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Abstract

We build a small open economy RBC model with financial frictions to analyze expansionary fiscal consolidations in emerging market economies (EMEs). We calibrate the model to India, which we view as a proto-typical EME. When factor income tax rates are *low*, a contractionary fiscal shock has an expansionary effect on output. The economy's debt/GDP ratio falls, and tax revenues rise. When factor income tax rates are *high*, a contractionary fiscal shock has an expansionary effect on output if government spending is valued sufficiently highly relative to private consumption by households in utility. We identify the mechanisms behind these results, and their implications for actual economies undertaking fiscal reforms.

Keywords : Expansionary Fiscal Consolidations, Fiscal Policy in Small Open Economies, Emerging Market Business Cycles, Financial Frictions.

JEL Codes : E32, E62

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1. Introduction

While many countries undertake fiscal consolidations to reduce their fiscal deficits, there is little consensus on the short and long term effects of fiscal austerity on public debt and potential economic growth. The 2010 World Economic Outlook (WEO) published by the IMF finds that domestic demand falls by about 1 percent in response to a fiscal consolidation. It also finds that fiscal contractions that rely on spending cuts tend to have smaller contractionary effects than tax based adjustments (IMF WEO, page 95). However, building on the seminal work of Giavazzi and Pagano (1990), another branch of the literature shows that fiscal retrenchments can stimulate growth in the short run, a phenomenon referred to as the "expansionary fiscal contraction" hypothesis.[1] Such expansions happen if the consolidation is structured in a way that increases confidence.

Most of the quantitative macroeconomic literature on fiscal contractions however is in the context of advanced economies.[2] What is missing is an understanding of the mechanisms behind fiscal consolidations in emerging market economies. Our paper attempts to fill this gap. We build a small open economy real business cycle (SOE RBC) model with financial frictions and fiscal policy that is more suited to analyzing fiscal contractions in EMEs. Our model builds on the work of Neumeyer and Perri (2005), Ghate, Gopalakrishnan, and Tarafdar (2016), and Hansen and Imrohoroglu (2016). We calibrate the model to India, which we view as a proto-typical small open economy, to understand the effects of fiscal contractions in small open emerging market economies.[3] Our main result is that when factor income tax rates are *low*, a contractionary fiscal shock can have an *expansionary* effect on GDP. The rise in GDP makes the economy's debt/GDP ratio fall. In contrast, when factor income tax rates are *high*, a contractionary fiscal shock has an expansionary effect on output

[1] See Alesina and Ardagna (2010).

[2] A large literature on fiscal consolidation on economic activity in advanced economies (Aiyagari et al., 1992; Baxter and King, 1993; Christiano and Eichenbaum, 1992; Gali, Lopez-Salido, and Valles, 2007) finds that with infinitely lived Ricardian households, an increase in (non-productive) government spending purchases (financed by current or future lump sum taxes) lowers the present value of after tax income and generates a negative wealth effect on consumption. The empirical literature on the effects of fiscal policy (Blanchard and Perotti (2002), Romer and Romer (2010)) also finds similar results.

[3] Neumeyer and Perri (2005), Aguiar and Gopinath (2007), and Chang and Fernandez (2013) provide important frameworks for understanding the impact of interest rate shocks in small open economy RBC models.

if government spending is valued "sufficiently highly" relative to private consumption by households in utility. If the relative weight on government spending by households in utility is low, contractionary fiscal policy *reduces* output. Public debt/GDP rises in the transition to the steady state, and tax revenues falls, thereby worsening macroeconomic outcomes.

Our analysis is policy relevant since in recent years many emerging market economies have undergone fiscal consolidations to reduce their fiscal deficits and public debt/GDP ratios. Figure 1, which plots the fiscal deficit/GDP ratio of Malaysia since 2009, depicts a fairly large reduction in the fiscal deficit/GDP ratio approximating 3.7%.

{Insert Figures 1 and 2 here}

Figure 2, which depicts the Indian case, also shows a central fiscal deficit/GDP reduction of a similar order of magnitude. The 2018 IMF Fiscal Monitor notes that many emerging market countries have already (Brazil, Saudi Arabia) or are in the process of implementing (Russia, China) fiscal consolidation plans. The novel aspect of our framework is that we build a unified dynamic stochastic general equilibrium framework that identifies conditions under which fiscal contractions are, (i) contractionary, and (ii) expansionary.

1.1. Model Description

Our theoretical framework builds on Neumeyer and Perri (2005), Ghate, Gopalakrishnan, and Tarafdar (2016), and Hansen and Imrohoroglu (2016). In particular, we add public debt to the framework of Ghate, Gopalakrishnan, and Tarafdar (2016) along the lines of Hansen and Imrohoroglu (2016).

The economy consists of firms, a government, and households. Firm wage payments are subject to working capital constraints, as in Neumeyer and Perri (2005) and Ghate, Gopalakrishnan, and Tarafdar (2016). Working capital constraints are the key financial friction in the model. To meet the working capital constraint, firms borrows from households domestically and abroad by issuing corporate debt which is priced at the international interest rate, R^*.

Infinitely lived households derive utility over private consumption (C_t) and government consumption (G_t) which are assumed to be perfect substitutes but with different weights;

leisure $(1 - H_t)$; government bonds (D_t), as in Hansen and Imrohoroglu (2015); and private bonds (B_t). We assume that households value holding government bonds relatively more than private bonds since private bonds are assumed to be relatively riskier compared to the risk free asset. Consumers form habits in their expenditure formation with utility depending on current consumption, C_t, relative to a habit reference level, $C_{t-1.}$ Effective consumption is given by $C_t^* = C_t + \zeta G_t$, where $\zeta > 0$ is the relative weight of government consumption in utility.[4]

The government collects tax revenue by imposing time invariant distortionary taxes on wage and capital incomes, does not balance its budget, and borrows by issuing debt at a rate $R_t^G > 1$. The government allocates G_t of it's total revenue towards government consumption. The residual is transferred to households in the form of a lump-sum transfer (T_t). The sovereign risk premium on public debt depends on the deviation of the period t debt-GDP (d_t) ratio relative to its steady state value $(\bar{d})$. If the debt-GDP ratio is higher than its steady state, then the rate at which the government borrows is higher. Thus, the sovereign risk premia required to borrow in international capital markets depends on domestic fundamentals in the economy. Finally, the interest rate on corporate debt, $R_t^p > 1$, is priced off of R_t^G as in many emerging market economies, which implies that $R_t^P > R_t^G$ (see Caballero, Fernandez, and Park (2016)). Hence, $R_t^P > R_t^G > R^*$.

We calibrate the model using a broad set of parameters representative of the Indian economy. Using Sims (2002), the solution to the log-linearized system is the state equation of the model in the form of a VAR (1). We discuss the intuition behind the impulse response functions generated by shocks to three main variables in the model: government spending, the foreign interest rate, and total factor productivity.

1.2. Main Results

The main insight obtained is to identify the mechanism and conditions under which fiscal contractions can be contractionary or expansionary in the short run. We first consider the case when factor income tax rates are low. A reduction in government consumption

[4] The presence of habits ensures that fiscal shocks lead to sluggish adjustments in effective consumption which ensures that steady state consumption, $\overline{C} > 0$.

leads to a rise in private consumption, but a decline in effective consumption, since government consumption and private consumption are substitutes in utility. A decline in effective consumption increases the marginal utility from effective consumption, which induces the household to work more. Despite the fall in government spending, low tax collections from factor incomes leads to a rise in public debt, plus a lump sum tax that is required for the government budget constraint to hold. The negative wealth effect from higher lump sum taxes induces households to work more. As a result, employment rises and wages fall. Since the capital stock is given in time period t, higher hours worked leads to higher GDP. Hence, on impact, a contractionary fiscal shock is expansionary. Higher output also induces households to buy more government and private bonds, since these enhance utility. Because the increase in government bonds increases by less than the increase in output, the debt-GDP ratio falls on impact. The reduction in the debt-GDP ratio relative to its steady state value reduces the sovereign risk premium, and depresses R_t^G. Since private sector debt is priced off of R_t^G, working capital loan rates fall. Higher output also increases the gross marginal product of capital, R_t. While ordinarily this would depress capital accumulation, higher labor supply increases the marginal productivity of private capital increasing investment and capital accumulation overall. This provides a further boost to output in the next period. We find that a fiscal contraction increases hours worked, GDP, investment and capital accumulation. It also reduces the public debt-GDP ratio and which reduces the sovereign risk premium.

Now consider the case when factor income tax rates are high.[5] We show that the incidence of a contractionary fiscal consolidation being expansionary now depends on the value of ζ, the parameter denoting the relative superiority of government consumption vis-a-vis private consumption in utility.[6] When ζ is low, a negative government spending shock increases private consumption and effective consumption. The marginal utility from effective consumption falls. Hours worked falls, and wages rise. A reduction in hours worked drives GDP down which reduces R on impact. A lower R increases investment and capital accumulation in the next period. However, the reduction in the marginal utility from effective consumption

[5] In the experiments we conduct later on, we arbitrarily set factor income taxes to be 10 times higher than the baseline case.

