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Effectiveness of Monetary and Fiscal Policy in Mitigating Pandemic-Induced Macroeconomic Impacts: Evidence from Large Net Oil Importers of Asia

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Abstract: *This paper employs a two-economy model, which incorporates New Keynesian features, to examine the impact of a coronavirus disease (COVID-19) induced supply shock on economic recovery in large net oil-importing Asian countries. It examines whether and to what extent monetary and fiscal policies are effective in mitigating such supply shock risks. Our calibrations and estimations reveal that a COVID-19 induced supply shock negatively impacted both the global and domestic economies alike and delayed their economic recovery. Specifically, shocks to total factor productivity and world output negatively affected domestic macroeconomic variables such as domestic output, inflation rate, interest rate, and government expenditure, amongst others. We show that monetary and fiscal policies efficiently mitigate the adverse effects arising from the supply shock.*

Keywords: COVID-19, supply shock, two-economy model, NK-DSGE, monetary policy, fiscal policy

JEL Classification: C63, D58, E47, E52, E62

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1. Introduction

The coronavirus disease (COVID-19) pandemic revealed the extent to which countries have become deeply interconnected and how this has potentially exposed both the real and financial sectors of economies and trade networks to sudden and extreme shocks. Policymakers have responded to the COVID-19 pandemic by implementing various combinations of policy measures to minimise further spread of the virus and to safeguard economies against recession. Joining the ongoing research attempting to estimate the impact of the pandemic on economies, this study examines the impact of a COVID-19 induced external supply shock on economic recovery in large oil-importing Asian countries and examines whether and to what extent fiscal and monetary policies are effective in mitigating the adverse impact of the supply shock on the macroeconomy.

Our study is motivated by the currently mixed evidence regarding the central role that remedial policy measures play in mitigating the impact of the COVID-19 pandemic (Busato et al., 2020; Eichenbaum et al., 2020a, 2020b; Faria-e Castro, 2021). Along these lines and focusing on Asia's largest oil-importing countries – China, India, Japan, and the Republic of Korea (henceforth, Korea) – we hypothesise how the pandemic-induced global supply-side shock would impact large oil-importing economies and how they would recover from this shock following the implementation of monetary and fiscal policies. Oil-importing countries appeal to us because they are arguably more prone to the adverse ramifications of extreme shocks like COVID-19. Chinn and Ito (2022) argued that global trade imbalances had reappeared before the onset of the pandemic outbreak. Further, the external sector report of the International Monetary Fund (IMF, 2020) observed that the external economic outlook was highly uncertain due to the COVID-19 crisis, as the adverse effects would be seen in economies dependent on severely affected sectors such as oil and tourism. This situation could also disrupt global trade and supply chains and hinder the global economic recovery. Together with the pandemic, the ongoing Russia–Ukraine conflict has led to a global supply shock via a surge in international oil prices. The conflict has constrained the economic and trade recovery, with most of the oil-importing countries experiencing rising current account and fiscal deficits as well as inflationary and exchange rate market pressures. Our analysis incorporated the COVID-19 shock in a micro-founded model, allowing us to credibly trace its impact on oil-importing economies and to understand the transmission process of the shock.

Many studies in the literature have examined COVID-19 and its impact on economies. However, they have mostly focused on COVID-19's impact on financial and commodity markets due to the availability of high-frequency data (Narayan, 2021). Some studies have focused on global trade, mainly on COVID-19's impact on the global supply and value chains (Baldwin and Tomiura, 2020; Kejžar and Velic, 2020; Vidya and Prabheesh, 2020; Saif, Ruan, and Obrenovic, 2021; Yu, Li, and Xie, 2021; Espitia et al., 2022). There is limited research on the role of policies in minimising the impact of COVID-19. The scant literature in this regard has mostly focused on developed countries, such as the United States (Danieli and Olmstead-Rumsey, 2020; Eichenbaum et al., 2020a, 2020b; Faria-e Castro, 2021) and the euro area countries (Busato et al., 2020; Hürtgen, 2020). Only three studies have considered developing and emerging market economies, such as China (Zhang et al., 2021), Indonesia (Lie, 2021), and Turkey (Can et al., 2021). In this paper, we address this research gap.

We contribute to the literature in various ways. First, we advance the literature on the effectiveness of monetary and fiscal policies during high uncertainty (see Busato et al., 2020; Can et al., 2021; Danieli and Olmstead-Rumsey, 2020; Eichenbaum et al., 2020a, 2020b; Faria-e Castro, 2021; Hürtgen, 2020; Zhang, Zhang, and Zhu, 2021). This literature evaluates the effectiveness of monetary and fiscal policies in isolation or together and focuses on how these policies influenced financial markets and economic activities during uncertain times. Our study shares a similar spirit with this literature but departs from it by being the first to analyse the effectiveness of these policies in combating the impact of the COVID-19 induced (oil price-led) global supply-side shock economic activity in large oil-importing countries of Asia. The COVID-19 pandemic is an extreme event that has few similarities with other extreme events recorded in the modern era. As such, policy responses have been more desperate than measured. Thus, assessing the effectiveness of the unusual policy responses would enhance our understanding of policy coordination and position us to better deal with a COVID-19-like event in the future. Second, prior studies have typically developed reduced-form approaches to examine the impacts of the pandemic on the economy. While reduced-form models have their merits, e.g. simpler and easier to interpret, they do a poor job at effectively incorporating various market imperfections and certain monopoly elements, such as nominal price rigidities (Blanchard, 2018). We set up a micro-found model, a New Keynesian Dynamic Stochastic General Equilibrium (NK-DSGE) model, which captures market imperfections and certain monopoly elements. Our approach is more appealing as it closely captures the features of an oil-importing economy and as such generates a more realistic picture of the impact of the pandemic on macroeconomic variables and how the monetary and fiscal policy responses influence this impact. Third, our results have strong potential to be extended to other oil-importing countries as the supply shock is homogenous across importing countries. Our study also has strong potential to open the scope for examining the role of policies in tackling the demand-side shock experienced in April 2020 because of the pandemic.

We employ a two-economy model, which incorporates New Keynesian features and covers the domestic economy and the rest of the world. We assume that these two economies are isomorphic as they feature the same economic entities, e.g. households, firms, and monetary and fiscal authorities. We calibrate the model parameters following the literature and simulate the model using the calibrated parameters. We then estimate the supply shocks and derive the impulse responses and posterior distributions using a Bayesian framework. The Bayesian framework allows us to exploit our data sets, obtained from various sources. We carefully formulate the priors and derive the posterior estimates for the model parameters. The Bayesian estimates show that the posterior estimates lie within the confidence interval, confirming the validity of our model.

Our estimations use quarterly post-2008 global financial crisis data spanning the period from the second quarter of 2009 to the first quarter of 2022. Our calibrations and estimations reveal that a COVID-19 induced supply shock negatively impacts the economic recovery. Shocks to total factor productivity and world output negatively affect the domestic macroeconomic variables. We show that monetary and fiscal policies efficiently mitigate the adverse effects of the supply shock. We demonstrate the robustness of our estimates through impulse response comparisons between simulation and estimation analysis.

The rest of the paper is structured as follows. Section 2 sets up the model. Section 3 discusses the estimation framework and data. Section 4 reports the calibration and estimation results. Section 5 provides the concluding remarks.

2. Model

We first present the two-economy model, which follows the open economy framework of Galí and Monacelli (2005) and incorporates New Keynesian features. We assume two isomorphic economies: the domestic economy and the rest of the world. These two economies are isomorphic as they feature the same economic entities, e.g. households, firms, and monetary and fiscal authorities, and optimise their objective functions.

2.1. Households

We assume a small open economy populated by infinitely lived households, whose objective is to optimise the expected present discounted value of lifetime utility subject to an intertemporal budget constraint.[12] The utility function of the representative household is given as follows:

$$\mathcal{U} = E_0 \sum_{t=0}^{\infty} \beta^t U_t \tag{1}$$

where $U_t = E_0 \sum_{t=0}^{\infty} \beta^t \left\{\frac{C_t^{1-\sigma}}{1-\sigma} + \chi \frac{G_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\phi}}{1+\phi}\right\}$ represents utility, E_0 is the expectation operator, and $\beta \in (0,1)$ is the subjective discounting factor. The parameter φ denotes the inverse of the elasticity of labour supply corresponding to the real wage rates, wherein χ represents the relative wage and σ is the measure of the inverse intertemporal elasticity of substitution. Likewise, C_t denotes consumption, N_t represents labour supply devoted towards work, and G_t denotes government consumption.

The representative household is faced with the following budget constraint, given in the standard form as:

$$P_t C_t + E_t\{Q_{t+1} D_{t+1}\} + T_t \leq D_t + (1-\tau_t) W_t N_t \tag{2}$$

where $Q_{t,t+1} = \left(\frac{1}{1+r_t}\right)$, and T_t and τ_t are the lump sum tax and income tax, respectively. The variable W_t is the nominal wage, D_t denotes nominal portfolio, P_t is the consumer price index, and C_t is the composite consumption index – consisting of the consumption of domestically produced goods $C_{H,t}$ and of imported goods $C_{F,t}$. The variables $C_{H,t}$ and $C_{F,t}$ are expressed as

$$C_{H,t} = \left[\int_0^1 C_{H,t}(i)^{\frac{g-1}{\varepsilon}} di\right]^{\frac{g}{\varepsilon-1}} \text{ and } C_{F,t} = \left[\int_0^1 C_{F,t}(i)^{\frac{g-1}{\varepsilon}} di\right]^{\frac{g}{\varepsilon-1}} \tag{3}$$

In a log-linearised form with deviations from the steady state, the forward-looking open economy IS curve in terms of output using a risk-sharing condition and national income identity is expressed as (see Galí and Monacelli, 2005):

$$\hat{y}_t = E_t\{\hat{y}_{t+1}\} - E_t\{\Delta \hat{g}_{t+1}\} + \alpha(\overline{\omega} - 1)(\rho_{c^*} - 1)\hat{c}_t^* - \frac{1}{\sigma_\alpha}\left\{\hat{r}_t - E_t\left(\hat{\pi}_{H,t+1}\right)\right\} \tag{4}$$

where $\sigma_\alpha \equiv \frac{\sigma}{(1-\alpha)+\alpha\overline{\omega}}$ and $\overline{\omega} \equiv \sigma\gamma + (1-\alpha)(\sigma\eta - 1)$. The parameter η denotes the elasticity of substitution between domestic and foreign goods, α is the share of domestic consumption allocated to the imported goods (degree of openness), and γ is the elasticity of substitution between the goods produced in different foreign countries. The variable $\hat{y}_t = ln\left({Y_t}/{\overline{Y}}\right) = y_t - \bar{y}$ is the endogenously determined output and $\bar{y}$ represents the value of output at the steady state. Likewise, government spending $g_t = ln\left(1 - {G_t}/{Y_t}\right)$; r_t is the nominal interest rate; and

[1] See also Çebi (2012) for a similar economy.

$\pi_{H,t} = ln\left({}^{P_{H,t}}/_{P_{H,t-1}}\right)$ is the domestic inflation rate. Further, $P_{H,t}$ is the domestic price level, $c_t^* = y_t^* - g_t^*$ is the exogenously determined world consumption (output), which follows an AR(1) autoregressive process, and the asterisk (*) denotes foreign variables. The forward-looking open economy IS curve in gap form is expressed as

$$\tilde{y}_t = E_t\{\tilde{y}_{t+1}\} - E_t\{\Delta\tilde{g}_{t+1}\} - \frac{1}{\sigma_\alpha}\left(\tilde{r}_t - E_t\{\tilde{\pi}_{H,t+1}\}\right) \quad (5)$$

where $\tilde{y}_t = \hat{y}_t - \hat{y}_t^n, \tilde{r}_t = \hat{r}_t - \hat{r}_t^n$. Presuming that government spending and taxes are zero in an economy based on the condition of zero deficit, viz. $\hat{g}_{t+1}^n = \hat{\pi}_{H,t+1}^n = 0$, we have $\tilde{g}_{t+1} = \hat{g}_{t+1}$. Finally, in equilibrium, the natural levels of output $\hat{y}_t^n$ and nominal interest rate $\hat{r}_t^t$ are expressed as

$$\hat{y}_t^n = \frac{(1+\varphi)}{(\sigma_\alpha + \varphi)}\hat{a}_t - \frac{(\sigma - \sigma_\alpha)}{(\sigma_\alpha + \varphi)}\hat{c}_t^* \quad (6)$$

$$\hat{r}_t^n = \sigma_\alpha(E_t\{\hat{y}_{t+1}^n\} - \hat{y}_t^n) + \sigma_\alpha\alpha(\overline{\omega} - 1)(\rho_{c^*} - 1)\hat{c}_t^* \quad (7)$$

where a_t is the logarithm of the technology process A_t.

2.2. Firms

The typical representative monopolistic firm is engaged in the production of differentiated goods using linear homogeneous technology, in accordance with the following production function:

$$Y_t(j) = A_t N_t(j) \quad (8)$$

where j denotes the j^{th} firm's production function. In line with Calvo (1983), we assume that a fraction of firms $(1-\theta)$ reset their prices. Only two types of firms exist as price setters under this assumption: (i) a fraction $(1-\zeta)$ that behave optimally in accordance with the Calvo optimality principle and change their prices with a probability of $(1-\theta)$; and (ii) a fraction ζ that exhibit backward-looking behaviour with a probability of (θ) when resetting their prices. The price $P_{H,t}^b$ chosen in accordance with rule of thumb by the price setter is given as (see Clarida, Galí, and Gertler, 1999):

$$P_{H,t}^b = P_{H,t-1}^* \frac{P_{H,t-1}}{P_{H,t-2}} \quad (9)$$

where $P_{H,t-1}^* = \left(P_{H,t-1}^f\right)^{1-\zeta}\left(P_{H,t}^b\right)^{\zeta}$ is the price chosen in period $t-1$ by both the optimising forward-looking $P_{H,t-1}^f$ and backward-looking $P_{H,t-1}^b$ price setters. This existence of both backward- and forward-looking behaviour of firms allows us to derive the log-linearised form of open economy hybrid Phillips curve in terms of deviation from the steady state, expressed as

$$\hat{\pi}_{H,t} = \lambda^b \hat{\pi}_{H,t-1} + \lambda^f E_t\{\hat{\pi}_{H,t+1}\} + \kappa \widehat{mc}_t + \varepsilon_t^{\pi} \quad (10)$$

$$\widehat{mc}_t = (\sigma_\alpha + \varphi)(\hat{y}_t - \hat{y}_t^n) - \sigma_\alpha \hat{g}_t + \hat{\tau}_t \quad (11)$$

where $\lambda^b = \frac{\zeta}{\theta+\zeta(1-\theta(1-\beta))}$, $\lambda^f = \frac{\beta\theta}{\theta+\zeta(1-\theta(1-\beta))}$, and $\kappa = \frac{(1-\beta\theta)(1-\theta)(1-\zeta)}{\theta+\zeta(1-\theta(1-\beta))}$; mc_t is the real marginal cost and $\tau_t = -\ln\left(1 - {T_t}/{Y_t}\right)$ is the log-linearised tax rate; and ε_t^{π} is the cost push (mark-up) shock, as included in the Phillips curve (see, amongst others, Smets and Wouters, 2003, 2007; Beetsma and Jensen, 2004; Ireland, 2004; Fragetta and Kirsanova, 2010; Çebi, 2012). We assume that cost push shock is independent and identically distributed (i.i.d) and normally distributed. Equation (11) shows that government spending, income tax, and output gap directly affect the marginal cost and indirectly affect inflation via Equation (10). The slope coefficient κ measures the sensitivity of inflation with respect to the marginal cost. Current domestic inflation is also affected by the real marginal cost, future expected inflation, and the past inflation expressed in terms of inflation inertia. Furthermore, λ^b and λ^f are expressed as the relative weights for the past and expected future inflation rate.

