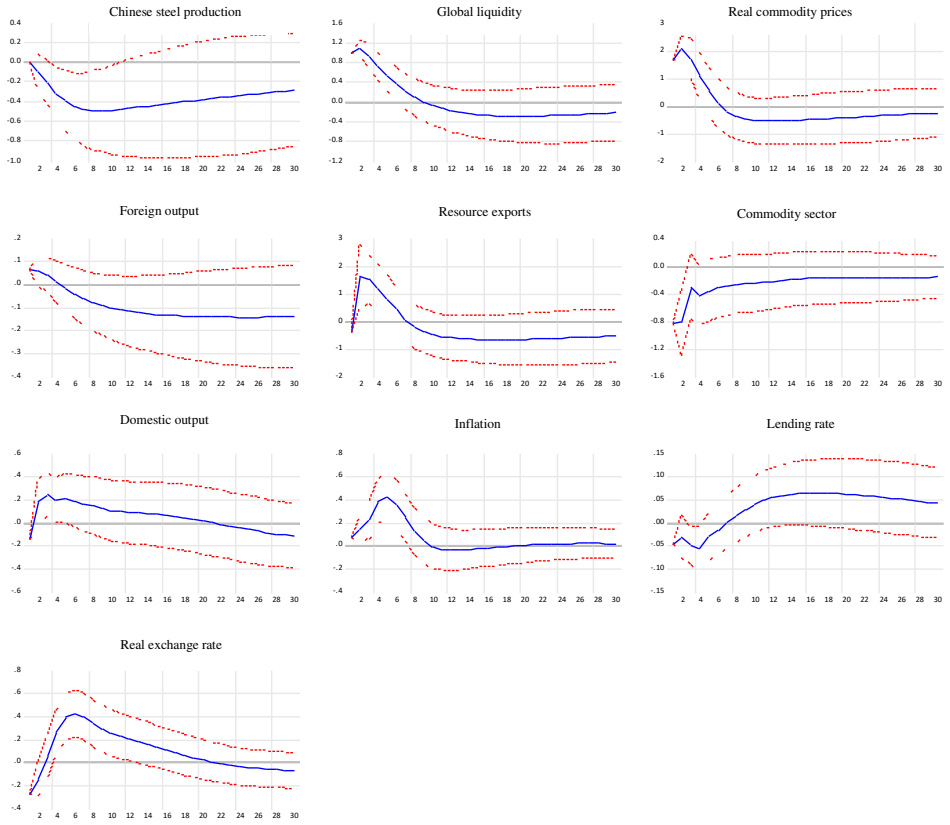
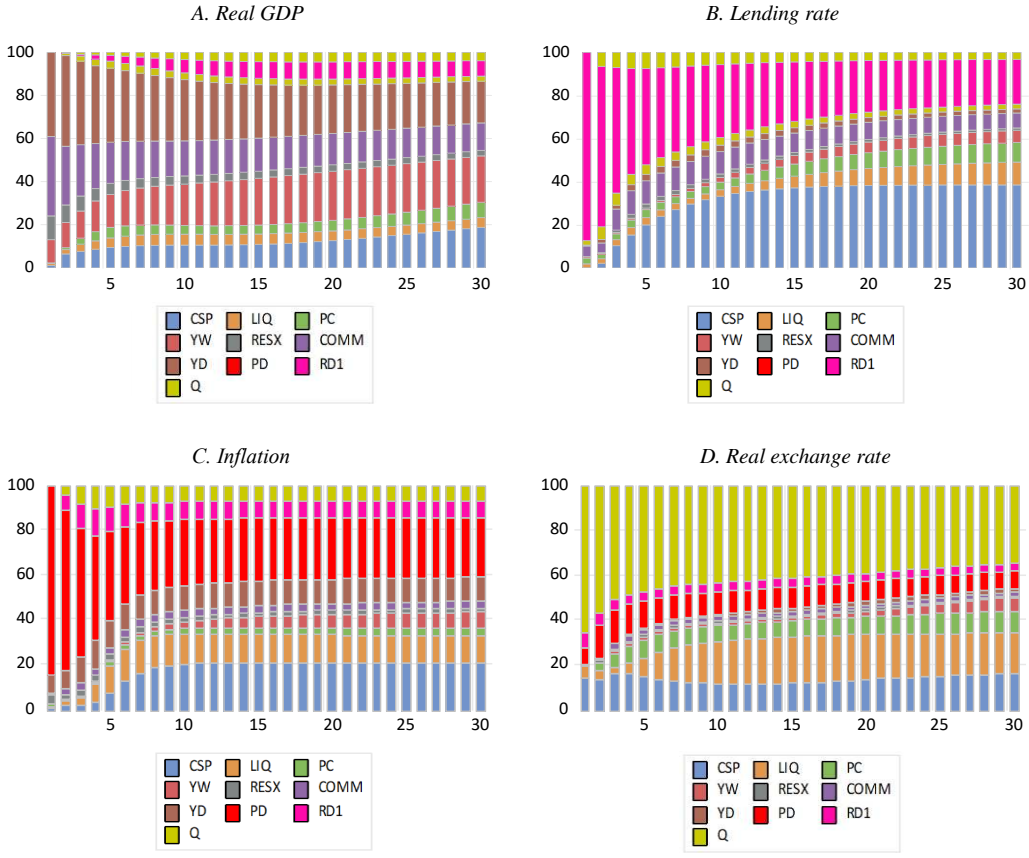