[6] Consistent with the empirical literature, we restrict $0 < \zeta < 1$ (see Ambler and Paquet (1996), and Barro (1981)).

requires a reduction in the marginal utility of holding public and private debt by households to maintain their marginal rate of substitution conditions. Hence, the demand for private and public debt rises. This raises the public debt-GDP ratio, pushing up the sovereign risk premium, the government borrowing rate, R_t^G, and therefore R_t^P. When ζ is high, the key difference is that a negative government spending shock increases private consumption, but reduces effective consumption. Hours work rises, which raises GDP, investment (because the marginal product of capital rises with higher employment), and capital, increasing output in the next period as well. Higher GDP implies that households demand more private and public debt, but because output has risen, the public-debt to GDP ratio falls. This reduces the sovereign risk premium, implying that both R_t^G and R_t^P fall. To balance its budget, the government lump sum taxes households. These lump sum taxes impose a negative wealth effect on households which induces the household to work more.

We compare these results with the propagation mechanism from foreign interest rate shocks, and TFP shocks. For these cases, the dynamics of the economy respond similarly to the low and high tax cases. A foreign interest rate shock raises R^P and R^G on impact. This reduces private consumption and effective consumption, and increases the demand for public and private debt since these now give higher returns. The reduction in effective consumption raises hours worked, but in the net hours worked falls, since higher lump sum taxes are required to balance the government budget constraint. This pushes hours worked down, and GDP falls.

Our analysis uncovers an interesting point of departure with respect to Neumeyer and Perri (2005). A reduction in GDP because of a rise in foreign interest rates also obtains in Neumeyer and Perri (2005). In that paper however, there is no fiscal policy. Here there is fiscal policy and public debt, and what drives the result is a fiscal policy channel. Unlike Neumeyer and Perri (2005), we also don't have to assume GHH preferences to obtain this result which makes our result more general.

With a TFP shock, both factor prices, wages, and the marginal product of capital, rise. Households work more, which increases GDP. increased employment raises the marginal product of capital which increases investment and the capital stock in the next period. Higher GDP raises consumption and effective consumption. The demand for public and private debt falls, which reduces R^P and R^G.

2. The Model

2.1. Firms

The economy consists of firms, a government, and households. At any given time t a representative firm produces final output using labor employed at time t and capital carried forward from time period $t-1$. However, prior to actual production, the firm needs to pay a portion $\theta \in [0,1]$ of its total wage bill. To meet this working capital constraint, the firm borrows from households by issuing debt. The firm issues corporate bonds (B_t) to households to whom they promise a return of R^P_{t-1} which is considered to be a markup over the domestic government bond interest rate, R^G_{t-1}.

The firm hires labor (H_t) and uses capital (K_{t-1}) accumulated in time period $t-1$ to produce final output Y_t such that

$$\max_{\{K_t, H_t\}} Y_t - R_t K_{t-1} - (1-\theta) W_t H_t - \theta W_t H_t R^P_{t-1}, \tag{1}$$

where,

$$Y_t = A_t K^{\alpha}_{t-1} H^{1-\alpha}_t \tag{2}$$

and A_t denotes exogenous total factor productivity (TFP). This yields the following first order conditions for firms.

$$\frac{(1-\alpha)Y_t}{H_t} = W_t \left[1-\theta+\theta R^P_{t-1}\right] \tag{3}$$

$$\frac{\alpha Y_t}{K_{t-1}} = R_t \tag{4}$$

The timing of events and decisions is identical to Neumeyer and Perri (2005) and Ghate et al. (2016). In the beginning of period t, which we denote as t^-, firms borrow $\theta W_t H_t$ to make advance payments to labor prior to actual production (which occurs at t). Firms then produce output and repay the loan borrowed at the end of time period (t^+), with workers receiving the rest of their wage bill $(1-\theta)W_tH_t$ at time t^+. Since the time gap between t^- and t, and between t and t^+ is very small, we drop these superscripts and consider the entire period as time period t.

2.2. Households

The economy is populated by infinitely lived households with a mass normalized to 1. The representative household consumes and invests a homogenous good and supplies labor and capital to firms. As in the vast literature on habit formation, we assume that consumers form habits in their expenditure formation with utility, U, depending on current consumption, C_t, relative to a habit reference level, C_{t-1}. The representative household has the following expected discounted lifetime utility

$$E_0 \sum_{t=0}^{\infty} \beta^t U(C_t^*, H_t, B_t, D_t), \tag{5}$$

where $\beta \in (0,1)$ denotes the households subjective discount factor. We assume that

$$C_t + \zeta G_t, \tag{6}$$

where household consumption (C_t) is augmented by government consumption (G_t). The parameter ζ captures the weight of public consumption in household utility, where $\zeta > 0$. Given our specification in equation (6), C_t and G_t are assumed to be perfect substitutes.[7] We assume that agents treat G_t as a given covariance stationary stochastic process (CSSP). Finally, households also derive utility from holding private and government debt (B_t and D_t respectively). Our specification of the household deriving utility over public debt follows Hansen and Imrohoroglu (2016). In the calibration exercise later, we assume that the preference for holding public debt is higher than private debt since public debt is the risk free asset.

[7] In an emerging markets context, an example of G_t can be public health or public transportation services whose quality is typically seen as being superior to private alternatives. See Barro (1981), Christiano and Eichenbaum (1992), and Ghate et al. (2016).

We adopt a unitary elasticity of substitution specification for instantaneous utility

$$U(C_t^*, H_t, B_t, D_t) = \mu \ln (C_t - \chi C_{t-1} + \zeta G_t) + (1 - \mu - \varphi_1 - \varphi_2) \ln (1 - H_t) \qquad (7)$$
$$+ \varphi_1 \ln (D_t) + \varphi_2 \ln (B_t) .$$

The household faces the following constraint

$$C_t + X_t + B_t + \kappa_1(B_t) + D_t + \kappa_2(D_t) \qquad (8)$$
$$= (1 - \tau_w) W_t H_t + (1 - \tau_k) R_t K_{t-1} + R_{t-1}^P B_{t-1} + R_{t-1}^G D_{t-1} + T_t$$

where B_t denotes private bond holdings, X_t denotes investment, $\tau_w \in [0, 1]$ is the tax on labor income, and $\tau_k \in [0, 1]$ is the tax on capital income. Agents take the competitive wage rate (W_t) and return to capital (R_t) as given in deciding optimal choices. For private bond holdings the term $\kappa(B_t)$ in (8) is the bond holding cost,

$$\kappa_1(B_t) = \frac{\kappa_1}{2} Y_t \left[\frac{B_t}{Y_t} - \frac{\bar{B}}{\bar{Y}} \right]^2 . \qquad (9)$$

Households also invest in government bonds (D_t) and holding these involves an analogous cost,

$$\kappa_2(D_t) = \frac{\kappa_2}{2} Y_t \left[\frac{D_t}{Y_t} - \frac{\overline{D}}{\bar{Y}} \right]^2 . \qquad (10)$$

The term X_t in (8) is the level of private investment

$$X_t = K_t - (1 - \delta) K_{t-1} + \Phi(K_t, K_{t-1}), \qquad (11)$$

where $\Phi(K_t, K_{t-1})$ is the capital adjustment costs such that[8]

$$\Phi(K_t, K_{t-1}) = \frac{\phi}{2} K_{t-1} \left[\left(\frac{K_t}{K_{t-1}} \right) - 1 \right]^2 . \qquad (12)$$

[8] An investment adjustment cost is required to make the volatility of private investments relative to output match empirically observed values. This is also a standard practice in RBC models.

Therefore,

$$X_t = K_t - (1-\delta)K_{t-1} + \frac{\phi}{2}K_{t-1}\left[\frac{K_t}{K_{t-1}} - 1\right]^2 \tag{13}$$

is the law of motion of capital accumulation.

2.3. Government Budget Constraint

The government in our model follows a non-discretionary fiscal policy. It collects tax revenue by imposing time invariant distortionary taxes on wage and capital incomes, does not balance its budget, and borrows by issuing debt at a rate R_t^G. The government allocates G_t of it's total revenue towards government consumption. The residual is transferred to households in the form of a lump-sum transfer (T_t). The following is the government budget constraint, in every time period t.

$$G_t + T_t = \tau_w W_t H_t + \tau_k R_t K_t + D_t - R_{t-1}^G D_{t-1}, \tag{14}$$

where

$$R_t^G = \xi_t R_t^* \tag{15}$$

R_t^G is assumed to be a mark-up over the international interest rate R_t^*.[9] The mark-up is the spread over the international interest rate, to capture sovereign risk, modelled as deviations from the steady state debt to GDP levels, i.e.,

$$\xi_t = \xi \exp\left(\frac{D_t}{Y_t} - \frac{\bar{D}}{\bar{Y}}\right), \text{ where } \xi > 0. \tag{16}$$

We further assume that the interest rate on private bonds is equal to the interest rate on government bonds with an additional mark-up, i.e.,

$$R_t^P = \Gamma_t R_t^G. \tag{17}$$

[9] We assume R_t^* to be an exogenous process. Typically in the literature, the international interest rate R_t^* is assumed to be the US 91 day T-Bill rates (see Neumeyer and Perri (2005), Ghate et al. (2016)).