2.3. Monetary Authority

Monetary policy is imperative to minimise the output gap and the negative effects associated with it. Monetary policy intervenes by keeping a check on inflation through the interest rate. This is better understood through the Taylor rule, given as

$$\hat{r}_t = \rho_r(\hat{r}_{t-1} - \hat{r}_{t-1}^n) + (1 - \rho_r)\left[r_\pi \hat{\pi}_{H,t} + r_y(\hat{y}_t - \hat{y}_t^n)\right] + \hat{r}_t^n + \varepsilon_t^r \quad (12)$$

where $\hat{r}_t^n$ is the natural level of the nominal interest rate, ρ_r is the coefficient of interest rate smoothing, and ε_t^r is the i.i.d. interest rate shock. The indicators r_π and r_y are the smoothing parameters for inflationary and output gaps, respectively. This rule postulates that the central bank's response to the target rate of interest depends on the deviation of inflation and interest rate from their steady state levels. Furthermore, while responding to the target interest rate, the central bank takes into consideration the past value of the interest rate in case $\rho_r \neq 0$. In an interdependent fiscal and monetary policy mix, monetary policy is concerned with fiscal borrowing while determining the rate of interest; hence, the modified Taylor rule (see Çebi, 2012) is written as

$$\hat{r}_t = \rho_r(\hat{r}_{t-1} - \hat{r}_{t-1}^n) + (1 - \rho_r)\left[r_\pi \hat{\pi}_{H,t} + r_y(\hat{y}_t - \hat{y}_t^n) + r_b(b_t - b_{t-1})\right] + \hat{r}_t^n + \varepsilon_t^r \quad (13)$$

2.4. Fiscal Policy

We formulate the fiscal policy rule for government spending and taxes in terms of the output gap, and public debt is expressed as follows (see also Muscatelli and Tirelli, 2005):

$$\hat{g}_t = \rho_g \hat{g}_{t-1} + (1-\rho_g)\left[g_y(\hat{y}_{t-1} - \hat{y}^n_{t-1}) + g_b \hat{b}_t\right] + \varepsilon^g_t \quad (1)$$

$$\hat{\tau}_t = \rho_\tau \hat{\tau}_{t-1} + (1-\rho_\tau)\left[\tau_y(\hat{y}_{t-1} - \hat{y}^n_{t-1}) + \tau_b \hat{b}_t\right] + \varepsilon^\tau_t \quad (2)$$

where g_y and τ_y demonstrate the sensitivity of government spending and taxes to the past values of the output gap, ρ_g and ρ_τ are the degree of smoothness parameters, g_b and τ_b are the feedback coefficients on unobservable debt stock, and ε^g_t and ε^τ_t are the i.i.d government spending and tax shocks. In accordance with the fiscal policy rule, government expenditure and revenue are determined by the output gap and public debt. Furthermore, corresponding to the fiscal policy rule, the fiscal authority is constrained by the fiscal solvency constraint, given as

$$\hat{b}_{t+1} = \hat{r}_t + \frac{1}{\beta_t}\left[\hat{b}_t - \hat{\pi}_{H,t} + (1-\beta)(\hat{\tau}_t - \hat{y}_t) + \frac{\bar{C}}{\bar{B}}(\hat{g}_t - \hat{\tau}_t)\right] \quad (3)$$

where $b_t = ln\left({}^{B_t}/_{P_{H,t-1}}\right)$, B_t denotes the nominal debt stock, $\bar{B}_t$ is the measure of the debt to gross domestic product (GDP) ratio, and $\bar{C}_t$ is the ratio of steady consumption to GDP.

2.5. Shocks and Policy Effectiveness

The stochastic behaviour of the variables in the above system is driven by several exogenous disturbances, particularly supply shocks, spending shocks, and inflationary shocks, both domestic and foreign. Policymakers can trace the innovations from these shocks, especially supply shocks, and hence can analyse the impact of the pandemic on the economy. Furthermore, rising oil prices affect domestic supply in the short run, positively impacting domestic inflation. These disturbances can affect the domestic composite consumption and the relative competitiveness of trading partners through the terms of trade and exchange rates. Hence, it is imperative to analyse the role of policy interventions in minimising these shocks. Through the specified open economy model, we evaluate the effectiveness of monetary and fiscal policies in mitigating the adverse impact of COVID-19 induced shocks.

3. Estimation Framework, Robustness, and Period

We perform simulation analysis to analyse the open economy DSGE model. The simulation analysis is based on calibration, for which the values of the proposed model parameters are calibrated from the available empirical literature. While examining the macroeconomic effects of supply shocks, our estimation strategy derives the specific impulse response and posterior from their respective prior, in accordance with the Bayesian econometric framework. We carry out impulse response comparisons between the simulated and the estimated results as robustness checks for our analysis.

Our empirical analysis considers data from the post-2008 global financial crisis until 2022, i.e. the second quarter of 2009 to the first quarter of 2022. For empirical analysis, we chose the four largest oil-importing countries in Asia – China, India, Japan, and Korea. Based on the proposed model, we consider several macroeconomic variables relevant to both the home and foreign economies. The main variables in our analysis are domestic and foreign consumption, the growth rate of output, price levels, and the inflation rates in terms of consumer prices. Further, the role of the rest of the world's output is examined while considering the effect on the domestic trade balance.

4. Calibration and Estimation Results

We calibrate the model parameters for all four economies. The calibrated values are sourced from different studies. Based on the calibration, we simulate the model and derive the separate impulse response due to varying shocks for all four economies. The respective calibrated values are reported in Table 1.

Table 1: Calibrated Values of Model Parameters

Param.	Description	China		India		Japan		Rep. of Korea	
		Value	Source	Value	Source	Value	Source	Value	Source
β_t	Subjective discounting factor	0.98	Zhang (2009)	0.98	Gabriel et al. (2012)	0.98	Fueki et al. (2016)	0.99	Kang & Suh (2017)
α_t	Degree of openness	0.25	Zheng & Guo (2013)	0.30	Goyal (2011)	0.58	Taguchi & Gunbileg (2020)	0.35	Choi & Hur (2015)
σ_t	Intertemporal elasticity of substitution	2.00	Zhang (2009)	1.99	Gabriel et al. (2012)	1.00	Iiboshi et al. (2015)	1.20	Choi & Hur (2015)
φ_t	Frisch elasticity of marginal disutility w.r.t. labour	0.01	Chang et al. (2012)	3.00	Ghate, Gupta & Mallick (2018)	5.00	Wang (2021)	0.27	Park (2020)
ζ_t	Degree of backwardness	0.76	Sanusi (2019)	0.76	Sanusi (2019)	0.76	Sanusi (2019)	0.76	Sanusi (2019)
θ_t	Degree of price stickiness	0.75	Xiao, Fan & Guo (2018)	0.75	Goyal (2011)	0.75	Wang (2021)	0.52	Park (2020)
η_t	Elasticity of substitution between differentiated goods	6.00	Sukhbaatar (2014)	6.00	Goyal (2011)	6.00	Ichiue et al. (2013)	4.16	Park (2020)
ρ_r	Interest rate smoothing	0.80	Dai, Minford & Zou (2015)	0.80	Gabriel et al. (2012)	0.99	Wang (2021)	0.782	Kang & Suh (2017)
r_π	Interest sensitivity of inflationary gap	0.24	Gu, Wang & Wu (2013)	0.50	Taylor (1993)	1.50	Wang (2021)	1.50	Kang & Suh (2017)
r_y	Interest sensitivity of output gap	1.50	Taylor (1993)	0.95	Goyal & Kumar (2018)	0.05	Wang (2021)	0.50	Park (2020)
ρ_g	Gov't exp. smoothness	0.05	Jia, Guo & Wang (2015)	0.25	Tapsoba (2013) as in Nandi (2020)	0.02	Sakuragawa & Hosono (2010)	0.13	Park (2020)
g_y	Gov't exp. due to output gap	0.16	Proxied by gov't exp. as % of GDP	0.07	Proxied by gov't exp. as % of GDP	0.47	Sugo & Ueda (2008)	0.13	Park (2020)
g_b	Elasticity of gov't exp. due to gov't debt	0.05	Proxied by target fiscal deficit as % of GDP	0.25	Tapsoba (2013),Nandi (2020)	0.45	Sakuragawa & Hosono (2010)	1.08	Hur & Lee (2021)

Param.	Description	China		India		Japan		Rep. of Korea	
		Value	Source	Value	Source	Value	Source	Value	Source
ρ_{τ}	Tax revenue smoothing	0.31	Sanusi (2019)	0.22	Sanusi (2019)	0.49	Kotera & Sakai (2018)	0.10	Hur & Lee (2021)
τ_{y}	Elasticity of tax revenue to output	0.12	Proxied by tax rev. as % of GDP	0.07	Proxied by tax rev. as % of GDP	0.03	Kotera & Sakai (2018)	0.10	Hur & Lee (2021)
τ_{b}	Elasticity of tax revenue to public debt	0.03	Sanusi (2019)	0.01	Sanusi (2019)	0.00	Kotera & Sakai (2018)	0.01	Choi & Hur (2015)
AR (1) Processes									
ρ_{a}	Productivity shock	0.94	Jia, Guo & Wang (2015)	0.82	Banerjee, Basu & Ghate (2020)	0.90	Sakuragawa & Hosono (2010)	0.70	Park (2020)
$\rho_{e\pi}$	Inflationary shock	0.62	Jia, Guo & Wang (2015)	0.16	Goyal & Kumar (2018)	0.62	Sakuragawa & Hosono (2010)	0.14	Hur & Lee (2021)
ρ_{er}	Monetary policy shock	0.50	Dai (2012)	0.32	Banerjee, Basu & Ghate (2020)	0.90	Sakuragawa & Hosono (2010)	0.10	Park (2020)
ρ_{eg}	Fiscal policy Shock	0.60	Jia, Guo & Wang (2015)	0.59	Anand et al. (2010)	0.60	Kotera & Sakai (2018)	0.10	Park (2020)
$\rho_{e\tau}$	Tax revenue shock	0.06	Sanusi (2019)	0.06	Sanusi (2019)	0.06	Kotera & Sakai (2018)	0.10	Hur & Lee (2021)
ρ_{cf}	Foreign output shock	0.36	Sanusi (2019)	0.36	Sanusi (2019)	0.90	Sakuragawa & Hosono (2010)	0.74	Lee & Song (2015)

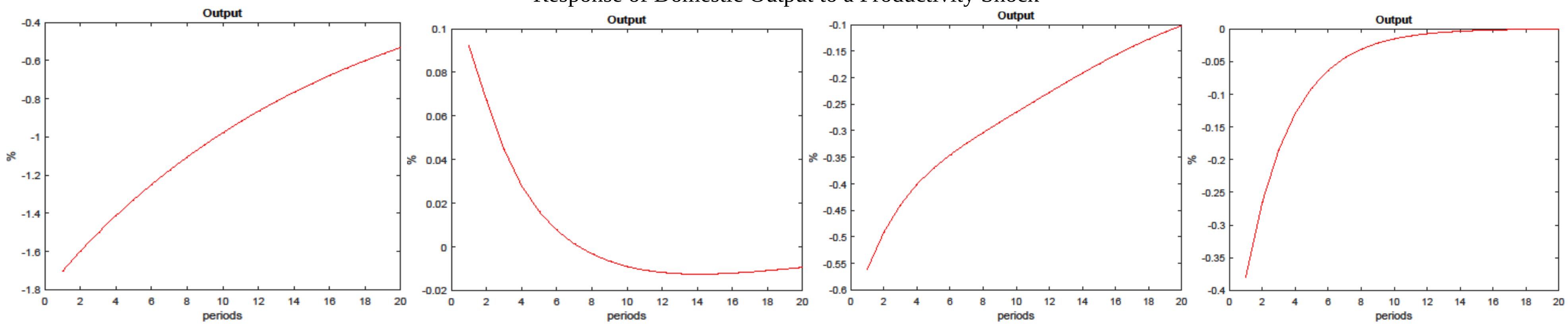
GDP = gross domestic product, exp. = expenditure, gov't = government, Param. = parameter, rev. = revenue, w.r.t. = with reference to.
Note: This table reports the baseline calibrated parametric values sourced from different studies, along with their description for the four economies.
Source: Author's compilation.

4.1. Response of Macroeconomic Variables to a Productivity Shock and Foreign Output Shock

We analyse the response of domestic output to a shock to total factor productivity in all four net oil-importing countries. We find that in all four countries, except India, the domestic output is negatively affected due to a decline in total factor productivity. However, in India, the shock leads to an initial positive impact followed by a persistent decline. We observe that the productivity shock not only causes the domestic output to fall but also leads to a rise in marginal cost or input price, leading to inflationary impact in the domestic economy. In China, however, we find that low economic activity due to a productivity shock leads to a negative impact on inflation. With regard to the impact on government expenditure and tax revenue, we find that a total factor productivity shock negatively affects government expenditure and tax revenue in China, Japan, and Korea, while such a shock tends to raise tax revenue in India due to the positive impact on domestic output. Overall, we observe that a negative shock to total factor productivity, induced by the COVID-19 pandemic, has negatively affected the overall macroeconomic environment in all four countries.

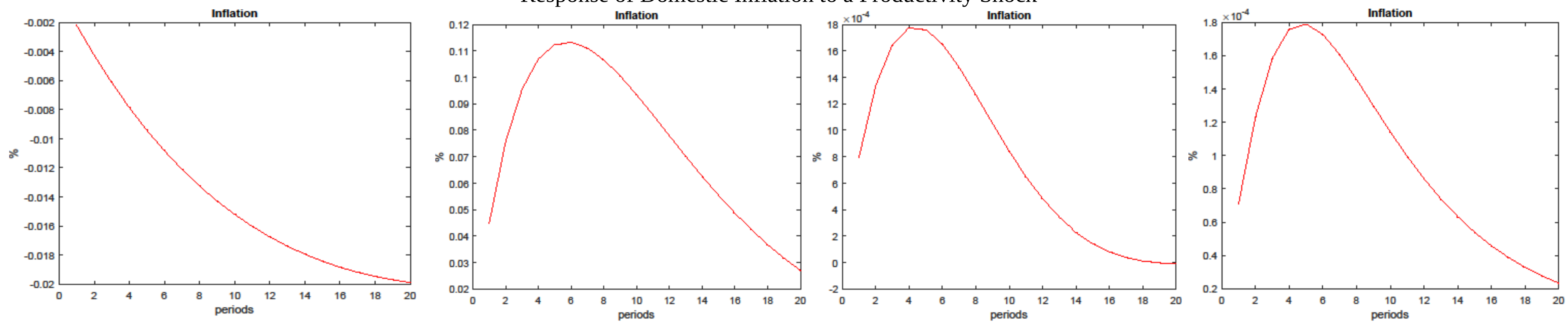
Figure 1: Response of Macroeconomic Variables to a Productivity Shock

Response of Domestic Output to a Productivity Shock



(a) China (b) India (c) Japan (d) Rep. of Korea

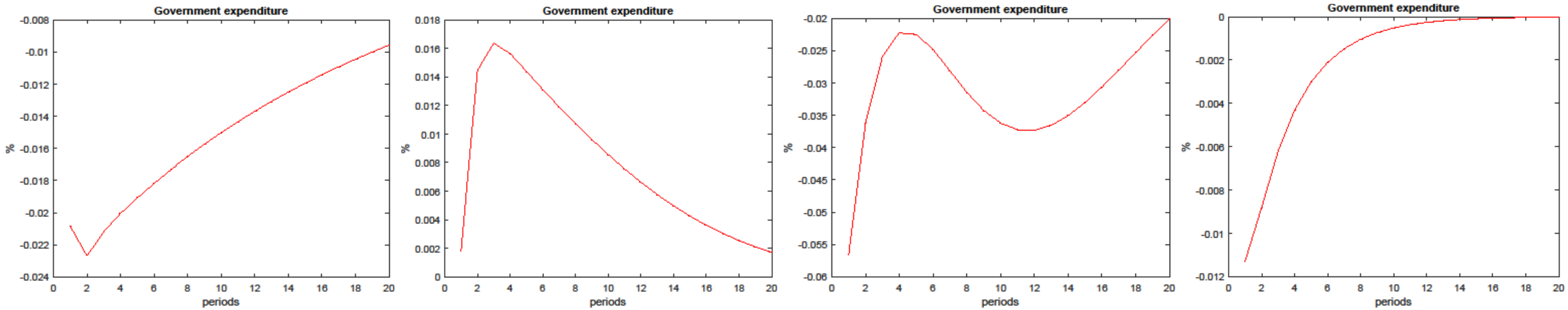
Response of Domestic Inflation to a Productivity Shock