Figure X1.4.Variance decomposition of selected domestic variables



Annex 2. Impulse response functions and variance decomposition: Cholesky identification

Figure X2.1. Impulse responses to a commodity demand shock ($\epsilon_{csp,t}$)

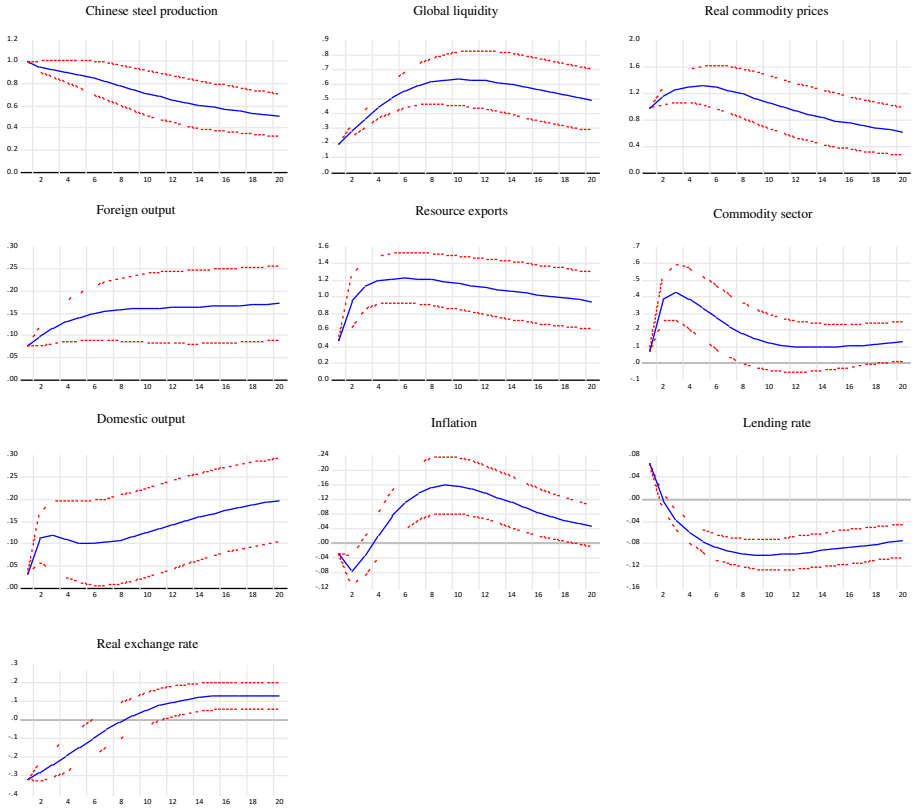


Figure X2.2. Impulse responses to a commodity supply shock ($\epsilon_{pc,t}$)