This reflects the fact that there is a risk premium in corporate bonds over government bonds. Hence, there are two mark-ups in the model: ξ_t, which is determined by macroeconomic fundamentals (public debt) and is endogenous, and Γ_t (which is exogenous).

In light of the above environment, given $\{A_t, R_t^*, G_t\}_{t=0}^{\infty}$, a vector of fiscal policy parameters $\{\tau_k, \tau_w, \zeta\}$, and initial conditions $K_{-1},\ B_{-1}, D_{-1},\ R_{-1}^P, R_{-1}^G$, a competitive equilibrium for our model is a vector of allocations of $\{C_t, K_t, D_t, B_t,$ and $H_t\}_{t=0}^{\infty}$ and factor prices $\{W_t$ and $R_t\}_{t=0}^{\infty}$ such that, for the given sequence of factor prices, (i) $\{K_t$ and $H_t\}_{t=0}^{\infty}$ solves the firm's profit maximization problem (1), and FOCs (3-4), (ii) $\{C_t, K_t, B_t, D_t, H_t\}_{t=0}^{\infty}$ maximizes the utility of the representative agent (5) subject to (2), (8), (6), (9), (10), (12), and (13) together with $C_t, K_t \geqslant 0$, (iii) T_t satisfies (14), (iv) a no-Ponzi associated with the initial conditions K_{-1}, B_{-1}, and D_{-1} holds for the representative agent, and finally, (v) all markets clear for all time periods. .

Collecting the decision rules and constraints across all economic actors, this definition of a competitive equilibrium results in the following system of nonlinear expectational difference equations that describe this "cycles only" model[10]:

$$\Lambda_t = \frac{\mu}{C_t - \chi C_{t-1} + \zeta G_t} - \frac{\chi\mu}{C_{t+1} - \chi C_t + \zeta G_{t+1}} \tag{N1}$$

$$(1-\tau_w)\Lambda_t W_t = \frac{1-\mu-\varphi_1-\varphi_2}{1-H_t} \tag{N2}$$

$$E_t\left\{\begin{array}{c}\beta\Lambda_{t+1}\left[1-\delta-\frac{\phi}{2}\left[\frac{K_{t+1}}{K_t}-1\right]^2+\frac{\phi K_{t+1}}{K_t}\left[\frac{K_{t+1}}{K_t}-1\right]+(1-\tau_k)R_{t+1}\right] \\ =\Lambda_t\left[1+\phi\left[\frac{K_t}{K_{t-1}}-1\right]\right]\end{array}\right\} \tag{N3}$$

$$E_t\left\{\beta\Lambda_{t+1}R_t^P = \Lambda_t\left[1+\kappa_1\left[\frac{B_t}{Y_t}-\frac{\bar{B}}{\bar{Y}}\right]\right]-\frac{\varphi_2}{B_t}\right\} \tag{N4}$$

$$E_t\left\{\beta\Lambda_{t+1}R_t^G = \Lambda_t\left[1+\kappa_2\left[\frac{D_t}{Y_t}-\frac{\bar{D}}{\bar{Y}}\right]\right]-\frac{\varphi_1}{D_t}\right\} \tag{N5}$$

$$\begin{aligned} C_t + K_t - (1-\delta)K_{t-1} + \frac{\phi}{2}K_{t-1}\left[\frac{K_t}{K_{t-1}}-1\right]^2 + B_t + \frac{\kappa_1}{2}Y_t\left[\frac{B_t}{Y_t}-\frac{\bar{B}}{\bar{Y}}\right]^2 + D_t \\ +\frac{\kappa_2}{2}Y_t\left[\frac{D_t}{Y_t}-\frac{\bar{D}}{\bar{Y}}\right]^2 = (1-\tau_w)W_tH_t + (1-\tau_k)R_tK_{t-1} + R_{t-1}^P B_{t-1} + R_{t-1}^G D_{t-1} + T_t \end{aligned} \tag{N6}$$

$$\frac{(1-\alpha)Y_t}{H_t} = W_t\left[(1-\theta)+\theta R_{t-1}^P\right] \tag{N7}$$

$$\frac{\alpha Y_t}{K_{t-1}} = R_t \tag{N8}$$

$$Y_t = A_t K_{t-1}^{\alpha} H_t^{1-\alpha} \tag{N9}$$

$$G_t + T_t = \tau_w W_t H_t + \tau_k R_t K_t + D_t - R_{t-1}^G D_{t-1} \tag{N10}$$

$$R_t^G = \xi R_t^* \exp\left(\frac{D_t}{Y_t}-\frac{\bar{D}}{\bar{Y}}\right) \tag{N11}$$

$$R_t^P = \Gamma R_t^G \tag{N12}$$

$$G_t \sim CSSP(\bar{G}, \rho_G, \sigma_G) \tag{N13}$$

$$A_t \sim CSSP(\bar{A}, \rho_A, \sigma_A) \tag{N14}$$

$$R_t^* \sim CSSP(\bar{R}^*, \rho_{R^*}, \sigma_{R^*}) \tag{N15}$$

where $CSSP$ denotes (an exogenous) covariance stationary stochastic process. The assumption that government debt has utility value following Hansen and Imrohoroglu (2016) asserts itself in the system above. The Euler equations governing private and public debt (equations

[10] We note that there is no source of deterministic growth in this model and so the log-linearized version we analyze next is to be interpreted in terms of Hodrick-Prescott filtered data analogs.

(N4) and (N5) respectively) are distinct from each other and distinct from that governing the determination of physical capital (equation (N3)). The working capital friction clearly introduces a wedge into the equation governing the determination of wages from the firms' side (equation (N2)). The remaining equations are standard relative to a baseline RBC model with real frictions.

3. Calibration

We analyze the log-linearized version of the model, which, following Sims (2001), can be written as a system of 15 equations in 15 variables:

$$\Gamma_0 X_{t+1} = \Gamma_1 X_t + \Psi \varepsilon_t + \Pi \eta_t$$

$$\text{where, } X_t = \{C_t, H_t, D_t, K_t, B_t, Y_t, W_t, R_t, R_t^P, R_t^G, T_t, \Lambda_t, G_t, A_t, R_t^*\}$$

and the matrices Γ_0, Γ_1, Ψ and Π are functions of 25 model parameters:

$$\beta, \chi, \mu, \zeta, \varphi_1, \varphi_2, \delta, \phi, \kappa_1, \kappa_2, \tau_w, \tau_k, \theta, \alpha, \Gamma, \xi, \bar{G}, \bar{A}, \bar{R}^*, \rho_G, \rho_A, \rho_{R^*}, \sigma_G, \sigma_A, \sigma_{R^*},$$

with $\bar{G} = \bar{A} = 1$, and three new variables reflecting idiosyncratic rational expectations errors (η_t) have been subsumed in the notation (see DeJong and Dave (2011)). Given the above representation, any linear solution method including that of Sims (2001) solves a system of linear expectational difference equations under rational expectations as

$$X_{t+1} = F X_t + G \varepsilon_t, \;\; E(\varepsilon_t \varepsilon_t') = \begin{bmatrix} \sigma_G^2 & 0 & 0 \\ 0 & \sigma_A^2 & 0 \\ 0 & 0 & \sigma_{R^*}^2 \end{bmatrix},$$

which is the state equation of the model in the form of a VAR (1).[11]

We calibrate the model to India, a proto-typical small open emerging market economy. Our baseline calibration proceeds as follows. We chose the value of $\overline{R}^*$ to equal 1.0035 so that

[11] We analyze the model using DYNARE v. 4.5.0.

it is close to the long run real interest rate on 91-Day US T-Bill bonds (with $\{\rho_{R^*}, \sigma_{R^*}\}$ being (0.7400, 0.0030)). Given that India has a very narrow income tax base and depends more on generating revenue from indirect taxation, we allow for low income taxes. In particular, we fix the factor income tax rates at $\tau_k = \tau_w = 0.01$ following the estimated average effective tax rates in Poirson (2006). Given data on R_t^P (Indian commercial paper) and R_t^G (91-day Indian T-bill rate) we obtain ξ and Γ as 1.01259 and 1.00131 respectively. Since we have included bond holding costs in our household constraint not just for realism in the EME context but also to ensure that the corresponding first order conditions do not follow a random walk, we assume them to be small ($\kappa_1 = \kappa_2 = 0.0062$). For similar realism in the Indian context, we set θ to be 0.5 and ϕ to be 8.8591. The impulse responses we discuss below are invariant to these parameter choices.