(a) China (b) India (c) Japan (d) Rep. of Korea

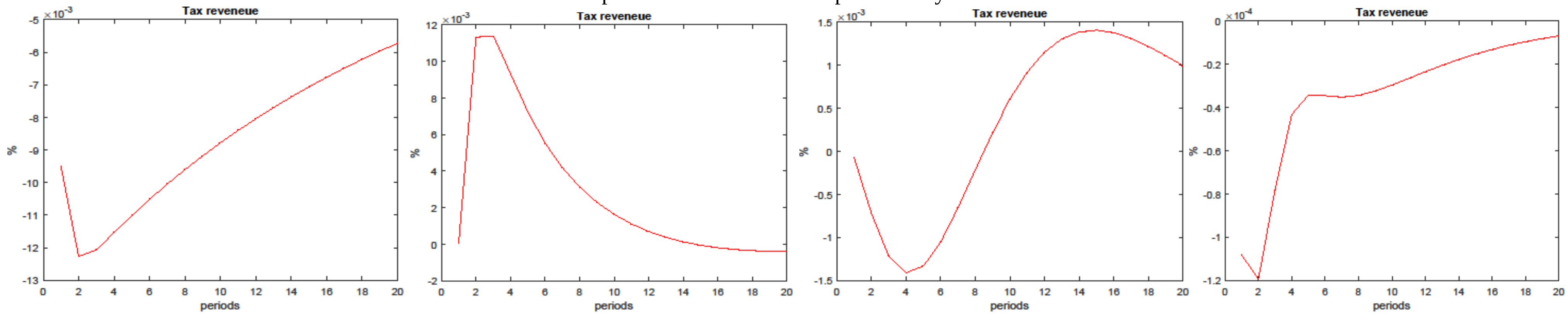
Figure 1: ***Continued***

Response of Government Expenditure to a Productivity Shock



(a) China (b) India (c) Japan (d) Rep. of Korea

Response of tax revenue to a productivity shock



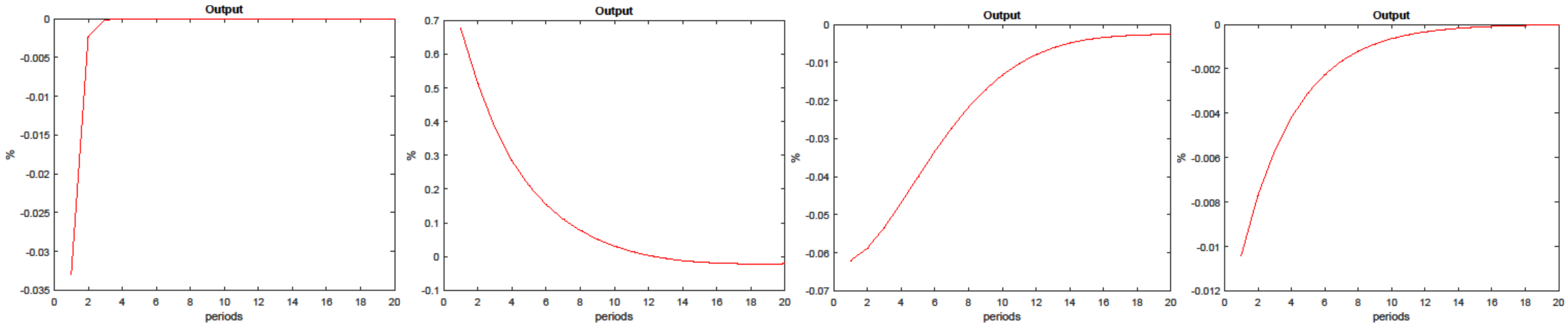
(a) China (b) India (c) Japan (d) Rep. of Korea

Notes: This figure presents the response of domestic output, inflation, government expenditure, and tax revenue to a productivity shock. Sub-figures (a), (b), (c), and (d) are responses for China, India, Japan, and the Republic of Korea, respectively.
Source: Author's calculations.

Next, we analyse how a pandemic-induced foreign output shock, led by muted aggregate demand and disruptions in global supply chains, would affect domestic macroeconomic variables. As Figure 2 shows, domestic output is adversely affected in China, Japan, and Korea by a sharp fall in world output, but the Indian economy responded conversely. This fall in output was followed by a falling price level in the three countries that experienced a decline in economic activity. However, in India, we observe an inflationary impact of a world output shock, leading to a rise in government expenditure and tax revenue. Likewise, Japan's government expenditure and tax revenue respond positively to the external shock. On the other hand, China and Korea exhibit a fall in tax revenue, led by declining world and domestic output.

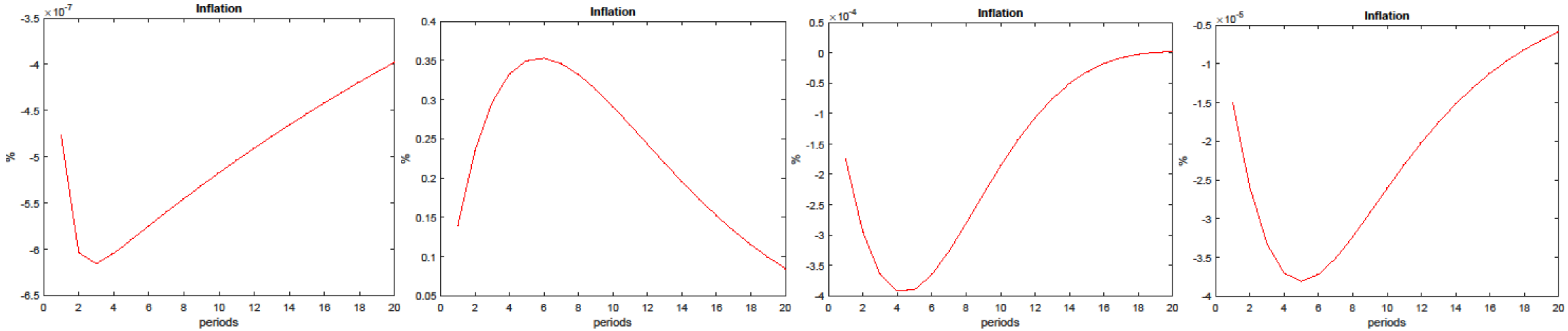
Figure 2: Response of Macroeconomic Variables to a Foreign Output Shock

Response of Domestic Output to a Foreign Output Shock



(a) China (b) India (c) Japan (d) Rep. of Korea

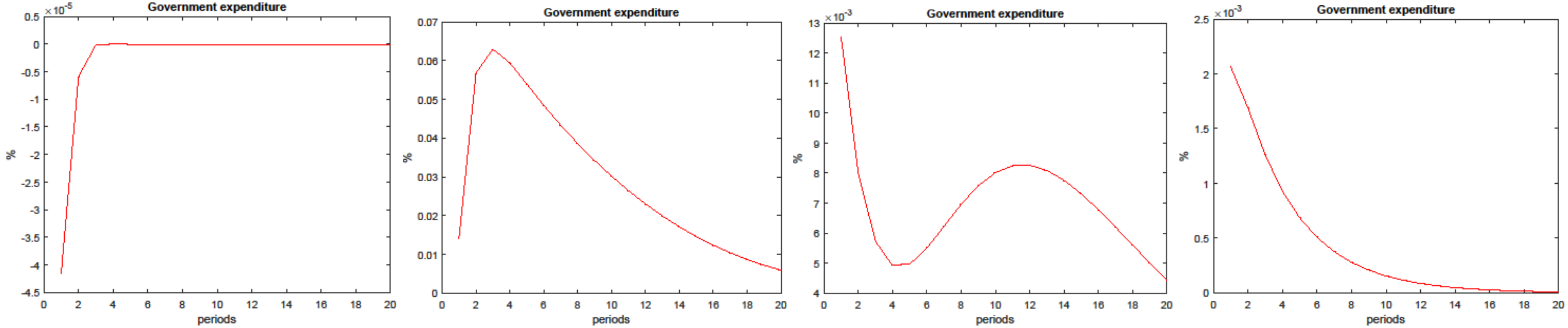
Response of Domestic Inflation to a Foreign Output Shock



(a) China (b) India (c) Japan (d) Rep. of Korea

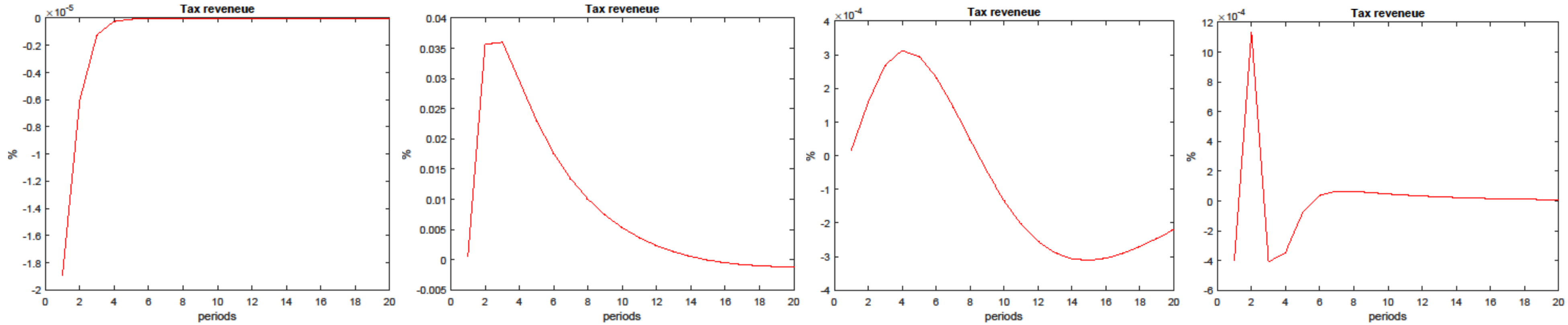
Figure 2: *Continued*

Response of Government Expenditure to a Foreign Output Shock



(a) China (b) India (c) Japan (d) Rep. of Korea

Response of Tax Revenues to a Foreign Output Shock



(a) China (b) India (c) Japan (d) Rep. of Korea

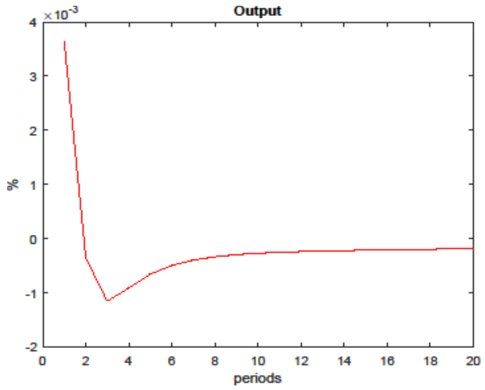
Notes: This figure presents the response of domestic output, inflation, government expenditure, and tax revenue to a foreign output shock. Sub-figures (a), (b), (c), and (d) are responses for China, India, Japan, and the Republic of Korea, respectively.
Source: Author's calculations.

4.2. Effectiveness of Fiscal and Monetary Policy

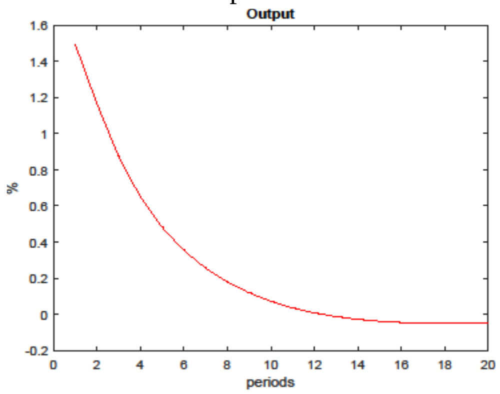
Next, we examine if the adverse impacts of the COVID-19 induced shocks on macroeconomic variables can be mitigated by fiscal and monetary policy. To this end, we first apply a fiscal policy shock and observe that an expansionary fiscal policy positively impacts domestic output in all four countries, with an inflationary effect in India due to a rise in economic activity. We find that fiscal policy leads to the stabilisation of inflation rates in China, Japan, and Korea. As expected, we find that an expansionary fiscal policy shock leads to a positive response in terms of government expenditure to revive the domestic economy, leading to an eventual rise in tax revenue, except in China. As can be observed, the fiscal policy shock leads to contrasting impacts of a productivity shock on domestic output. Therefore, the overall response of the expansionary fiscal policy produces a favourable influence on domestic output, inflation, government expenditure, and tax revenue, leading to an improvement in the macroeconomic conditions of these economies.

Figure 3: Response of Macroeconomic Variables to a Fiscal Policy Shock

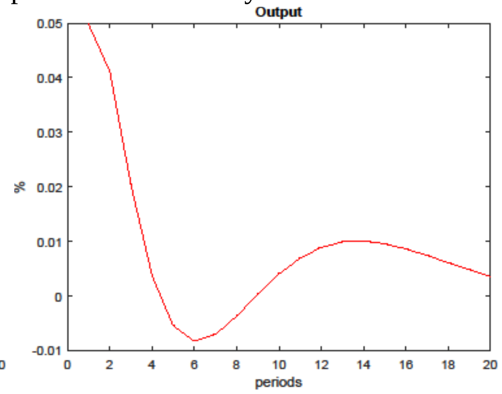
Response of Domestic Output to a Fiscal Policy Shock



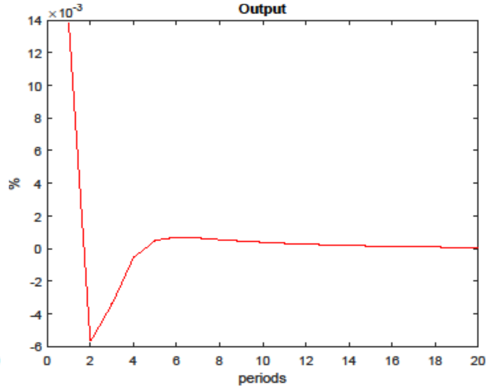
(a) China



(b) India

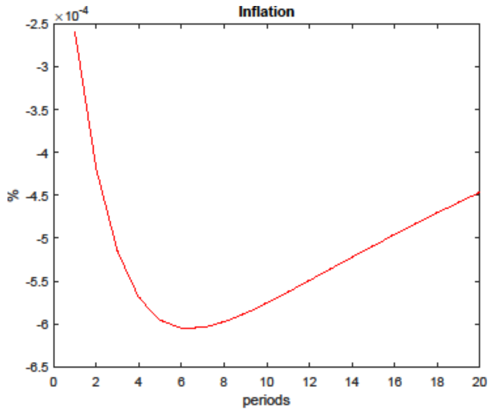


(c) Japan

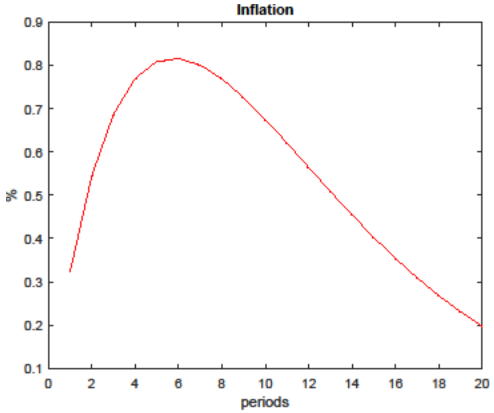


(d) Rep. of Korea

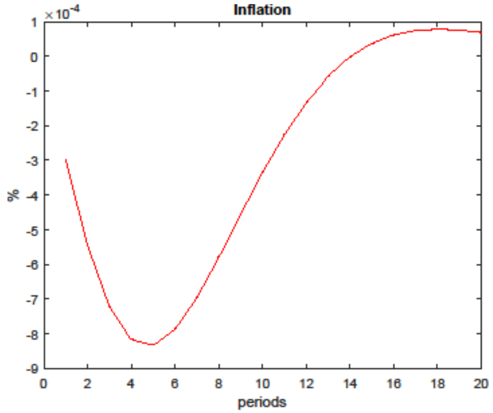
Response of Domestic Inflation to a Fiscal Policy Shock