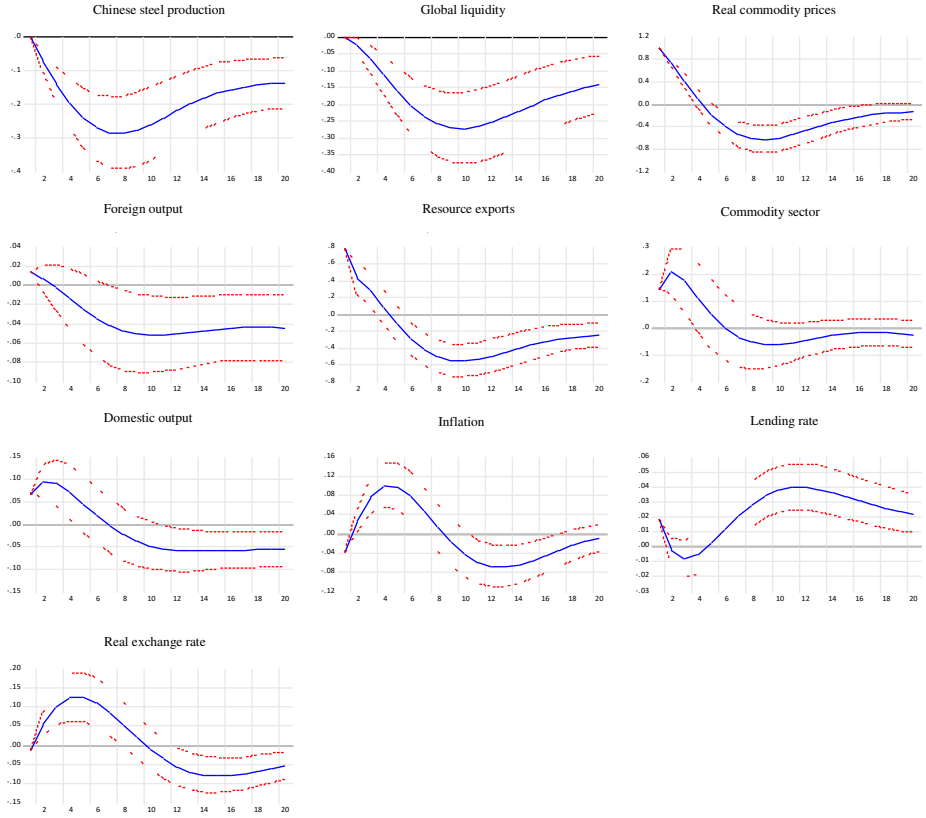


Figure X2.3. Impulse responses to a global liquidity shock ($\epsilon_{liq,t}$)

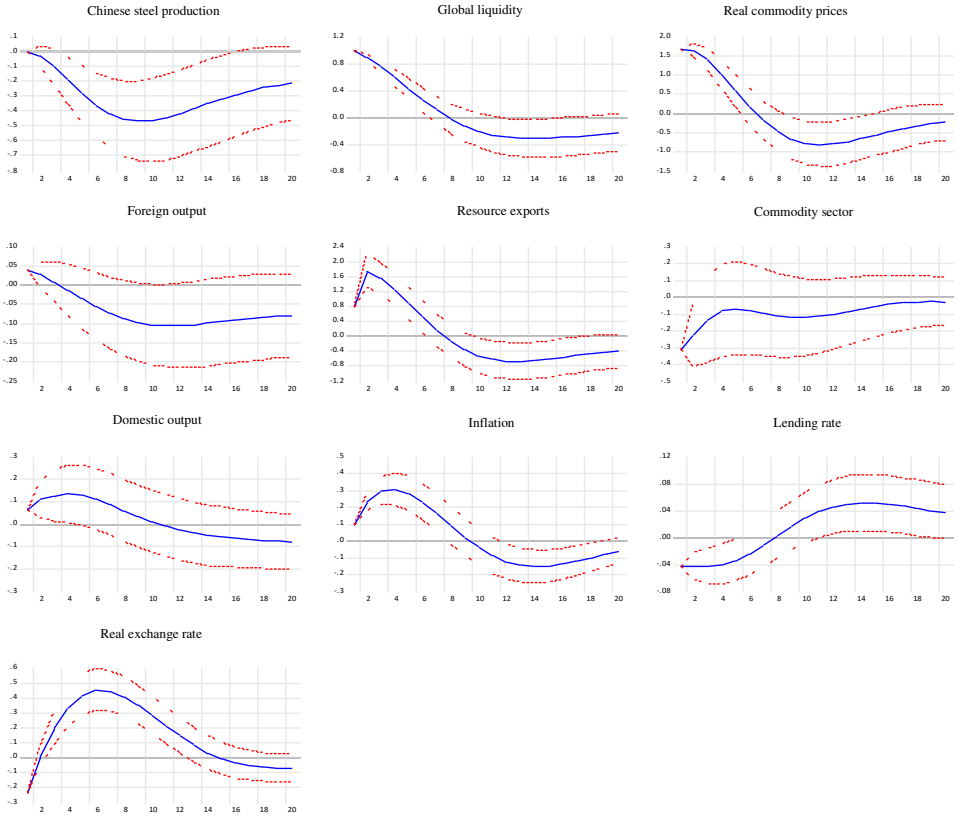


Figure X2.4. Variance decomposition of selected domestic variables