Table 1: Baseline Parameters

Parameters	Values	Source	Parameters	Values	Source
μ	0.4	Arbitrary	$\kappa_1 = \kappa_2$	0.006	Arbitrary
ζ	< 1	Barro (1981)	ρ_G	0.59	Anand and Prasad. (2010)
χ	0.4	Arbitrary	ρ_A	0.82	Basu et al. (2018)
ϑ_1	0.2	Arbitrary	ρ_{R^*}	0.74	Authors' Calculation
ϑ_2	0.15	Arbitrary	σ_G	0.026	Anand et al. (2010)
α	0.36	Ghate et al. (2016)	σ_A	0.016	Anand et al. (2010)
β	0.98	Gabriel et al. (2012)	σ_{R^*}	0.003	Calculated
δ	0.025	Banerjee and Basu (2017)	$\overline{R}^*$	1.0035	Calculated
$\tau_w = \tau_k$	0.01	Poisron (2006)	ξ	1.01259	Calculated
ϕ	8.8591	Arbitrary	Γ	1.001312	Calculated
θ	0.5	Arbitrary	$\overline{G} = \overline{A}$	1	Arbitrary

Our choices for preference parameter values reflect the following intuition. We set μ to be 0.4 to give the highest weight to consumption and φ_1 and φ_2 to be 0.2 and 0.15 respectively to reflect that due to risk considerations households would give less weight to private bonds than government bonds. These parameter values then imply a weight of approximately a third on leisure which corresponds to the notion that households spend approximately that amount of time on non-employment activity. Table 1 above summarizes our choice of parameters in our model.

4. Impulse Responses

Our model features three exogenous shock processes, for G_t, R_t^* and A_t (all in logarithmic deviations from steady state). The HP filtered model equivalent impulse responses for these shocks are provided below. The following impulse responses are for our baseline case which is for $\tau_w = \tau_k = 0.01$ and $\zeta = 0.8$.

4.1. G Shock

{Insert Figure 3 here}

Figure 3 depicts the case of a negative government spending shock (government consumption falls). A reduction in government consumption leads to a rise in private consumption, but a decline in effective consumption (cs), since government consumption and private consumption are substitutes in utility. A decline in effective consumption increases the marginal utility from effective consumption, which induces the household to work more. Since the capital stock is given in time period t, higher hours worked leads to higher GDP, which directly increases the return on capital, R_t. Despite a drop in w_t, R_t^P, and R_t^G, disposable income of households increase. Hence, on impact, a contractionary fiscal shock is expansionary, and higher output and disposable income also induces households to buy more government and private bonds, since these enhance utility.

Because the increase in government bonds increases by less than the increase in output, the debt-GDP ratio falls on impact. The reduction in the debt-GDP ratio relative to its steady state value reduces the sovereign risk premium, and depresses R_t^G. Since private sector debt is priced off of R_t^G, working capital loan rates also fall. Finally, higher output increases the gross marginal product of capital, R_t. While ordinarily this would depress capital accumulation, higher labor supply increases the marginal productivity of private capital increasing investment and capital accumulation overall. This provides a further boost to output in the next period. In sum, a fiscal contraction increases hours worked, GDP, investment and capital accumulation. It also reduces the public debt-GDP ratio, the fiscal deficit, and therefore the sovereign risk premium.

4.2. R^* Shock

{Insert Figure 4 here}

Figure 4 depicts the case of a positive foreign interest rate, R^*, shock. A foreign interest rate shock on R^* raises R^P and R^G on impact. This reduces private consumption and effective consumption, and increases the demand for public and private debt since these now give higher returns. The reduction in effective consumption raises hours worked, but in the net hours worked falls, since falling lump sum and proportional taxes induces households to enjoy more leisure. This pushes hours worked down, and GDP falls. The reduction in GDP is similar to the adverse effect on GDP of a rise in foreign interest rates in Neumeyer and Perri (2005). In Neumeyer and Perri however, there is no fiscal policy. The reduction in GDP in our model obtains because of a fiscal policy channel where higher lump sum taxes are required to balance the government budget constraint.

4.3. TFP Shock

{Insert Figure 5 here}

Figure 5 depicts the case of a positive TFP ($\widehat{A}$ shock). With a TFP shock, both factor prices, wages, and the marginal product of capital, rise. Households work more, which increases GDP. More employment raises the marginal product of capital which increases investment and the capital stock in the next period. Higher GDP raises consumption and effective consumption. The demand for public and private debt falls, which reduces R^P and R^G.

4.4. Policy Experiments

Finally, as policy experiments, we consider the case where taxes are high, i.e., $\tau_w = \tau_k = 0.1$[12] In this case, we consider two cases – a high value of ζ, i.e., $\zeta = 0.8$ and low value of ζ, i.e., $\zeta = 0.3$. Figure 6a corresponds to the case where $\zeta = 0.8$. Figure 6b on the other hand corresponds to the case where $\zeta = 0.3$.

{Insert Figure 6a here}

Figure 6a depicts the case of a negative government spending shock with high factor income taxes. A reduction in government consumption leads to a rise in private consumption, but a decline in effective consumption. The transmission channel in this case is similar to our baseline case, corresponding to Figure 3.

{Insert Figure 6b here}

Figure 6b depicts the case of a negative government spending shock with high factor income taxes and lower ζ. A reduction in government consumption leads to a rise in private consumption, and an increase in effective consumption, since government consumption has a lower coefficient in utility. An increase in effective consumption decreases the marginal utility from effective consumption, which induces the household to work less leading to lower GDP, and lower Interest on capital, R_t. Hence, on impact, a contractionary fiscal shock is contractionary.

These experiments show that the incidence of a contractionary fiscal consolidation being expansionary depends on the value of ζ, the parameter denoting the relative superiority of government consumption vis-a-vis private consumption in utility.[13] When ζ is low, as in Figure 6b, a negative government spending shock increases private consumption and effective consumption. The marginal utility from effective consumption falls. Hours worked falls, and wages rise. A reduction in hours worked drives GDP down which reduces R on impact.

[12] We arbitrarily set factor income taxes to be 10 times higher than the baseline case to denote the situation of high taxes.

[13] Consistent with the empirical literature, we restrict $0 < \zeta < 1$ (see Ambler and Paquet (1996), and Barro (1981)).

A lower R increases investment and capital accumulation in the next period. However, the reduction in the marginal utility from effective consumption requires a reduction in the marginal utility of holding public and private debt by households to maintain their marginal rate of substitution conditions. Hence, the demand for private and public debt rises. This raises the debt-GDP ratio, pushing up the sovereign risk premium, the government borrowing rate, R^G, and therefore R^P. When ζ is high, the key difference is that a negative government spending shock increases private consumption, but reduces effective consumption. Hours worked rises, which raises GDP, investment (because the marginal product of capital rises with higher employment), and capital, increasing output in the next period as well. Higher GDP implies that households demand more private and public debt, but because output has risen, the public-debt to GDP ratio falls. This reduces the sovereign risk premium, implying that both R^G and R^P fall. To balance its budget, the government lump sum taxes households. These lump sum taxes impose a negative wealth effect on households which also reinforce the increase in hours worked from the marginal utility channel.

5. Conclusion

To model fiscal consolidations in EMEs, we develop a simple SOE RBC model with fiscal policy and financial frictions to derive conditions under which fiscal contractions can be expansionary. The main result of our paper is show that the incidence of expansionary fiscal consolidations depends crucially on whether factor income tax rates are low or high. When tax rates are high, we show that the incidence of expansionary fiscal contractions depends on the relative weight that households place on government consumption in utility. We also show that positive foreign interest rate channels can reduce output in the short run, but via a channel that does not require assuming that households have GHH preferences as in Neumeyer and Perri (2005). In the future, we plan to add monetary-fiscal interactions to the model, to derive endogenous responses by the monetary authority to fiscal contractions. It would be interesting to characterize the value of the fiscal multiplier in this case.

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Technical Appendix

This appendix provides the derivation of the linear system comprising the model we analyze. We note that this model is built for use with HP-filtered data and as such does not feature deterministic trends.

A.1 The Household's Problem

A representative household maximizes utility:

$$\max_{\{C_t,H_t,B_t,D_t,K_t\}} E_0\sum_{t=0}^{\infty}\beta^t \left[\begin{array}{c} \mu\ln(C_t-\chi C_{t-1}+\zeta G_t)+(1-\mu-\varphi_1-\varphi_2)\ln(1-H_t) \\ +\varphi_1\ln(D_t)+\varphi_2\ln(B_t)\end{array}\right],$$

where $\beta\in(0,1)$, $G_t\sim CSSP(\bar{G},\rho_G,\sigma_G)$ and subject to,

$$C_t+K_t-(1-\delta)K_{t-1}+\frac{\phi}{2}K_{t-1}\left[\frac{K_t}{K_{t-1}}-1\right]^2+B_t+\frac{\kappa_1}{2}Y_t\left[\frac{B_t}{Y_t}-\frac{\bar{B}}{\bar{Y}}\right]^2+D_t+\frac{\kappa_2}{2}Y_t\left[\frac{D_t}{Y_t}-\frac{\bar{D}}{\bar{Y}}\right]^2$$
$$=(1-\tau_w)W_tH_t+(1-\tau_k)R_tK_{t-1}+R^P_{t-1}B_{t-1}+R^G_{t-1}D_{t-1}+T_t$$

where $CSSP$ denotes a covariance stationary stochastic process. The Lagrangian of the problem, where Λ_t is the multiplier on the household budget constraint, is