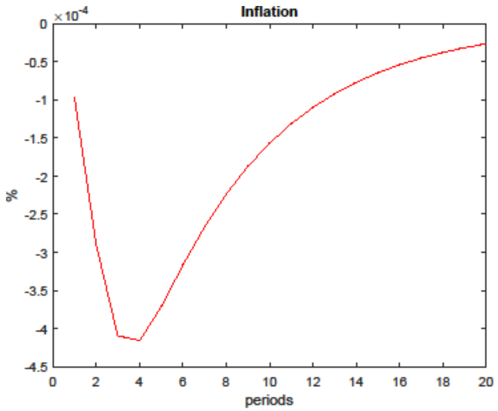
(a) China



(b) India



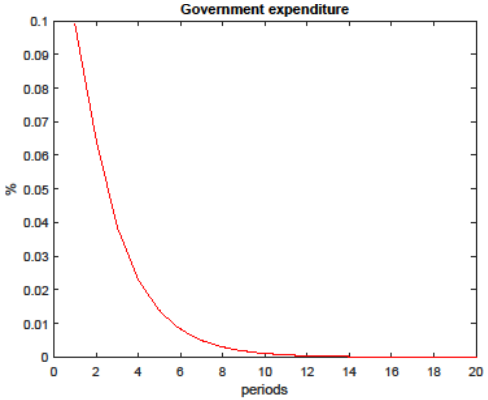
(c) Japan



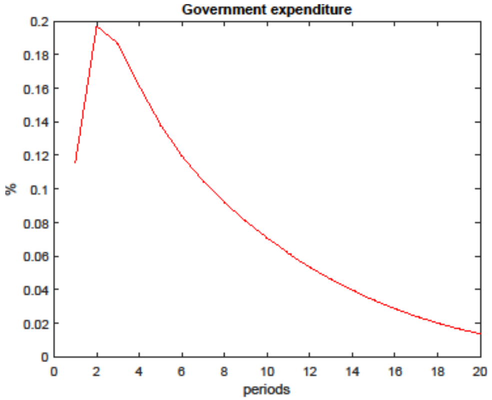
(d) Rep. of Korea

Figure 3: *Continued*

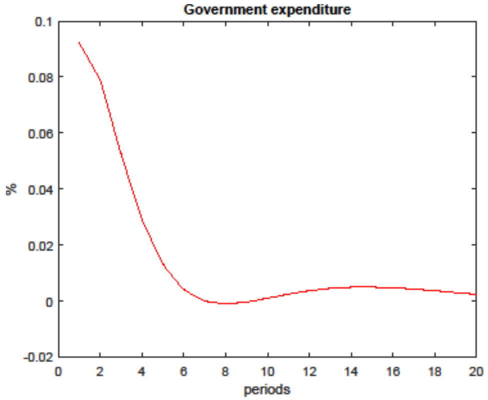
Response of Government Expenditure to a Fiscal Policy Shock



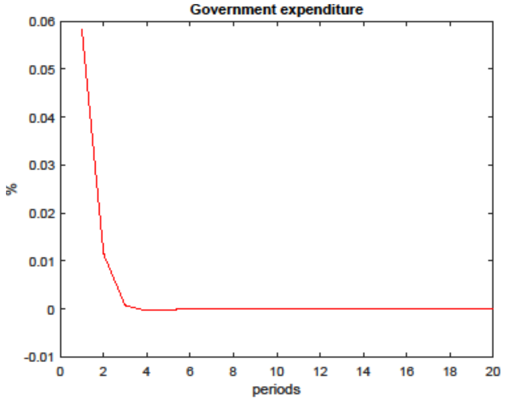
(a) China



(b) India

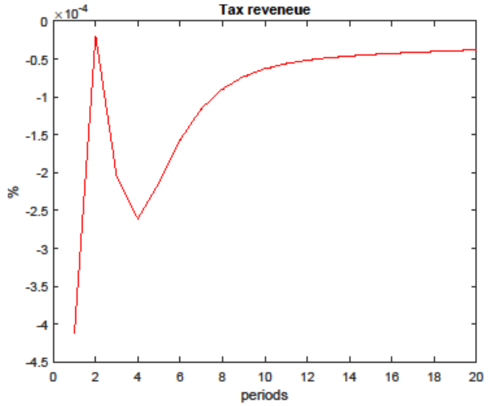


(c) Japan

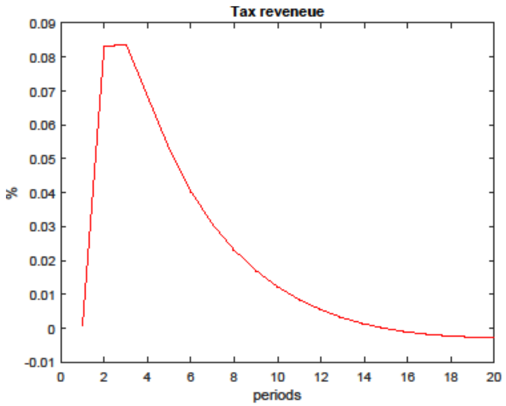


(d) Rep. of Korea

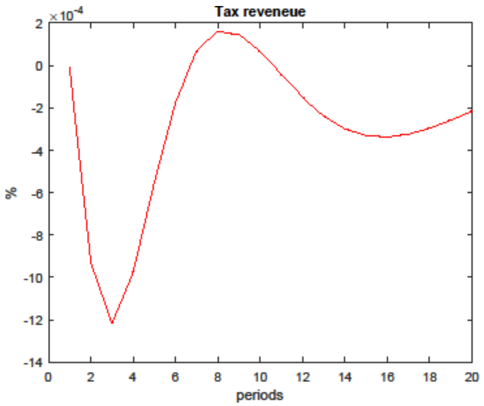
Response of Tax Revenues to a Fiscal Policy Shock



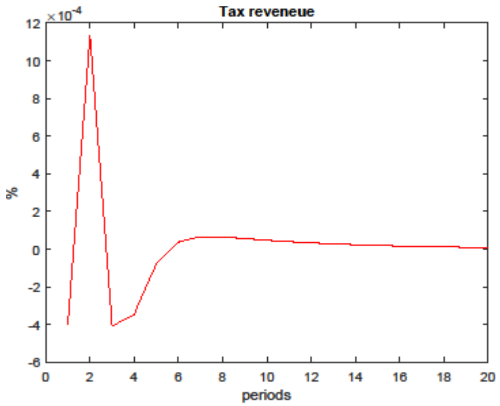
(a) China



(b) India



(c) Japan



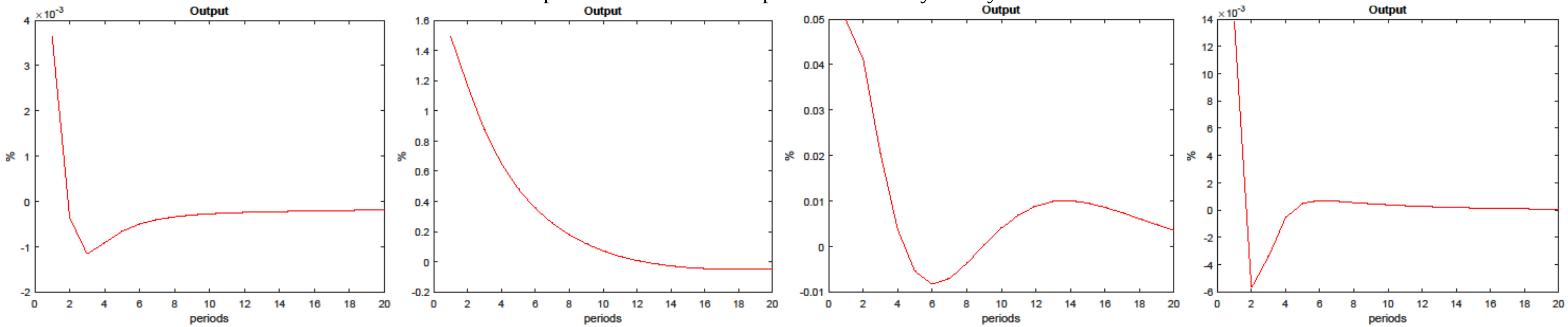
(d) Rep. of Korea

Notes: This figure presents the response of domestic output, inflation, government expenditure, and tax revenue to a fiscal policy shock. Sub-figures (a), (b), (c), and (d) are responses for China, India, Japan, and the Republic of Korea, respectively.
Source: Author's calculations.

As a final step, we explore the role of monetary policy in mitigating the adverse impacts of the pandemic on macroeconomic variables. Figure 4 reports that domestic output responds positively because of an expansionary monetary policy shock. In Japan, the expansionary monetary policy leads to a large increase in domestic economic activity. Hence, both fiscal and monetary policies are effective in mitigating the adverse impacts of the pandemic-induced negative impacts on productivity, output, etc. As expansionary monetary policy boosts the domestic economy, we see an inflationary impact of a monetary policy shock in China, Japan, and Korea. Likewise, government expenditure increased with a rise in prices and output, leading to a positive impact on tax revenue in China and Korea. However, in India, declining inflation led to a reduction in both government expenditure and tax revenues. We find a strong, significant, and consistent positive impact of monetary policy on domestic macroeconomic variables. Overall, our results for the four largest net oil-importing countries of Asia reveal that domestic and external shocks, induced by the pandemic, lead to a negative impact on the domestic macroeconomy. However, monetary and fiscal policies are effective in minimising these adverse effects by providing the necessary push to economic activity.

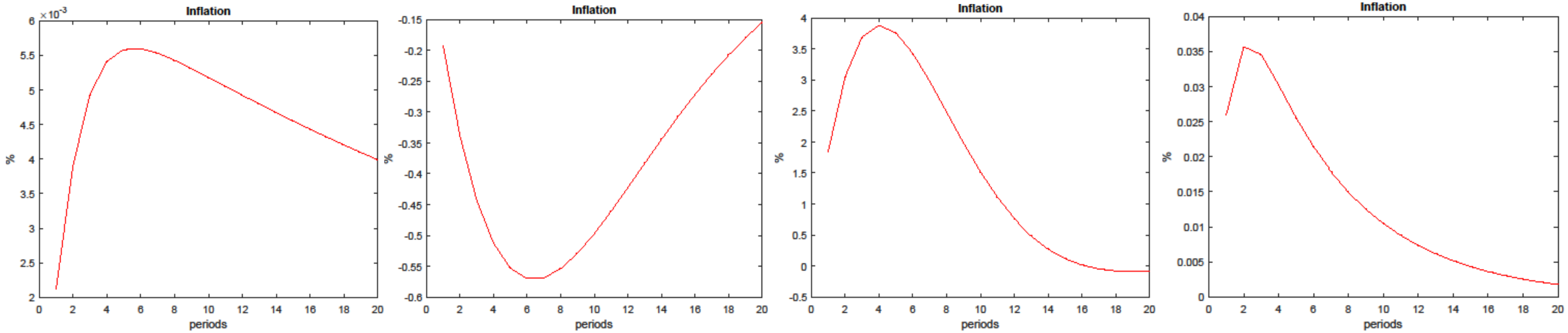
Figure 4: Response of Macroeconomic Variables to a Monetary Policy Shock.

Response of Domestic Output to a Monetary Policy Shock



(a) China (b) India (c) Japan (d) Rep. of Korea

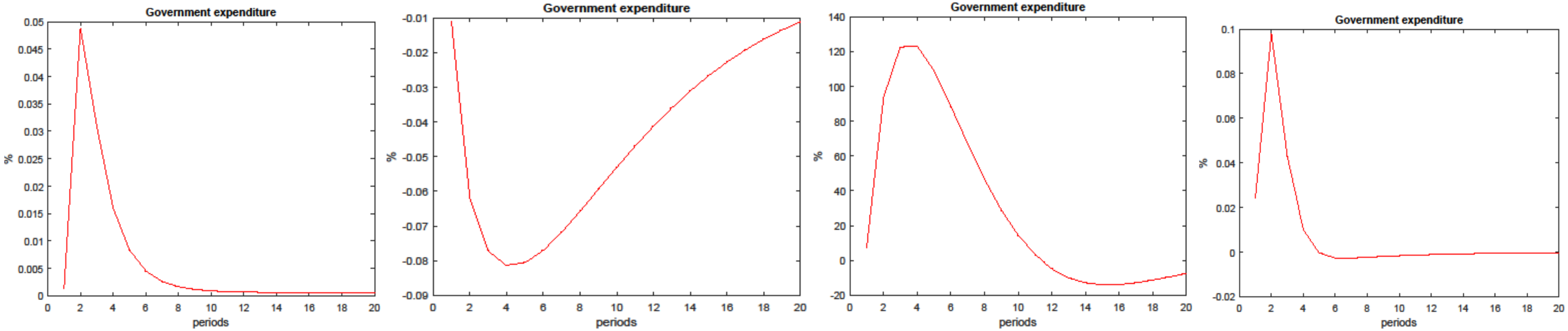
Response of Domestic Inflation to a Monetary Policy Shock



(a) China (b) India (c) Japan (d) Rep. of Korea

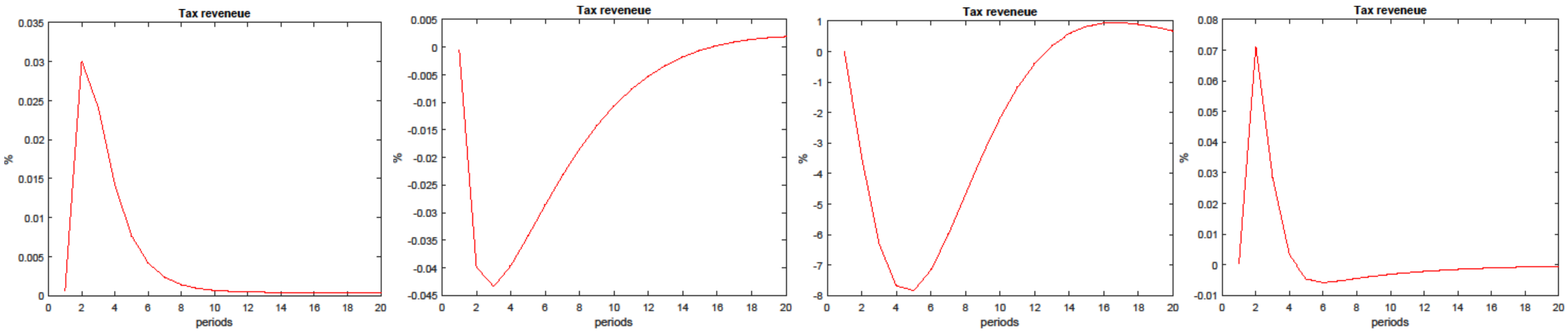
Figure 4: *Continued*

Response of Government Expenditure to a Monetary Policy Shock



(a) China (b) India (c) Japan (d) Rep. of Korea

Response of Tax Revenues to a Monetary Policy Shock



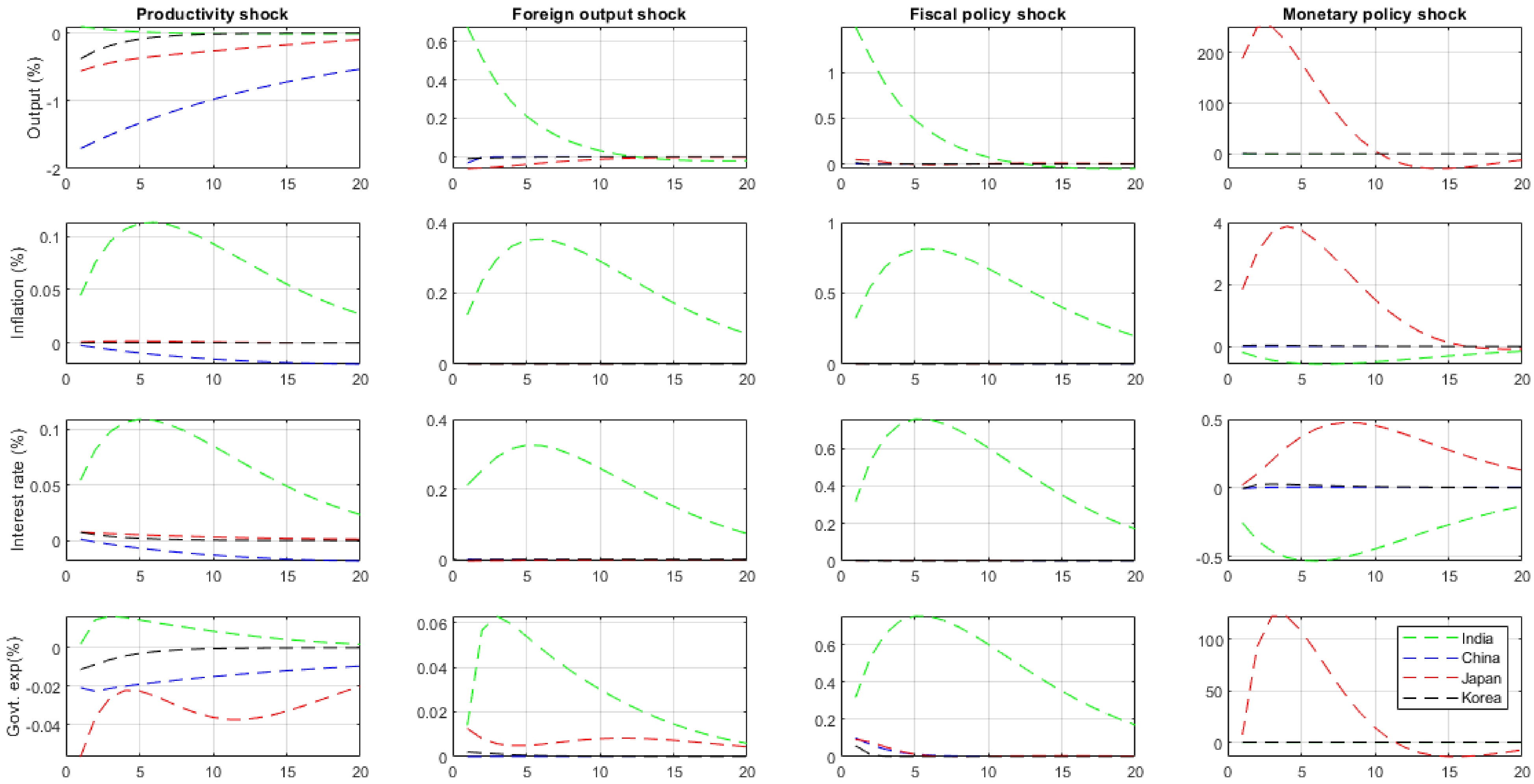
(a) China (b) India (c) Japan (d) Rep. of Korea

Notes: This figure presents the response of domestic output, inflation, government expenditure, and tax revenue to a monetary policy shock. Sub-figures (a), (b), (c), and (d) are responses for China, India, Japan, and the Republic of Korea, respectively.
Source: Author's calculations.