$$\max_{\{C_t,H_t,B_t,D_t,K_t\}} L=\left[\sum_{t=0}^{\infty}\beta^t\left[\mu\ln(C_t-\chi C_{t-1}+\zeta G_t)+(1-\mu-\varphi)\ln(1-H_t)+\varphi\ln(D_t)\right]\right]$$
$$-\left[\sum_{t=0}^{\infty}\beta^t\Lambda_t\left[\begin{array}{c} C_t+K_t-(1-\delta)K_{t-1}+\frac{\phi}{2}K_{t-1}\left[\frac{K_t}{K_{t-1}}-1\right]^2+B_t \\ +\frac{\kappa_1}{2}Y_t\left[\frac{B_t}{Y_t}-\frac{\bar{B}}{\bar{Y}}\right]^2+D_t+\frac{\kappa_2}{2}Y_t\left[\frac{D_t}{Y_t}-\frac{\bar{D}}{\bar{Y}}\right]^2 \\ -\left[(1-\tau_w)W_tH_t+(1-\tau_k)R_tK_{t-1}+R^P_{t-1}B_{t-1}+R^G_{t-1}D_{t-1}+T_t\right]\end{array}\right]\right]$$

and the FONC are, for C_t, H_t, K_t, B_t and D_t respectively,

$$\Lambda_t = \frac{\mu}{C_t - \chi C_{t-1} + \zeta G_t} - \frac{\chi\mu}{C_{t+1} - \chi C_t + \zeta G_{t+1}}$$
$$(1-\tau_w)\Lambda_t W_t = \frac{1-\mu-\varphi_1-\varphi_2}{1-H_t}$$
$$E_t \left\{ \begin{array}{c} \beta\Lambda_{t+1}\left[(1-\delta) - \frac{\phi}{2}\left[\frac{K_{t+1}}{K_t} - 1\right]^2 + \frac{\phi K_{t+1}}{K_t}\left[\frac{K_{t+1}}{K_t} - 1\right] + (1-\tau_k)R_{t+1}\right] \\ = \Lambda_t\left[1 + \phi\left[\frac{K_t}{K_{t-1}} - 1\right]\right] \end{array} \right\}$$
$$E_t\left\{\beta\Lambda_{t+1}R_t^P = \Lambda_t\left[1 + \kappa_1\left[\frac{B_t}{Y_t} - \frac{\bar{B}}{\bar{Y}}\right]\right] - \frac{\varphi_2}{B_t}\right\}$$
$$E_t\left\{\beta\Lambda_{t+1}R_t^G = \Lambda_t\left[1 + \kappa_2\left[\frac{D_t}{Y_t} - \frac{\bar{D}}{\bar{Y}}\right]\right] - \frac{\varphi_1}{D_t}\right\}.$$

The household problem therefore delivers the following system of 7 equations:

$$\Lambda_t = \frac{\mu}{C_t - \chi C_{t-1} + \zeta G_t} - \frac{\chi\mu}{C_{t+1} - \chi C_t + \zeta G_{t+1}}$$
$$(1-\tau_w)\Lambda_t W_t = \frac{1-\mu-\varphi_1-\varphi_2}{1-H_t}$$
$$E_t\left\{\beta\Lambda_{t+1}\left[(1-\delta) - \frac{\phi}{2}\left[\frac{K_t}{K_{t-1}} - 1\right]^2 + \phi\frac{K_{t+1}}{K_t}\left[\frac{K_t}{K_{t-1}} - 1\right] + (1-\tau_k)R_{t+1}\right] = \Lambda_t\left[1 + \phi\left[\frac{K_t}{K_{t-1}} - 1\right]\right]\right\}$$
$$E_t\left\{\beta\Lambda_{t+1}R_t^P = \Lambda_t\left[1 + \kappa_1\left[\frac{B_t}{Y_t} - \frac{\bar{B}}{\bar{Y}}\right]\right] - \frac{\varphi_2}{B_t}\right\}$$
$$E_t\left\{\beta\Lambda_{t+1}R_t^G = \Lambda_t\left[1 + \kappa_2\left[\frac{D_t}{Y_t} - \frac{\bar{D}}{\bar{Y}}\right]\right] - \frac{\varphi_1}{D_t}\right\}$$
$$C_t + K_t - (1-\delta)K_{t-1} + \frac{\phi}{2}K_{t-1}\left[\frac{K_t}{K_{t-1}} - 1\right]^2 + B_t + \frac{\kappa_1}{2}Y_t\left[\frac{B_t}{Y_t} - \frac{\bar{B}}{\bar{Y}}\right]^2 + D_t + \frac{\kappa_2}{2}Y_t\left[\frac{D_t}{Y_t} - \frac{\bar{D}}{\bar{Y}}\right]^2$$
$$= (1-\tau_w)W_t H_t + (1-\tau_k)R_t K_{t-1} + R_{t-1}^P B_{t-1} + R_{t-1}^G D_{t-1} + T_t$$
$$\text{where } G_t \sim CSSP(\bar{G}, \rho_G, \sigma_G)$$

in 15 parameters

$$\{\beta, \chi, \mu, \zeta, \varphi_1, \varphi_2, \delta, \phi, \kappa_1, \kappa_2, \tau_w, \tau_k, \bar{G}, \rho_G, \sigma_G\}$$

and 13 variables

$$\{C_t, G_t, H_t, D_t, K_t, B_t, Y_t, W_t, R_t, R_t^P, R_t^G, T_t, \Lambda_t\}.$$

A2. The Firm's Problem

The firm seeks to maximize it's profits given by,

$$\max_{\{K_{t-1},H_t\}} \; Y_t - R_t K_{t-1} - (1-\theta) W_t H_t - \theta W_t H_t R^P_{t-1},$$

subject to

$$\begin{aligned} Y_t &= A_t K^{\alpha}_{t-1} H_t^{1-\alpha} \\ A_t &\sim CSSP(\bar{A}, \rho_A, \sigma_A) \end{aligned}$$

This optimization yields 2 FONCs,

$$\begin{aligned} \frac{(1-\alpha)Y_t}{H_t} &= W_t \left[(1-\theta) + \theta R^P_{t-1}\right] \\ \frac{\alpha Y_t}{K_{t-1}} &= R_t \end{aligned}$$

The firm problem therefore delivers the following system of 4 equations:

$$\begin{aligned} \frac{(1-\alpha)Y_t}{H_t} &= W_t \left[(1-\theta) + \theta R^P_{t-1}\right] \\ \frac{\alpha Y_t}{K_{t-1}} &= R_t \\ Y_t &= A_t K^{\alpha}_{t-1} H_t^{1-\alpha} \\ A_t &\sim CSSP(\bar{A}, \rho_A, \sigma_A) \end{aligned}$$

with the addition of 5 parameters $\{\theta, \alpha, \bar{A}, \rho_A, \sigma_A\}$ and 1 variable (A_t) to the household system.

A.3 Government Budget Constraint

The government budget constraint is given by

$$G_t + T_t = \tau_w W_t H_t + \tau_k R_t K_t + D_t - R^G_{t-1} D_{t-1},$$

where

$$\begin{aligned}
R_t^G &= \xi R_t^* \exp\left(\frac{D_t}{Y_t} - \frac{\bar{D}}{\bar{Y}}\right) \\
R_t^P &= \Gamma R_t^G \\
R_t^* &\sim CSSP(\bar{R}^*, \rho_{R^*}, \sigma_{R^*})
\end{aligned}$$

The specification for government behavior therefore delivers 4 additional equations to the system so far:

$$\begin{aligned}
G_t + T_t &= \tau_w W_t H_t + \tau_k R_t K_t + D_t - R_{t-1}^G D_{t-1} \\
R_t^G &= \xi R_t^* \exp\left(\frac{D_t}{Y_t} - \frac{\bar{D}}{\bar{Y}}\right) \\
R_t^P &= \Gamma R_t^G \\
R_t^* &\sim CSSP(\bar{R}^*, \rho_{R^*}, \sigma_{R^*})
\end{aligned}$$

with the addition of 5 parameters $\{\xi, \Gamma, \bar{R}^*, \rho_{R^*}, \sigma_{R^*}\}$ and 1 variable (R_t^*) to the system given by the household and firm problems.

A.4 The Nonlinear System

Collecting across economic actors, the system of expectational difference equations is

$$\Lambda_t = \frac{\mu}{C_t - \chi C_{t-1} + \zeta G_t} - \frac{\chi\mu}{C_{t+1} - \chi C_t + \zeta G_{t+1}} \tag{N1}$$

$$(1-\tau_w)\Lambda_t W_t = \frac{1-\mu-\varphi_1-\varphi_2}{1-H_t} \tag{N2}$$

$$E_t\left\{\beta\Lambda_{t+1}\left[1-\delta-\frac{\phi}{2}\left[\frac{K_{t+1}}{K_t}-1\right]^2+\frac{\phi K_{t+1}}{K_t}\left[\frac{K_{t+1}}{K_t}-1\right]+(1-\tau_k)R_{t+1}\right]=\Lambda_t\left[1+\phi\left[\frac{K_t}{K_{t-1}}-1\right]\right]\right\} \tag{N3}$$

$$E_t\left\{\beta\Lambda_{t+1}R_t^P = \Lambda_t\left[1+\kappa_1\left[\frac{B_t}{Y_t}-\frac{\bar{B}}{\bar{Y}}\right]\right]-\frac{\varphi_2}{B_t}\right\} \tag{N4}$$

$$E_t\left\{\beta\Lambda_{t+1}R_t^G = \Lambda_t\left[1+\kappa_2\left[\frac{D_t}{Y_t}-\frac{\bar{D}}{\bar{Y}}\right]\right]-\frac{\varphi_1}{D_t}\right\} \tag{N5}$$

$$C_t + K_t - (1-\delta)K_{t-1} + \frac{\phi}{2}K_{t-1}\left[\frac{K_t}{K_{t-1}}-1\right]^2 + B_t + \frac{\kappa_1}{2}Y_t\left[\frac{B_t}{Y_t}-\frac{\bar{B}}{\bar{Y}}\right]^2 + D_t + \frac{\kappa_2}{2}Y_t\left[\frac{D_t}{Y_t}-\frac{\bar{D}}{\bar{Y}}\right]^2 \tag{N6}$$

$$= (1-\tau_w)W_tH_t + (1-\tau_k)R_tK_{t-1} + R_{t-1}^P B_{t-1} + R_{t-1}^G D_{t-1} + T_t$$

$$\frac{(1-\alpha)Y_t}{H_t} = W_t\left[(1-\theta)+\theta R_{t-1}^P\right] \tag{N7}$$

$$\frac{\alpha Y_t}{K_{t-1}} = R_t \tag{N8}$$

$$Y_t = A_t K_{t-1}^{\alpha} H_t^{1-\alpha} \tag{N9}$$

$$G_t + T_t = \tau_w W_t H_t + \tau_k R_t K_t + D_t - R_{t-1}^G D_{t-1} \tag{N10}$$

$$R_t^G = \xi R_t^* \exp\left(\frac{D_t}{Y_t}-\frac{\bar{D}}{\bar{Y}}\right) \tag{N11}$$

$$R_t^P = \Gamma R_t^G \tag{N12}$$

$$G_t \sim CSSP(\bar{G}, \rho_G, \sigma_G) \tag{N13}$$

$$A_t \sim CSSP(\bar{A}, \rho_A, \sigma_A) \tag{N14}$$

$$R_t^* \sim CSSP(\bar{R}^*, \rho_{R^*}, \sigma_{R^*}) \tag{N15}$$

which is a nonlinear system of 15 equations in:

- 25 parameters $\{\beta, \chi, \mu, \zeta, \varphi_1, \varphi_2, \delta, \phi, \kappa_1, \kappa_2, \tau_w, \tau_k, \theta, \alpha, \Gamma, \xi, \bar{G}, \bar{A}, \bar{R}^*, \rho_G, \rho_A, \rho_{R^*}, \sigma_G, \sigma_A, \sigma_{R^*}\}$

and,

- 15 variables $\{C_t, H_t, D_t, K_t, B_t, Y_t, W_t, R_t, R_t^P, R_t^G, T_t, \Lambda_t, G_t, A_t, R_t^*\}$.

A.5 The Nonstochastic Steady State

Assume that the steady state values $\bar{A}$, $\bar{G}$ and $\bar{R}^*$ are in hand, then $\bar{R}^G$ is in hand from equation 11 above:

$$R_t^G = \xi R_t^* \exp\left(\frac{D_t}{Y_t} - \frac{\bar{D}}{\bar{Y}}\right) \rightarrow \bar{R}^G = \xi \bar{R}^*.$$

Equation (3) above yields the expression for $\bar{R}$:

$$E_t \left\{ \begin{array}{c} \beta\Lambda_{t+1}\left[1 - \delta - \frac{\phi}{2}\left[\frac{K_{t+1}}{K_t} - 1\right]^2 + \frac{\phi K_{t+1}}{K_t}\left[\frac{K_{t+1}}{K_t} - 1\right] + (1-\tau_k)R_{t+1}\right] \\ = \Lambda_t\left[1 + \phi\left[\frac{K_t}{K_{t-1}} - 1\right]\right] \end{array} \right\} \rightarrow \bar{R} = \frac{1 - \beta(1-\delta)}{\beta(1-\tau_k)},$$

and finally equation (12) above yields the expression for $\bar{R}^P$:

$$R_t^P = \Gamma R_t^G \rightarrow \bar{R}^P = \Gamma \bar{R}^G$$

The remaining (9) equation system in the steady state is

$$\bar{\Lambda} = \frac{\mu(1-\chi)}{(1-\chi)\bar{C} + \zeta\bar{G}}$$

$$(1-\tau_w)\bar{\Lambda}\bar{W} = \frac{1 - \mu - \varphi_1 - \varphi_2}{1 - \bar{H}}$$

$$\beta\bar{\Lambda}\bar{R}^P = \bar{\Lambda} - \frac{\varphi_2}{\bar{B}}$$

$$\beta\bar{\Lambda}\bar{R}^G = \bar{\Lambda} - \frac{\varphi_1}{\bar{D}}$$

$$\bar{C} + \delta\bar{K} + \bar{B} + (1 - \bar{R}^G)\bar{D} = (1-\tau_w)\bar{W}\bar{H} + (1-\tau_k)\bar{R}\bar{K} + \bar{R}^P\bar{B} + \bar{T}$$

$$\frac{(1-\alpha)\bar{Y}}{(1-\theta+\theta\bar{R}^P)\bar{H}} = \bar{W} \leftrightarrow \frac{\bar{W}\bar{H}}{\bar{Y}} = \frac{1-\alpha}{1-\theta+\theta\bar{R}^P}$$

$$\frac{\alpha\bar{Y}}{\bar{K}} = \bar{R}$$

$$\bar{Y} = \bar{A}\bar{K}^\alpha\bar{H}^{1-\alpha}$$

$$\bar{G} + \bar{T} = \tau_w\bar{W}\bar{H} + \tau_k\bar{R}\bar{K} + \bar{D} - \bar{R}^G\bar{D}$$

from which we need to determine the steady state values for C_t, H_t, D_t, K_t, Y_t, W_t, T_t, B_t and Λ_t. Combining the 5^{th} and 9^{th} equations in the above system eliminates

$$\bar{T} = \tau_w \bar{W}\bar{H} + \tau_k \bar{R}\bar{K} + \bar{D} - \bar{R}^G \bar{D} - \bar{G}$$

and yields

$$\begin{aligned}
\bar{\Lambda} &= \frac{\mu(1-\chi)}{(1-\chi)\bar{C} + \zeta\bar{G}} \\
(1-\tau_w)\bar{\Lambda}\bar{W} &= \frac{1-\mu-\varphi_1-\varphi_2}{1-\bar{H}} \\
\bar{\Lambda} &= \frac{\varphi_2}{\bar{B}(1-\beta\bar{R}^P)} \\
\bar{D} &= \frac{\varphi_1}{(\bar{\Lambda}-\beta\bar{\Lambda}\bar{R}^G)} \\
\bar{G} + (1-\bar{R}^P)\bar{B} &= \bar{W}\bar{H} + (\bar{R}-\delta)\bar{K} - \bar{C} \\
\bar{W} &= \frac{(1-\alpha)\bar{Y}}{(1-\theta+\theta\bar{R}^P)\bar{H}} \\
\frac{\alpha\bar{Y}}{\bar{K}} &= \bar{R} \\
\bar{Y} &= \bar{A}\bar{K}^\alpha \bar{H}^{1-\alpha}
\end{aligned}$$

Next, we can eliminate $\bar{K} = \alpha\frac{\bar{Y}}{\bar{R}}$

$$\bar{Y} = \bar{A}\left(\alpha\frac{\bar{Y}}{\bar{R}}\right)^\alpha \bar{H}^{1-\alpha} \tag{18}$$

$$\bar{Y} = \left(\bar{A}\left(\frac{\alpha}{\bar{R}}\right)^\alpha\right)^{\frac{1}{1-\alpha}} \bar{H} \tag{19}$$

$$\bar{Y} = \vartheta_1\bar{H}, \;\; \vartheta_1 = \left(\bar{A}\left(\frac{\alpha}{\bar{R}}\right)^\alpha\right)^{\frac{1}{1-\alpha}} \tag{20}$$

yielding

$$
\begin{aligned}
\bar{\Lambda} &= \frac{\mu(1-\chi)}{(1-\chi)\bar{C}+\zeta\bar{G}} \\
(1-\tau_w)\bar{\Lambda}\bar{W} &= \frac{1-\mu-\varphi_1-\varphi_2}{1-\bar{H}} \\
\bar{\Lambda} &= \frac{\varphi_2}{\bar{B}(1-\beta\bar{R}^P)} \\
\bar{D} &= \frac{\varphi_1}{(\bar{\Lambda}-\beta\bar{\Lambda}\bar{R}^G)} \\
\bar{G}+(1-\bar{R}^P)\bar{B} &= \bar{W}\bar{H}+(\bar{R}-\delta)\bar{K}-\bar{C} \\
\bar{W} &= \frac{(1-\alpha)\vartheta_1}{(1-\theta+\theta\bar{R}^P)} = \vartheta_2
\end{aligned}
$$