4.3. Comparative Impulse Response Analysis: India, China, Japan, and Korea

We examine the resilience of different shocks across the four economies, and the results are reported in Figure 5. This figure shows that fiscal and monetary policy shocks positively affect the macroeconomic variables in all four economies. Further, productivity and foreign output shocks negatively affected the domestic output and overall macroeconomic environment in all countries, except India, which is less affected by these shocks than other economies. This implies that, relative to India, these economies were highly susceptible to any macroeconomic disturbance provoked by an external shock since these economies are more integrated with the world economy. Moreover, relative to monetary policy, fiscal policy is highly effective in influencing the macroeconomic variables given that fiscal variables have a quicker short-term response than monetary policy stimuli.

Figure 5: IRF Comparison to Macroeconomic Shocks



Exp. = expenditure, Govt. = government, IRF = impulse response function.

Notes: This figure presents a comparative view of the impact of productivity shock, foreign output shock, fiscal policy shock, and monetary policy shock on macroeconomic variables. The first and second rows show the response of domestic output and inflation, whereas the third and fourth rows present the response of government expenditure and tax revenue. 'Korea' refers to the Republic of Korea.

Source: Author's calculations.

5. Robustness Checks

5.1. Choice of Prior and Posterior of Parameters in the Bayesian Estimation

The robustness check first involves estimation based on the Bayesian framework. This is a modern workhorse technique for estimating the dynamic stochastic general equilibrium model. The framework is based on an estimation of the posterior from its corresponding prior in accordance with Bay's law, given as

$$\boldsymbol{p(\theta|y^t)} = \frac{\boldsymbol{L(y^t|\theta)P(\theta)}}{\int \boldsymbol{(y^t|\theta)p(\theta)d\theta}}$$

where $\boldsymbol{P(\theta)}$ is the probability density associated with parameter $\boldsymbol{\theta}$, $\boldsymbol{L(y^t|\theta)}$ is the likelihood function of the sample with $\boldsymbol{t}$ observations, and $\int \boldsymbol{(y^t|\theta)p(\theta)d\theta}$ is the marginal likelihood, respectively.

The Bayesian estimation analysis infers that our estimated posterior is aligned with its respective prior. Table 2 shows that the prior mean for the parameter falls within the 90% high-powered density confidence interval. The table also shows that our data are more informative, given that our estimated posterior does not completely overlap with its respective prior counterparts (Figure 6).

Table 2: Prior and Posterior of Parameters

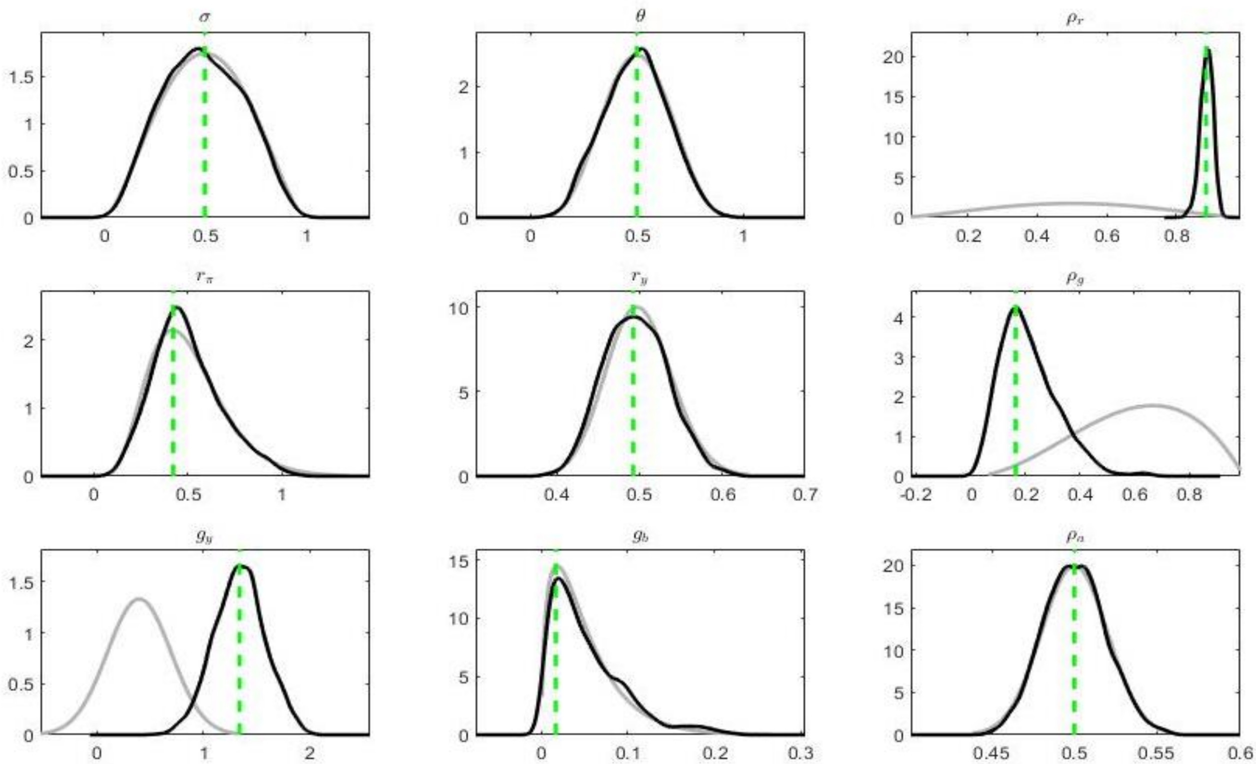
Param.	Dist.	Prior		Sources	Posterior		90% HPD interval	
		Mean	SD		Mean	SD		
China								
σ_t	Beta	0.500	0.200	Zheng & Guo (2013)	0.049	0.277	0.179	0.814
φ_t	Normal	2.000	0.750	Dai, Minford & Zhou (2015)	0.302	0.037	0.299	0.304
θ_t	Beta	0.500	0.150	Dai, Minford & Zhou (2015)	0.493	0.175	0.239	0.737
ρ_r	Beta	0.500	0.200	Zheng & Guo (2013)	0.887	0.020	0.855	0.917
r_π	Gamma	0.500	0.040	Liu, Sun & Zhang (2020)	0.493	0.182	0.203	0.792
r_y	Gamma	0.500	0.040	Liu, Sun & Zhang (2020)	0.495	0.039	0.430	0.557
ρ_g	Beta	0.600	0.200	Liu, Sun & Zhang (2020)	0.212	0.100	0.045	0.367
g_y	Normal	0.400	0.300	Liu, Sun & Zhang (2020)	1.339	0.244	0.959	1.752
g_b	Gamma	-0.050	0.040	Zheng & Guo (2013)	0.052	0.022	0.000	0.109
AR (1) coefficients								
ρ_a	Beta	0.708	0.200	Zheng and Guo (2013)	0.500	0.020	0.469	0.531
ρ_{cf}	Beta	0.994	0.200	Liu, Sun & Zhang (2020)	0.923	0.037	0.867	0.981
ρ_{er}	Beta	0.019	0.200	Liu, Sun & Zhang (2020)	0.586	0.271	0.289	0.924

Param.	Dist.	Prior		Sources	Posterior		90% HPD interval	
		Mean	SD		Mean	SD		
ρ_{eg}	Beta	0.990	0.200	Zheng & Guo (2013)	0.490	0.277	0.170	0.813
India								
σ_t	Normal	1.000	0.750	Gabriel, Levine & Yang (2016)	0.931	0.749	-0.343	2.153
φ_t	Normal	2.000	0.500	Drygalla, Holtemöller & Kiesel (2020)	0.327	0.404	-0.001	0.972
θ_t	Beta	0.750	0.150	Gabriel, Levine & Yang (2016)	0.744	0.157	0.499	0.988
ρ_r	Beta	0.700	0.200	Mohanty and Klau (2005)	0.757	0.124	0.204	0.998
r_π	Beta	0.132	0.016	Goyal & Kumar (2018)	0.131	0.015	0.106	0.160
r_y	Beta	0.182	0.050	Goyal & Kumar (2018)	0.163	0.055	0.076	0.242
ρ_g	Beta	0.800	0.100	Drygalla, Holtemöller & Kiesel (2020)	0.506	0.165	0.265	0.734
g_y	Normal	0.000	0.500	Drygalla, Holtemöller & Kiesel (2020)	-0.032	0.045	-0.088	0.020
g_b	Normal	0.000	0.500	Drygalla, Holtemöller & Kiesel (2020)	-0.022	0.006	-0.033	-0.010
AR (1) Coefficients								
ρ_a	Beta	0.500	0.200	Gabriel, Levine & Yang (2016)	0.499	0.277	0.163	0.820
ρ_{cf}	Beta	0.500	0.200	Hur & Lee (2021)	0.781	0.100	0.615	0.957
ρ_{er}	Beta	0.500	0.200	Adolfson et al. (2007)	0.487	0.242	0.242	0.764
ρ_{eg}	Beta	0.500	0.200	Gabriel et al. (2010)	0.437	0.248	0.163	0.719
Japan								
σ_t	Normal	1.000	0.370	Sugo & Ueda (2008)	0.937	0.370	0.312	1.517
φ_t	Normal	2.000	0.750	Sugo & Ueda (2008)	-0.277	0.117	-0.613	0.205
θ_t	Beta	0.750	0.050	Iiboshi et al. (2015)	0.754	0.050	0.678	0.844
ρ_r	Normal	1.000	0.150	Sugo & Ueda (2008)	0.453	0.088	0.297	0.608
r_π	Normal	0.500	0.200	Sugo & Ueda (2008)	1.389	0.149	1.202	1.593
r_y	Normal	0.010	0.100	Sugo & Ueda (2008)	0.078	0.023	0.029	0.125
ρ_g	Beta	0.800	0.010	Kotera & Sakai (2018)	0.800	0.010	0.782	0.816
g_y	Normal	0.000	0.500	Kotera & Sakai (2018)	0.151	0.508	-0.710	0.907
g_b	Normal	-0.000	0.500	Kotera & Sakai (2018)	-0.647	0.468	-1.498	0.591
AR (1) coefficients								
ρ_a	Beta	0.850	0.100	Iiboshi et al. (2015)	0.848	0.010	0.831	0.863
ρ_{cf}	Beta	0.500	0.200	Hur & Lee (2021)	0.849	0.010	0.409	0.786
ρ_{er}	Beta	0.800	0.100	Iiboshi et al. (2015)	0.602	0.100	0.834	0.867
ρ_{eg}	Beta	0.850	0.100	Iiboshi et al. (2015)	0.850	0.010	0.833	0.867
Rep. of Korea								

Param.	Dist.	Prior		Sources	Posterior		90% HPD interval	
		Mean	SD		Mean	SD		
σ_t	Gamma	1.200	0.470	Choi & Hur (2015)	1.002	0.370	0.357	1.569
φ_t	Gamma	3.000	0.100	Kang & Suh (2017)	2.941	0.991	2.763	3.107
θ_t	Beta	0.500	0.100	Hur & Lee (2021)	0.499	0.106	0.335	0.657
ρ_r	Beta	0.700	0.100	Lee & Song (2015)	0.826	0.026	0.778	0.874
r_π	Normal	1.700	0.100	Lee & Song (2015)	1.557	0.116	1.382	1.737
r_y	Normal	0.500	0.100	Lee & Song (2015)	0.574	0.095	0.399	0.741
ρ_g	Beta	0.500	0.150	Hur & Lee (2021)	0.444	0.166	0.220	0.647
g_y	Normal	0.500	0.100	Hur & Lee (2021)	0.536	0.100	0.362	0.713
g_b	Gamma	0.500	0.300	Hur & Lee (2021)	0.400	0.224	0.045	0.732
AR (1) coefficients								
ρ_a	Beta	0.500	0.200	Kang & Suh (2017)	0.505	0.277	0.187	0.837
ρ_{cf}	Beta	0.500	0.200	Hur & Lee (2021)	0.483	0.277	0.143	0.807
ρ_{er}	Beta	0.850	0.200	Kang & Suh (2017)	0.961	0.081	0.922	0.997
ρ_{eg}	Beta	0.500	0.080	Hur & Lee (2021)	0.859	0.075	0.751	0.974

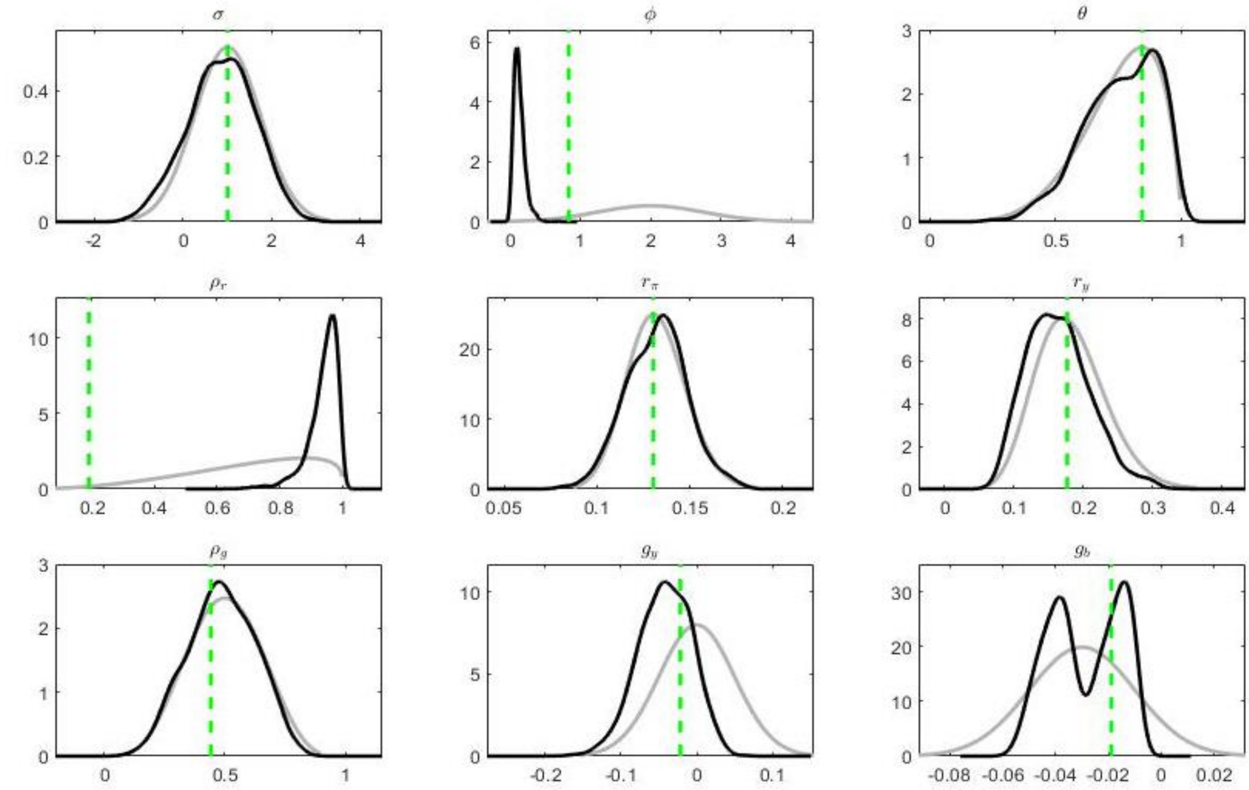
Dist. = distance, HPD = high-powered density, Param. = parameter, SD = standard deviation.
Notes: This table reports the prior and posterior estimates for model parameters. We observe the closeness of the posterior mean to their respective prior means, with statistically significant estimates as all parameters fall within the 90% confidence band.
Source: Author’s compilation.

Figure 6: Prior and Posterior Plot

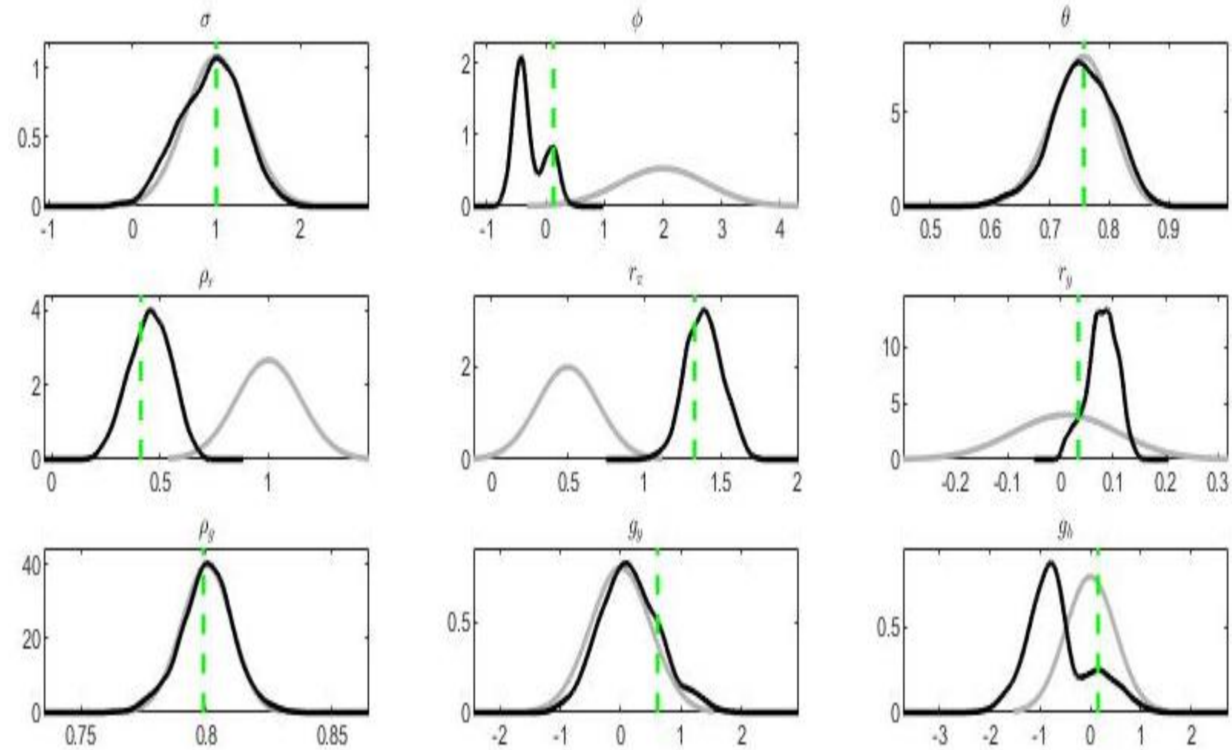


(a) China

Figure 6: ***Continued***

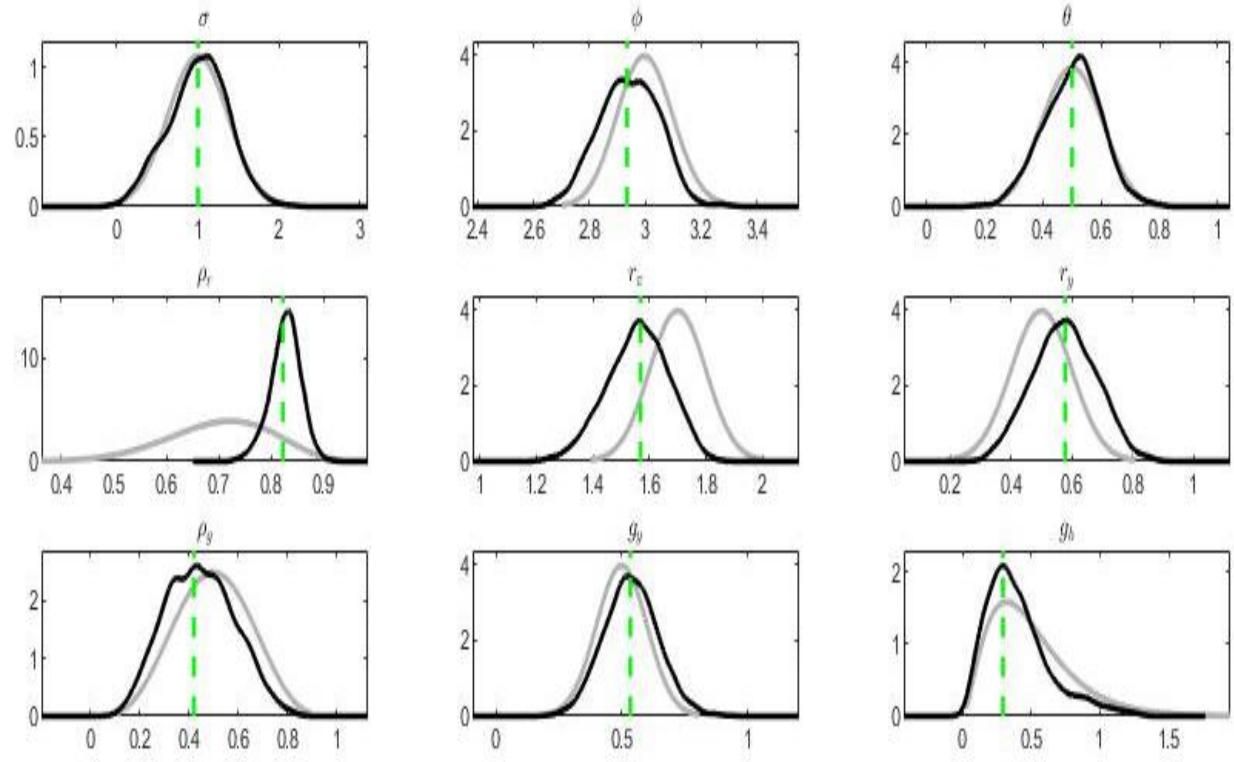


(b) India



(c) Japan

Figure 6: ***Continued***



(d) Rep. of Korea

Notes: The figure presents the prior and posterior estimates for model parameters. We observe the closeness of the posterior mean to their respective prior means, with statistically significant estimates, as all parameters fall within the 90% confidence band as in Table 2.
Source: Author's calculations.

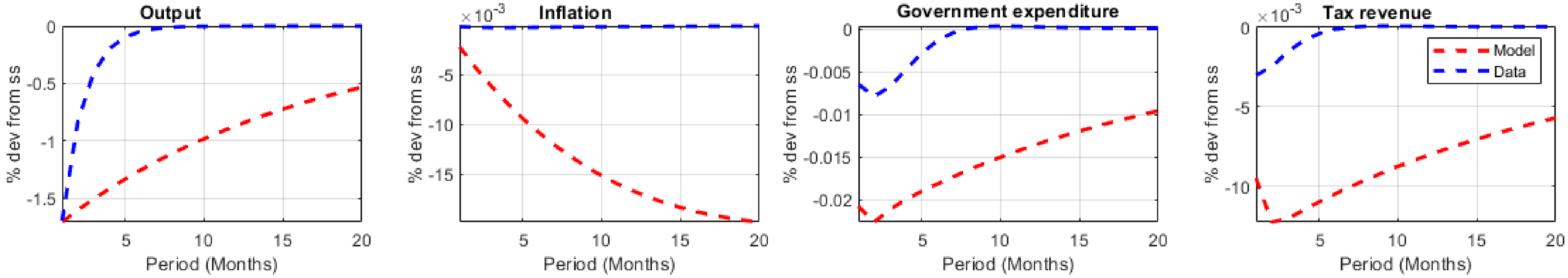
The estimated parameters from the Bayesian analysis for all four economies infer that most of the parameters fall within the confidence band of the high-powered density interval. Further, the plots imply that most of the posterior estimates divert from their mode estimates, suggesting the informativeness of the data with certain exceptions. Additionally, in India, labour supply is more elastic to any disturbance as the inverse of the Frisch elasticity parameters shows more divergence relative to other parameters. Likewise, in China, in addition to the labour supply elasticity parameter, the fiscal and monetary policy parameters are susceptible to shocks. Overall, the posterior estimates infer that domestic macroeconomic variables are positively affected by both internal and external shocks.

5.2. Comparison of Simulated Responses and Estimated Impulse Responses

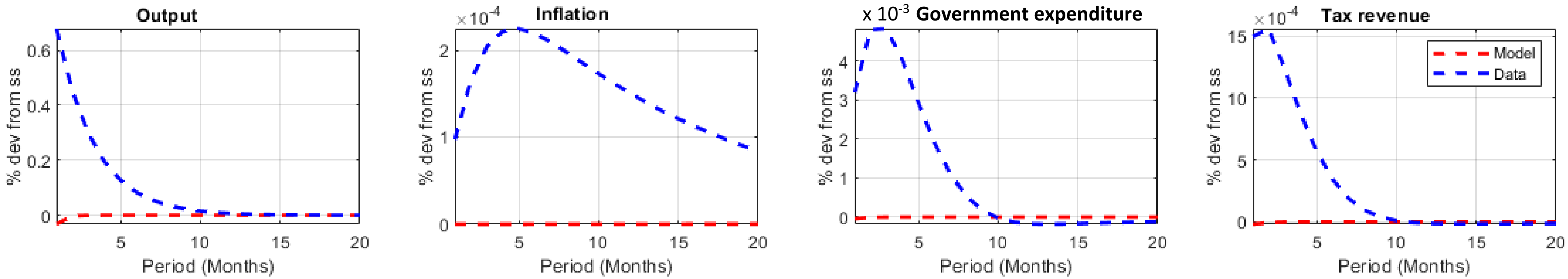
As a second robustness check for our results, a comparison is made between the model-generated impulse responses due to different shocks with their estimated counterparts. The results are reported in Figures 7–10 for the four economies.

Figure 7: Impulse Response Comparison (China)

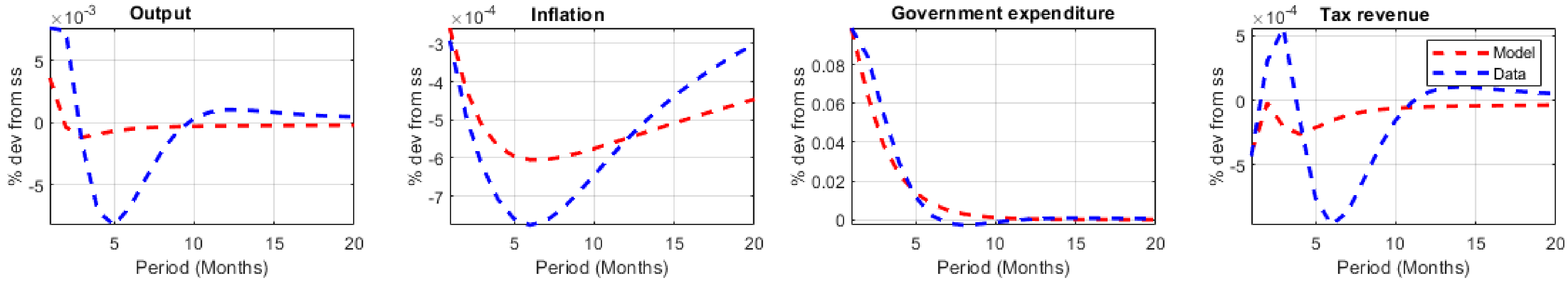
(a) Productivity shock



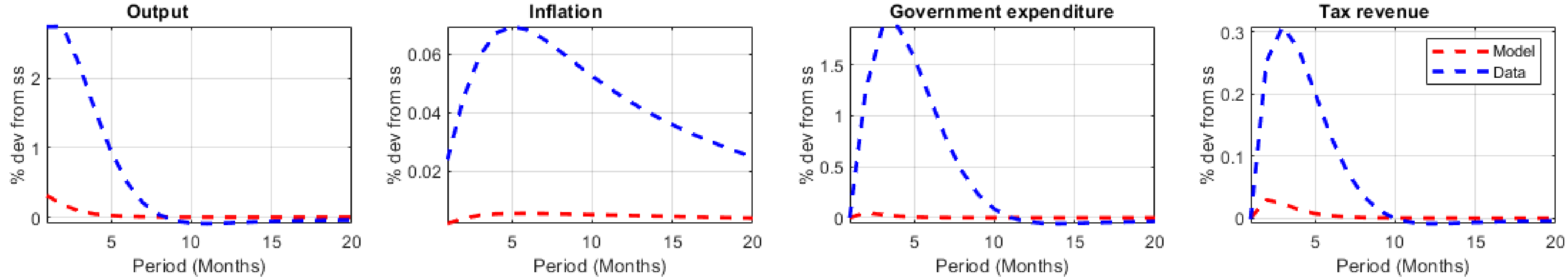
(b) Foreign output shock



(c) Fiscal policy shock



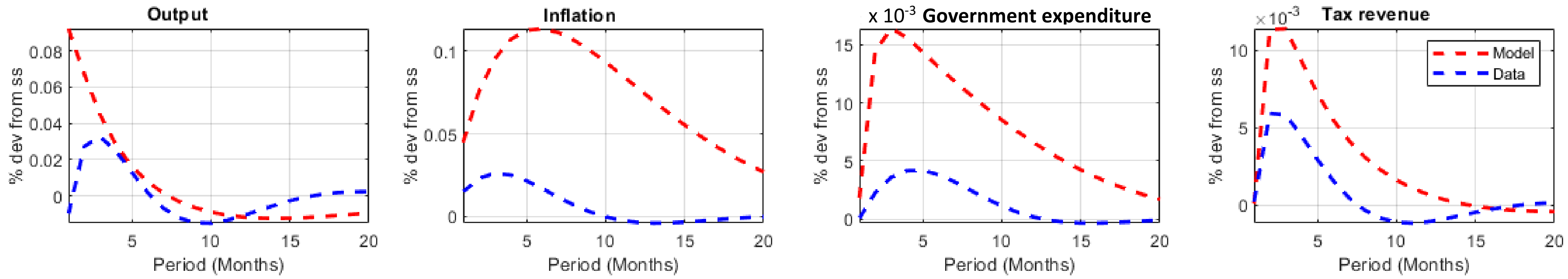
(d) Monetary policy shock



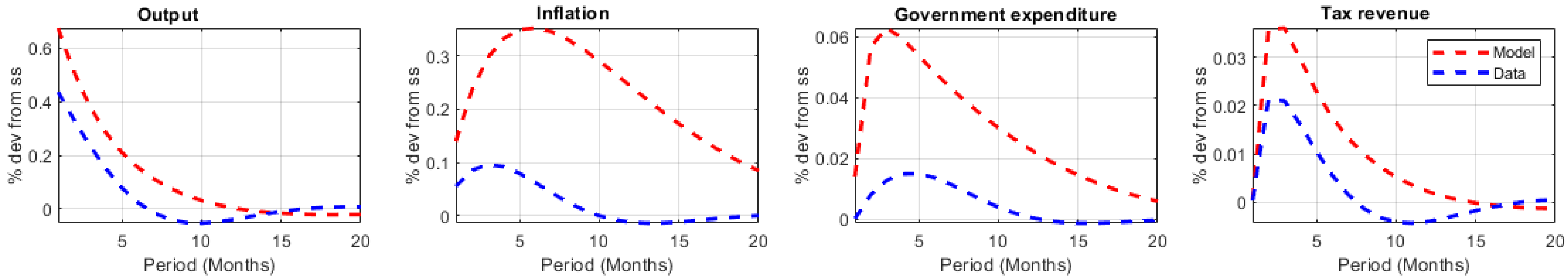
Notes: This figure presents the model comparison between impulse responses from the model and data due to productivity shock, foreign output shock, fiscal policy shock, and monetary policy shock in the case of China, as shown in panels (a), (b), (c), and (d), respectively.
Source: Author's calculations.