Then letting $\vartheta_3 = 1-\mu-\varphi_1-\varphi_2$

$$
\begin{aligned}
\bar{C} &= \frac{\mu}{\bar{\Lambda}} - \frac{\zeta\bar{G}}{1-\chi} \\
\bar{H} &= \frac{(1-\tau_w)\vartheta_2\bar{\Lambda}-\vartheta_3}{(1-\tau_w)\vartheta_2\bar{\Lambda}} \\
\bar{B} &= \frac{(1-\beta\bar{R}^P)}{\varphi_2}\bar{\Lambda} \\
\bar{D} &= \frac{(1-\beta\bar{R}^G)}{\varphi_1}\bar{\Lambda} \\
\vartheta_6\bar{\Lambda}^2-\vartheta_5\bar{\Lambda}+\vartheta_4 &= 0 \\
\bar{\Lambda} &= \frac{\vartheta_5 \pm \sqrt{\vartheta_5^2-4\vartheta_4\vartheta_6}}{2\vartheta_6} \\
\vartheta_4 &= \bar{R}\vartheta_2(1-\chi)\varphi_2\vartheta_3+(1-\chi)\varphi_2(\bar{R}-\delta)\alpha\vartheta_1\vartheta_3+\bar{R}\vartheta_2\mu(1-\tau_w)(1-\chi)\varphi_2 \\
\vartheta_5 &= \left[\begin{array}{c} \bar{R}\vartheta_2(1-\chi)\varphi_2\vartheta_2(1-\tau_w)+(1-\chi)\varphi_2(\bar{R}-\delta)\alpha\vartheta_1(1-\tau_w)\vartheta_2 \\ +\bar{R}\vartheta_2(1-\tau_w)\varphi_2\zeta\bar{G}-\bar{R}\vartheta_2(1-\tau_w)(1-\chi)\varphi_2\bar{G} \end{array}\right] \\
\vartheta_6 &= \bar{R}\vartheta_2(1-\tau_w)(1-\chi)(1-\bar{R}^P)(1-\beta\bar{R}^P).
\end{aligned}
$$

Figures

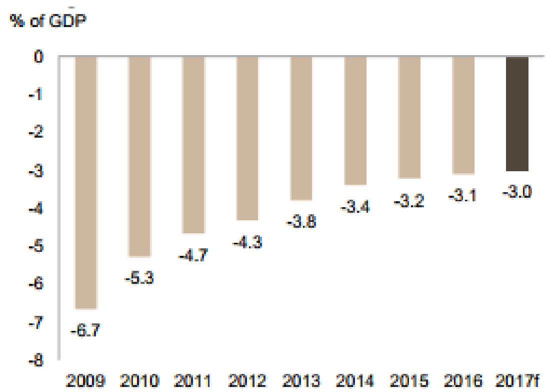

Figure 1. Fiscal Deficit as % of GDP in Malaysia.

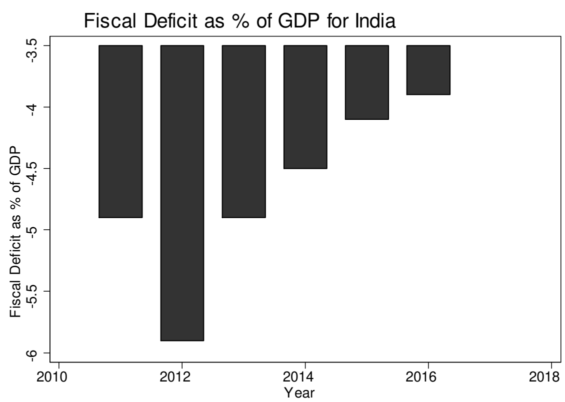

Figure 2. Fiscal Deficit as % of GDP in India.