Figure 8: Impulse Response Comparison (India)

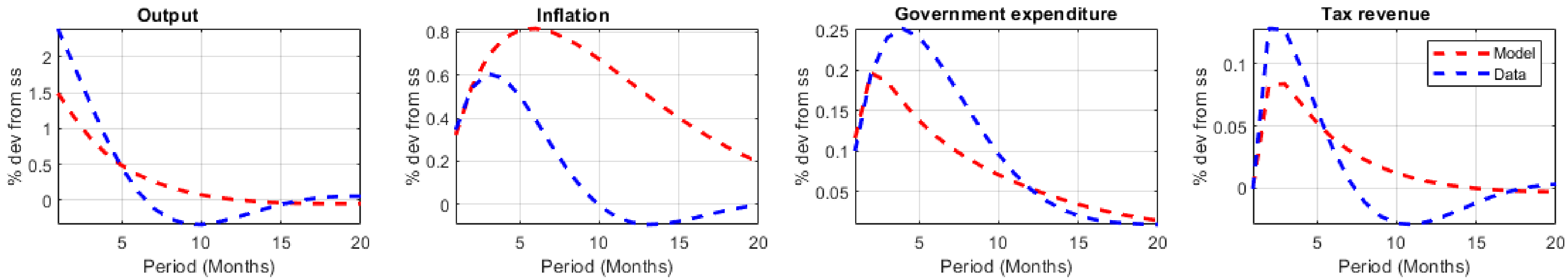
(a) Productivity shock



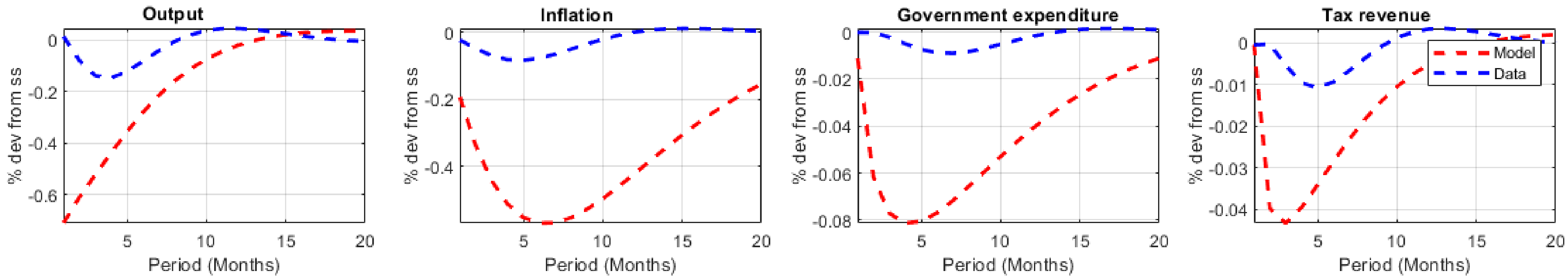
(b) Foreign output shock



(c) Fiscal policy shock



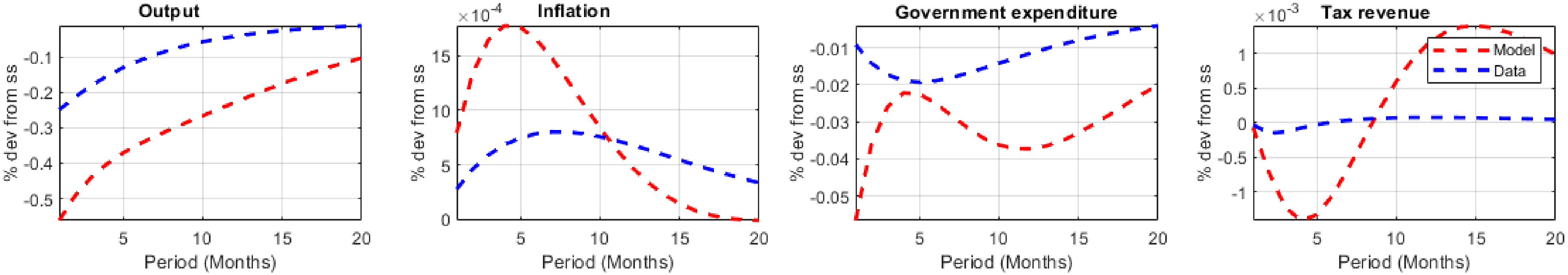
(d) Monetary policy shock



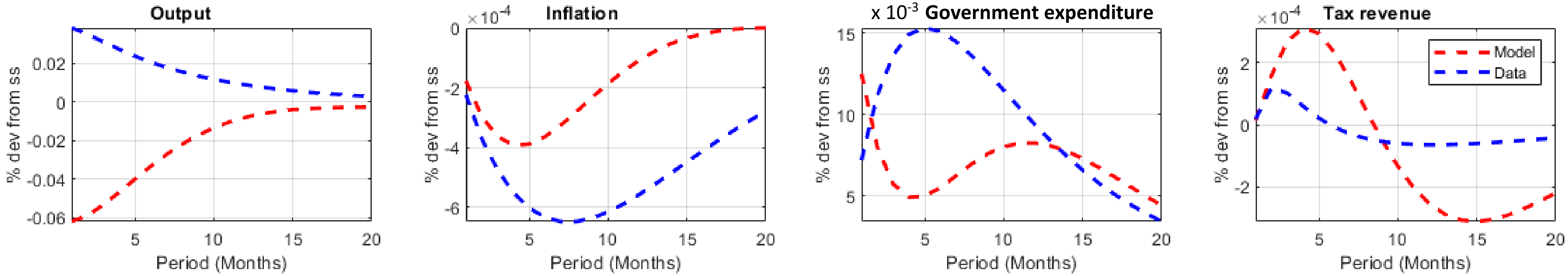
Notes: This figure presents the model comparison between impulse responses from the model and data, due to productivity shock, foreign output shock, fiscal policy shock, and monetary policy shock in the case of India, as shown in panels (a), (b), (c), and (d), respectively.
Source: Author's calculations.

Figure 9: Impulse Response Comparison (Japan)

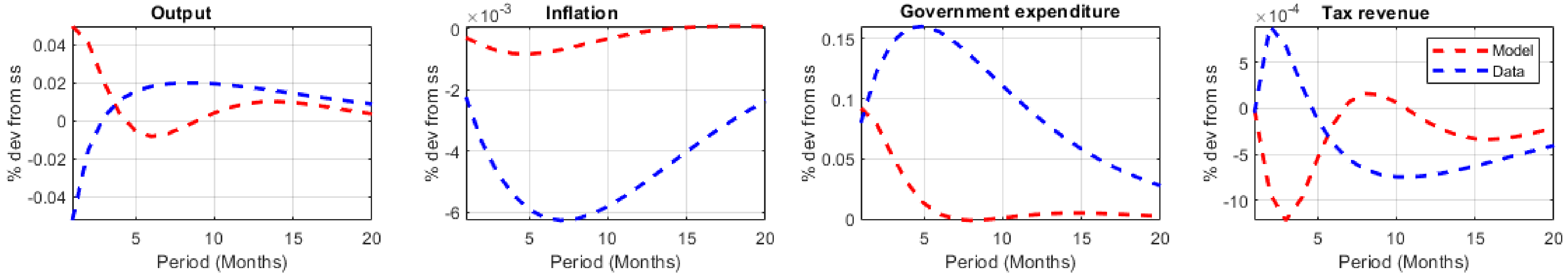
(a) Productivity shock



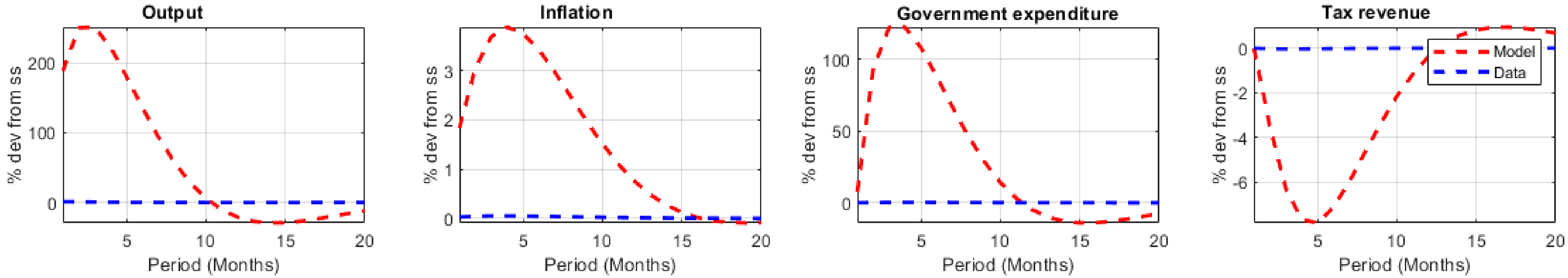
(b) Foreign output shock



(c) Fiscal policy shock



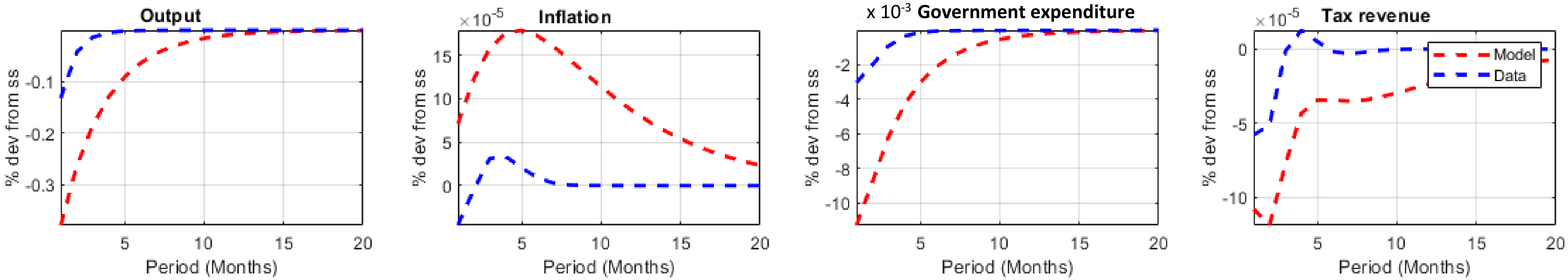
(d) Monetary policy shock



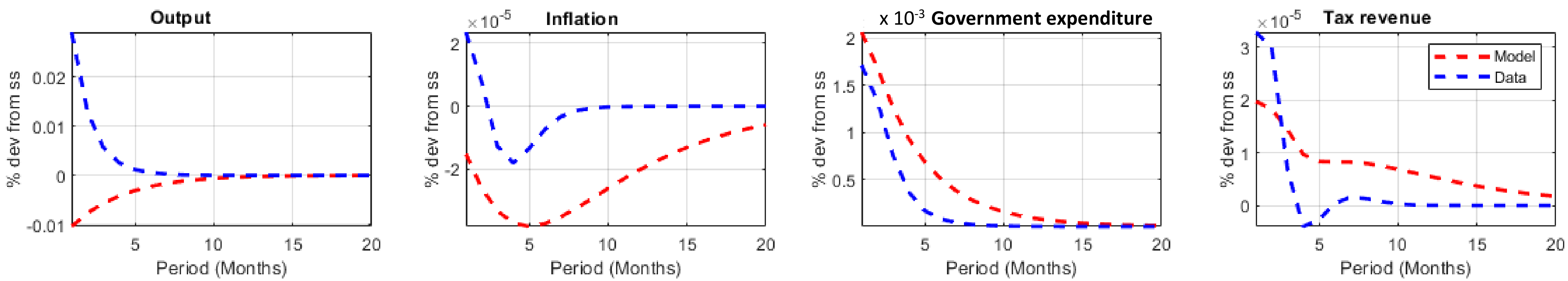
Notes: This figure presents the model comparison between impulse responses from the model and data, due to productivity shock, foreign output shock, fiscal policy shock, and monetary policy shock in the case of Japan, as represented in panels (a), (b), (c), and (d), respectively.
Source: Author's calculations.

Figure 10: Impulse Response Comparison (Republic of Korea)

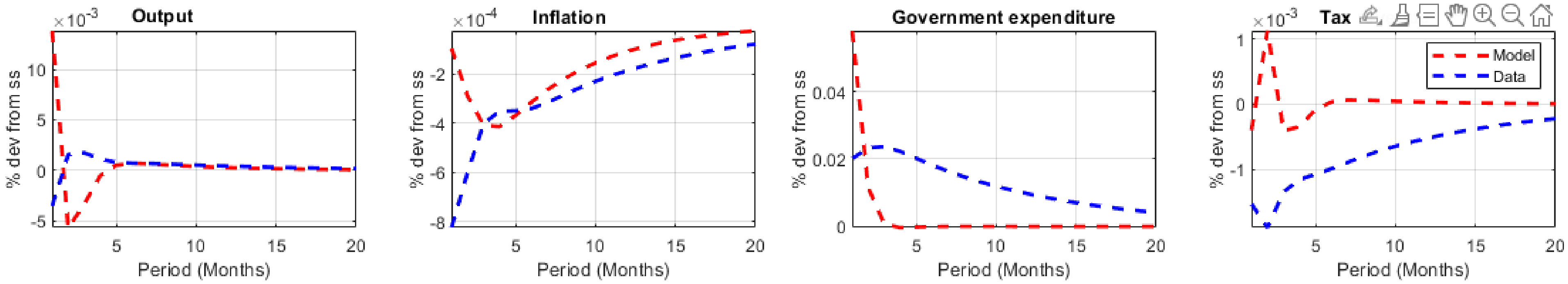
(a) Productivity shock



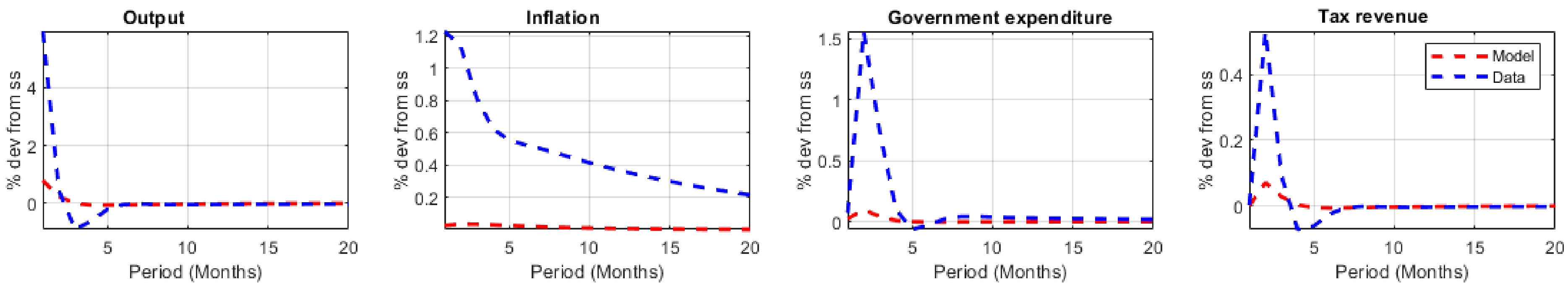
(b) Foreign output shock



(c) Fiscal policy shock



(d) Monetary policy shock



Notes: This figure presents the model comparison between impulse responses from the model and data, due to productivity shock, foreign output shock, fiscal policy shock, and monetary policy shock in the case of the Republic of Korea, as shown in panels (a), (b), (c), and (d), respectively.
Source: Author's calculations.

The outcome of the impulse response comparison for China from Figure 7 reveals that the responses of output, government expenditure, and tax revenue to a productivity and foreign output shock are robust wherein the impulse responses exhibit similar signs of the impact for both model-generated and estimated results. Similarly, fiscal and monetary policy mitigate the ill effects by boosting domestic output, government expenditure, and tax revenue. In India, we find an interesting result as the impulse responses from the data estimation show that a productivity shock leads to a negative impact on domestic output. For the remaining macroeconomic variables, we find good consistency between the model-generated impulse responses and the estimation from data. However, in Japan and Korea, we find that fiscal policy leads to a negative impact on domestic output and tax revenue. The remaining results are quite robust in terms of both the direction of the impact and the reversion towards the steady state.

In China, Figure 7 reveals the high responsiveness of endogenous variables to productivity and foreign output shocks. Both the model- and data-generated impulse responses reveal high convergence amongst each other. Notably, the endogenous variables under these shocks also show a quick response towards the steady state. The quick response due to a fiscal policy shock (panel (c)) with good convergence between the model and estimated impulse response implies greater effectiveness of fiscal policy in China compared with monetary policy. Likewise, the model comparison analysis in terms of impulse response matching for India with regards to different shocks imply a uniform trajectory. For instance, we observe a positive output effect for both model and estimated impulse response with a narrow gap between the two estimates in the case of total factor productivity shock. In a similar context, the impulse responses for government expenditure and tax revenue due to a total factor productivity shock move in a similar direction. The results from the fiscal policy and monetary policy analysis also follow the uniform trend. Thus, our model estimated impulse response analysis is in line with our simulated analysis.

The impulse response comparison for Japan reveals that both the derived and estimated impulse responses show better convergence amongst each other. The results of this convergence are reported in Figure 9. It is evident from the figure that, except for the impact of the fiscal and productivity shocks on output and government expenditure, most of the endogenous variables for the rest of the shocks show a uniform pattern. This implies that the DSGE model is a good fit for the Japanese economy. Further, as a microscopic analysis, we observe that because of the productivity and foreign output shocks (see panels (a) and (b) of Figure 9), the respective impulse responses mostly show a parallel pattern compared with the bulged pattern of other shocks.

Finally, Figure 10 provides an impulse response comparison for the Korean economy. It is evident from the figure that most impulse responses show a similar pattern between the model and data, which is an indication of a good fit. Further, we observe that this collinear pattern of impulse responses quickly reverts to the steady state in the case of the productivity and monetary policy shocks relative to the fiscal and foreign output shocks. This infers that the endogenous variables are highly responsive to the monetary policy shock in the Korean economy, which reflects the high effectiveness of monetary policy.

Overall, it is evident from all the figures that both the model and estimated impulse responses follow a uniform pattern, which proves a good fit between the model and the historical data.

6. Conclusion

This study has examined the impact of shocks due to total factor productivity and foreign output on domestic macroeconomic variables, such as domestic output, inflation, government expenditure, and tax revenue, in major oil-importing nations – China, India, Japan, and Korea. Further, we have tried to identify policy effectiveness, in terms of monetary and fiscal policy shocks, as a response to mitigate the ill effects of these shocks. Through the simulated framework in dynamic macroeconomic modelling, the study inferred that both shocks (total factor productivity and world output shocks) negatively affect the domestic macroeconomic environment in these economies. Further, our policy analysis reflected that monetary and fiscal policies efficiently mitigate the adverse effects on macroeconomic variables.

Moreover, using the data collected from different sources to the mode, we employed the Bayesian estimation framework. After proper prior formulation, we derived the posterior estimates for the model parameters. The results of the Bayesian analysis infer that almost all the posterior estimates lie within the confidence interval, confirming the validity of our model. Finally, our analysis in a Bayesian context reveals that there is significant information from the data in explaining the variations, as reflected in the shocks that produce a disturbing influence on the macroeconomic stability of these major oil-importing economies.

References

Adolfson, M., S. Laséen, J. Lindé, and M. Villani (2007), 'Bayesian Estimation of an Open Economy DSGE Model with Incomplete Pass-Through', *Journal of International Economics*, 72(2), pp.481–511.

Anand, R., S. Peiris, and M. Saxegaard (2010), 'An Estimated Model with Macrofinancial Linkages for India', *IMF Working Paper*, No. WP/10/21. Washington, DC: International Monetary Fund.

Baldwin, R. and E. Tomiura (2020), 'Thinking Ahead About the Trade Impact of COVID-19', in R. Baldwin and B. Weder di Mauro (eds.) *Economics in the Time of COVID-19*. London: Centre for Economic Policy Research, pp.59–71.

Banerjee, S., P. Basu, and C. Ghate (2020), 'A Monetary Business Cycle Model for India', *Economic Inquiry,* 58(3), pp.1362–86.

Beetsma, R.M.W.J. and H. Jensen (2004), 'Mark-Up Fluctuations and Fiscal Policy Stabilization in a Monetary Union', *Journal of Macroeconomics*, 26(2), pp.357–76.

Blanchard, O. (2018), 'On the Future of Macroeconomic Models', *Oxford Review of Economic Policy*, 34(1–2), pp.43–54.

Busato, F., B. Chiarini, G. Cisco, M. Ferrara, and E. Marzano (2020), 'Lockdown Policies: A Macrodynamic Perspective for COVID-19', *CESifo Working Papers*, No. 8465. Munich: Munich Society for the Promotion of Economic Research – CESifo.

Calvo, G.A. (1983), 'Staggered Prices in a Utility-Maximizing Framework', *Journal of Monetary Economics*, 12(3), pp.383–98.

Can, U., Z.G. Can, M.E. Bocuoglu, and M.E. Dogru (2021), 'The Effectiveness of the Post-COVID-19 Recovery Policies: Evidence from a Simulated DSGE Model for Turkey', *Economic Analysis and Policy*, 71(C), pp.694–708.

Çebi, C. (2012), 'The Interaction Between Monetary and Fiscal Policies in Turkey: An Estimated New Keynesian DSGE model', *Economic Modelling*, 29(4), pp.1258–67.

Chang, C., Z. Liu, and M.M. Spiegel (2012), 'Monetary Policy in a DSGE Model with "Chinese Characteristics"', *Federal Reserve Bank of San Francisco Working Paper Series,* No. 2012-13. San Francisco, CA: Federal Reserve Bank of San Francisco. https://www.frbsf.org/wp-content/uploads/sites/4/ChangLiuSpiegel.pdf

Chinn, M.D. and H. Ito (2022), 'A Requiem for "Blame It on Beijing" Interpreting Rotating Global Current Account Surpluses', *Journal of International Money and Finance*, 121, 102510.

Choi, J. and J. Hur (2015), 'An Examination of Macroeconomic Fluctuations in Korea Exploiting a Markov-Switching DSGE Approach', *Economic Modelling*, 51, pp.183–99.

Clarida, R., J. Galí, and M. Gertler (1999), 'The Science of Monetary Policy: A New Keynesian Perspective', *Journal of Economic Literature*, 37(4), pp.1661–707.

Dai, L. (2012), 'Does the DSGE Model Fit the Chinese Economy? A Bayesian and Indirect Inference Approach', PhD Thesis, Cardiff University.

Dai, L., P. Minford, and P. Zhou (2015), 'A DSGE Model of China', *Applied Economics*, 47(59), pp.6438–60.

Danieli, A. and J. Olmstead-Rumsey (2020), 'Sector-Specific Shocks and the Expenditure Elasticity Channel During the COVID-19 Crisis'.

Drygalla, A., O. Holtemöller, and K. Kiesel (2020), 'The Effects of Fiscal Policy in an Estimated DSGE Model – The Case of the German Stimulus Packages During the Great Recession', *Macroeconomic Dynamics*, 24(6), pp.1315–45.

Eichenbaum, M.S., S. Rebelo, and M. Trabandt (2020a), 'Epidemics in the New Keynesian Model', *NBER Working Paper Series*, No. 27430. Cambridge, MA: National Bureau of Economic Research.

——— (2020b), 'The Macroeconomics of Epidemics', *NBER Working Paper Series*, No. 26882. Cambridge, MA: National Bureau of Economic Research.

Espitia, A., A. Mattoo, N. Rocha, M. Ruta, and D. Winkler (2022), 'Pandemic Trade: COVID-19, Remote Work and Global Value Chains', *The World Economy*, 45(2), pp.561–89.

Faria-e Castro, M. (2021), 'Fiscal Policy During a Pandemic', *Journal of Economic Dynamics and Control*, 125, 104088.

Fragetta, M. and T. Kirsanova (2010), 'Strategic Monetary and Fiscal Policy Interactions: An Empirical Investigation', *European Economic Review*, 54(7), pp.855–79.

Fueki, T., I. Fukunaga, H. Ichiue, and T. Shirota (2016), 'Measuring Potential Growth with an Estimated DSGE Model of Japan's Economy', *International Journal of Central Banking*, 12(1), 1–32.

Gabriel, V., P. Levine, J. Pearlman, and B. Yang (2010), 'An Estimated DSGE Model of the Indian Economy', *Discussion Papers in Economics*, No. DP 12/10. Guildford, UK: University of Surrey.

——— (2012), 'An Estimated DSGE Model of the Indian Economy', in C. Ghate (ed.) *The Oxford Handbook of the Indian Economy*. Kettering, UK: Oxford Academic, pp.835–90.

Gabriel, V., P. Levine, and B. Yang (2016), 'An Estimated DSGE Open Economy Model of the Indian Economy with Financial Frictions', in C. Ghate and K. Kletzer (eds.) *Monetary Policy in India: A Modern Macroeconomic Perspective*. New Delhi: Springer, pp. 455–506.

Galí, J. and T. Monacelli (2005), 'Monetary Policy and Exchange Rate Volatility in a Small Open Economy', *Review of Economic Studies*, 72(3), pp.707–34.

Ghate, C., S. Gupta, and D. Mallick (2018), 'Terms of Trade Shocks and Monetary Policy in India', *Computational Economics*, 51(1), pp.75–121.

Goyal, A. (2011), ‘A General Equilibrium Open Economy Model for Emerging Markets: Monetary Policy with a Dualistic Labor Market’, *Economic Modelling*, 28(3), pp.1392–404.

Goyal, A. and A. Kumar (2018), ‘Active Monetary Policy and the Slowdown: Evidence from DSGE Based Indian Aggregate Demand and Supply’, *Journal of Economic Asymmetries*, 17, pp.21–40.

Gu, B., J. Wang, and J. Wu (2013), ‘An Estimated DSGE Model for Business Cycle Analysis in China’, *Frontiers of Economics in China*, 8(3), pp.390–429.

Hur, J. and K.K. Lee (2021), ‘What Are the Consequences of Korea’s New Fiscal Rule?’.

Hürtgen, P. (2020), ‘Fiscal Sustainability During the COVID-19 Pandemic’, *Working Paper*, No. 35/2020. Frankfurt: Deutsche Bundesbank.

Ichiue, H., T. Kurozumi, and T. Sunakawa (2013), ‘Inflation Dynamics and Labor Market Specifications: A Bayesian Dynamic Stochastic General Equilibrium Approach for Japan’s Economy’, *Economic Inquiry*, 51(1), pp.273–87.

Iiboshi, H., T. Matsumae, R. Namba, and S.-I. Nishiyama (2015), ‘Estimating a DSGE Model for Japan in a Data-Rich Environment’, *Journal of the Japanese and International Economies*, 36, pp.25–55.

IMF (2020), *External Sector Report: Global Imbalances and the COVID-19 Crisis*. Washington, DC: International Monetary Fund.

Ireland, P.N. (2004), ‘Technology Shocks in the New Keynesian Model’, *Review of Economics and Statistics*, 86(4), pp.923–36.

Jia, J., J. Guo, and Z. Wang (2015), ‘The Fiscal–Monetary Policy Mix and Exchange Rate Stability: A Dynamic Stochastic General Equilibrium Model with Chinese Characteristics’, *Emerging Markets Finance and Trade*, 51(4), pp.729–46.

Kang, H. and H. Suh (2017), ‘Macroeconomic Dynamics in Korea During and After the Global Financial Crisis: A Bayesian DSGE Approach’, *International Review of Economics & Finance*, 49, pp.386–421.

Kejžar, K.Z. and A. Velic (2020), ‘COVID-19, Trade Collapse and GVC Linkages: European Experience’, *Covid Economics*, 61, pp.222–44.

Kotera, G. and S. Sakai (2018), ‘Policy Simulation of Government Expenditure and Taxation Based on the DSGE Model’, *Public Policy Review*, 14(4), pp.613–40.

Lee, J. and J. Song (2015), ‘Housing and Business Cycles in Korea: A Multi-Sector Bayesian DSGE Approach’, *Economic Modelling*, 45, pp.99–108.

Lie, D. (2021), ‘Implications of State-Dependent Pricing for DSGE Model-Based Policy Analysis in Indonesia’, *Economic Analysis and Policy*, 71, pp.532–52.

Liu, D., W. Sun, and X. Zhang (2020), ‘Is the Chinese Economy Well Positioned to Fight the COVID-19 Pandemic? The Financial Cycle Perspective’, *Emerging Markets Finance and Trade*, 56(10), pp.2259–76.

Mohanty, M.S. and M. Klau (2005), 'Monetary Policy Rules in Emerging Market Economies: Issues and Evidence', in R.J. Langhammer and L.V. de Souza (eds.) *Monetary Policy and Macroeconomic Stabilization in Latin America*. Springer: Berlin and Heidelberg, pp.205–45.

Muscatelli, V.A. and P. Tirelli (2005), 'Analyzing the Interaction of Monetary and Fiscal Policy: Does Fiscal Policy Play a Valuable Role in Stabilisation?', *CESifo Economic Studies*, 51(4), pp.549–85.

Nandi, A. (2020), 'Indian Fiscal Policy: A DSGE Primer', *The Journal of Developing Areas*, 54(2).

Narayan, P.K. (2021), 'COVID-19 Research Outcomes: An Agenda for Future Research', *Economic Analysis and Policy*, 71, pp.439–45.

Park, K.-D. (2020), 'The Effects of Unconventional Monetary Policy in Korea', Doctoral Thesis, University of Bath, UK.

Saif, N.A., J. Ruan, and B. Obrenovic (2021), 'Sustaining Trade During COVID-19 Pandemic: Establishing a Conceptual Model Including COVID-19 Impact', *Sustainability*, 13(10), 5418.

Sakuragawa, M. and K. Hosono (2010), 'Fiscal Sustainability of Japan: A Dynamic Stochastic General Equilibrium Approach', *Japanese Economic Review*, 61(4), pp.517–37.

Sanusi, K.A. (2019), 'An Econometric Analysis of Fiscal Policy and Monetary Policy Interdependence: Comparative Study Between Nigeria and South Africa', Doctoral Thesis. North-West University.

Smets, F. and R. Wouters (2003), 'An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area', *Journal of the European Economic Association*, 1(5), pp.1123–75.

——— (2007), 'Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach', *Working Paper Series*, No. 722. Frankfurt: European Central Bank.

Sugo, T. and K. Ueda (2008), 'Estimating a Dynamic Stochastic General Equilibrium Model for Japan', *Journal of the Japanese and International Economies*, 22(4), pp.476–502.

Sukhbaatar, B. (2014), 'Monetary Policy Regime Through the Lense [sic] of New Keynesian DSGE Model: Case of Mongolia', Master's Thesis, Charles University, Prague.

Taguchi, H. and G. Gunbileg (2020), 'Monetary Policy Rule and Taylor Principle in Mongolia: GMM and DSGE Approaches', *International Journal of Financial Studies*, 8(4), 71.

Tapsoba, S.J.-A. (2013), 'Options and Strategies for Fiscal Consolidation in India', *Economic Modelling*, 43, pp.225–37.

Taylor, J.B. (1993), 'Discretion Versus Policy Rules in Practice', *Carnegie-Rochester Conference Series on Public Policy*, 39(C), pp.195–214.

Vidya, C.T. and K.P. Prabheesh (2020), 'Implications of COVID-19 Pandemic on the Global Trade Networks', *Emerging Markets Finance and Trade*, 56(10), pp.2408–21.

Wang, R. (2021), ‘Evaluating the Unconventional Monetary Policy of the Bank of Japan: A DSGE Approach’, *Journal of Risk and Financial Management*, 14(6), 253.

Xiao, B., Y. Fan, and X. Guo (2018), ‘Exploring the Macroeconomic Fluctuations Under Different Environmental Policies in China: A DSGE Approach’, *Energy Economics*, 76, pp.439–56.

Yu, Z., Y. Li, and X. Xie (2021), ‘Long-Term Trade Impact of Epidemic Outbreaks: Is It V-Shaped?’, *Economic Analysis and Policy*, 71, pp.16–40.

Zhang, W. (2009), ‘China’s Monetary Policy: Quantity Versus Price Rules’, *Journal of Macroeconomics*, 31(3), pp.473–484.

Zheng, T. and H. Guo (2013), ‘Estimating a Small Open Economy DSGE Model with Indeterminacy: Evidence from China’, *Economic Modelling*, 31(1), pp.642–52.

Zhang, X., Y. Zhang, and Y. Zhu (2021), ‘COVID-19 Pandemic, Sustainability of Macroeconomy, and Choice of Monetary Policy Targets: A NK-DSGE Analysis Based on China’, *Sustainability*, 13(6), 3362.

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