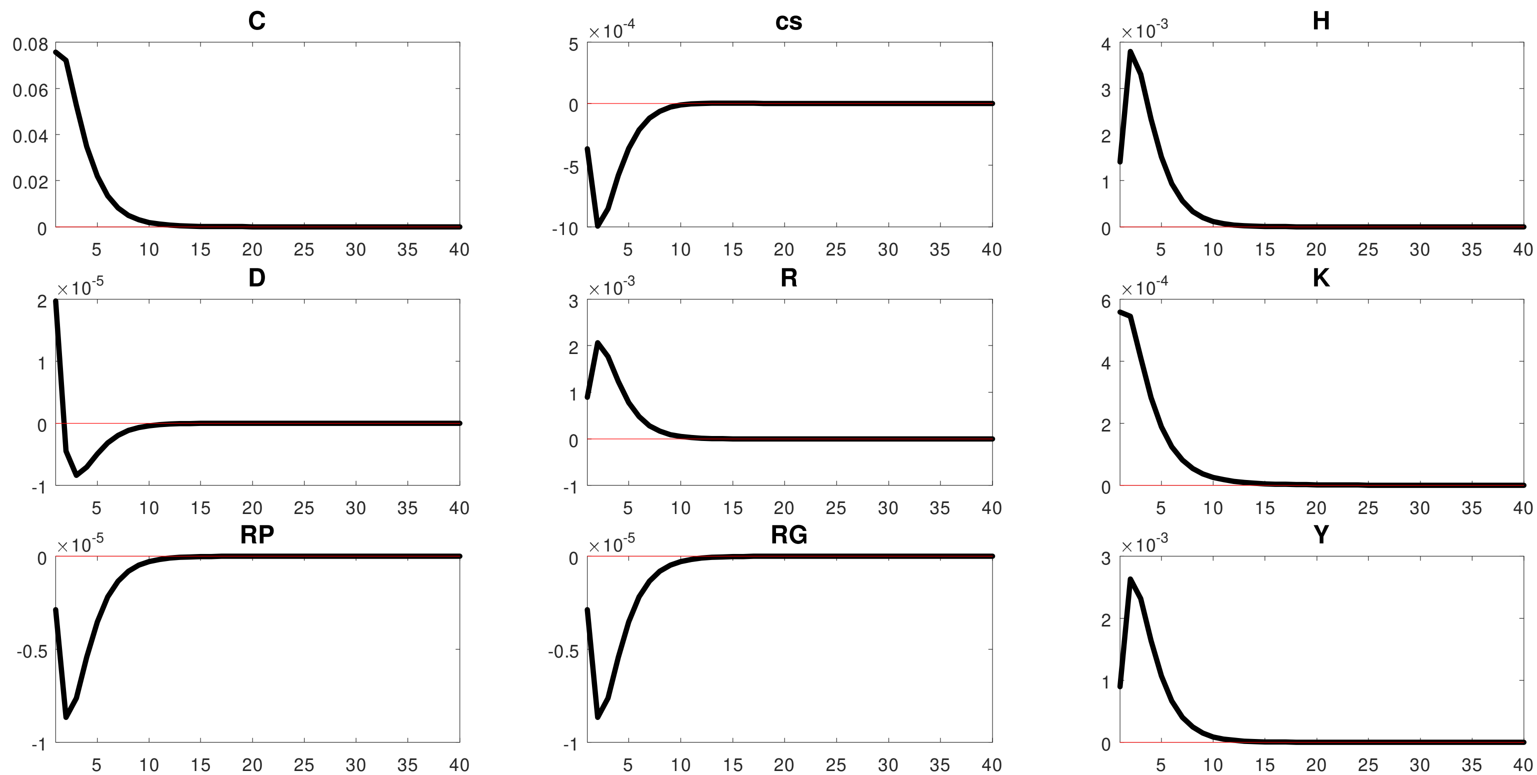

Figure 3: Impulse responses for a single period $\widehat{G}$ shock

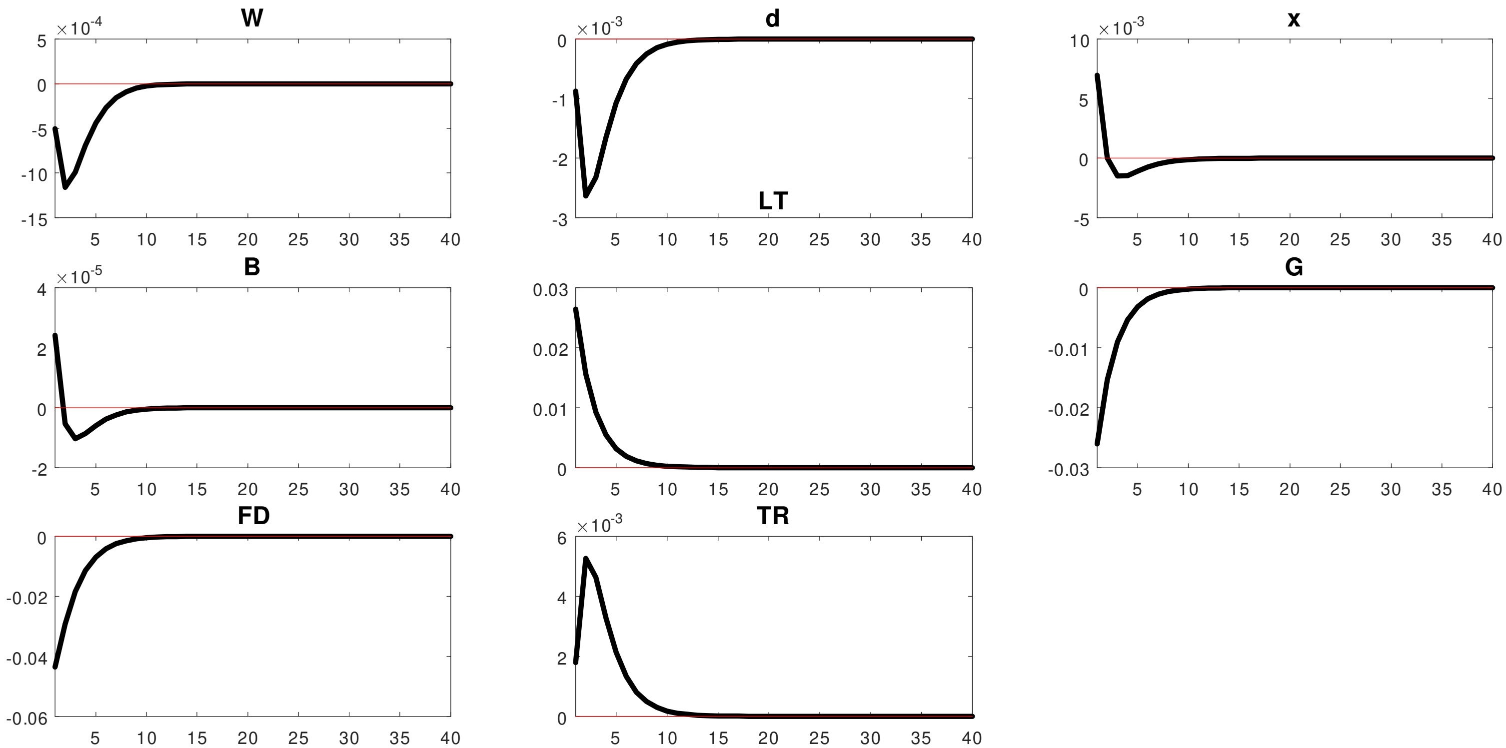

Figure 3: Impulse responses for a single period $\widehat{G}$ shock

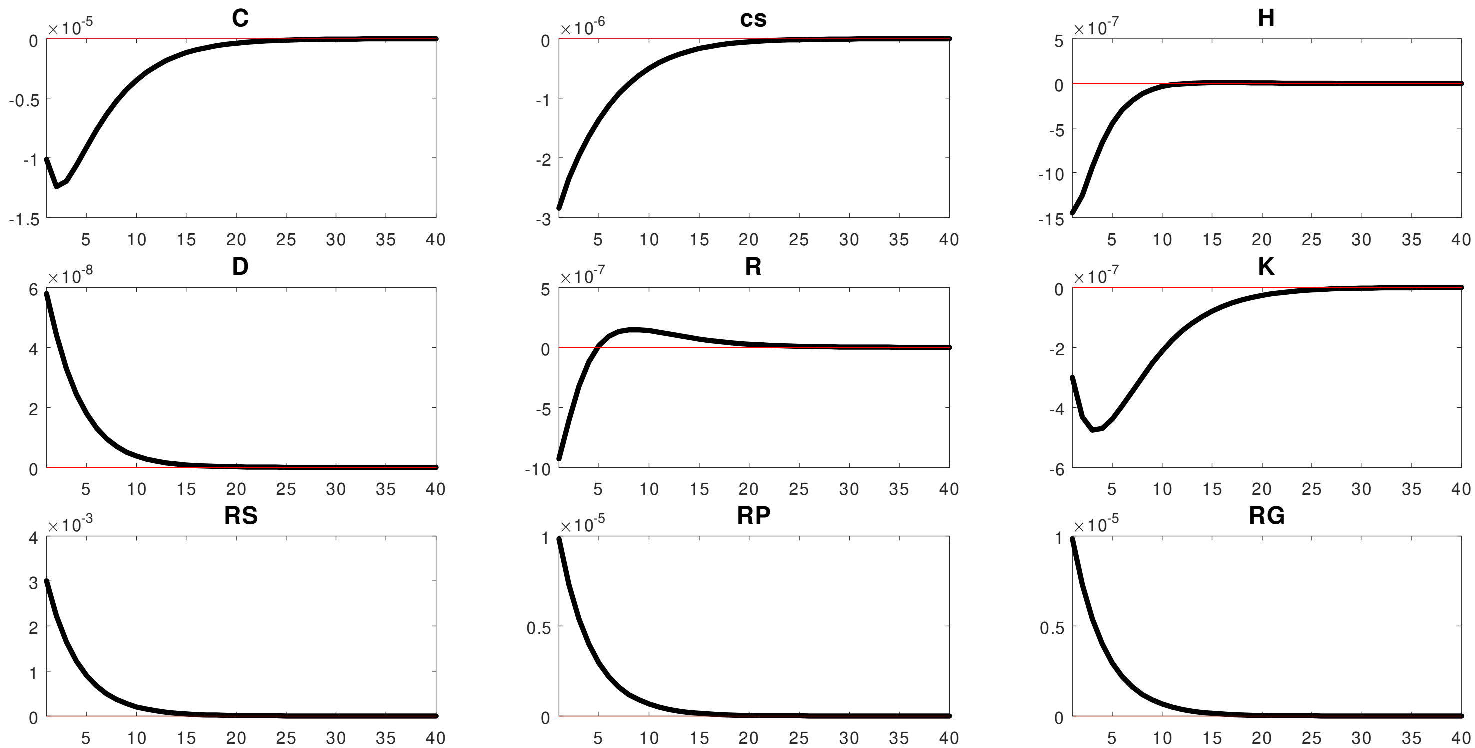

Figure 4: Impulse responses for a single period $\widehat{R}^*$ shock

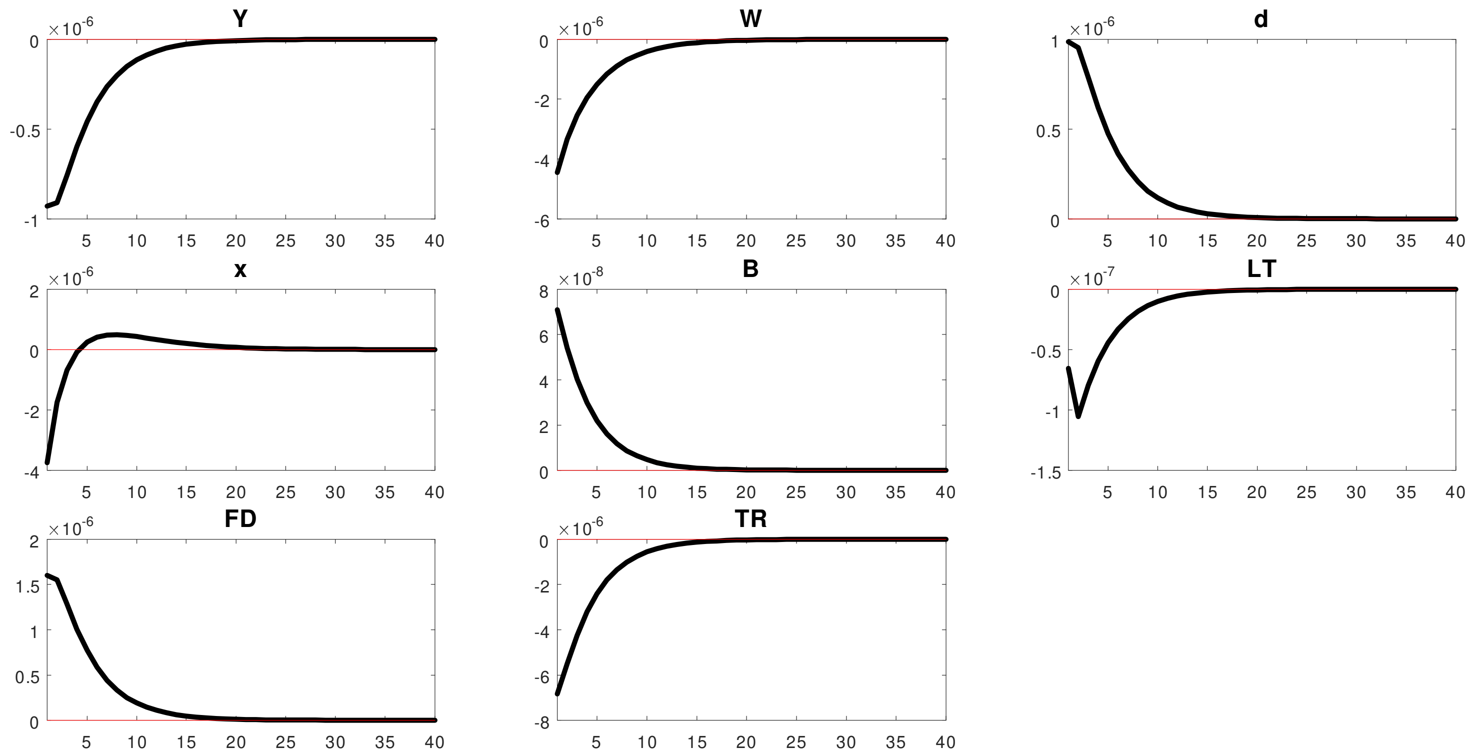

Figure 4: Impulse responses for a single period $\widehat{R}^*$ shock

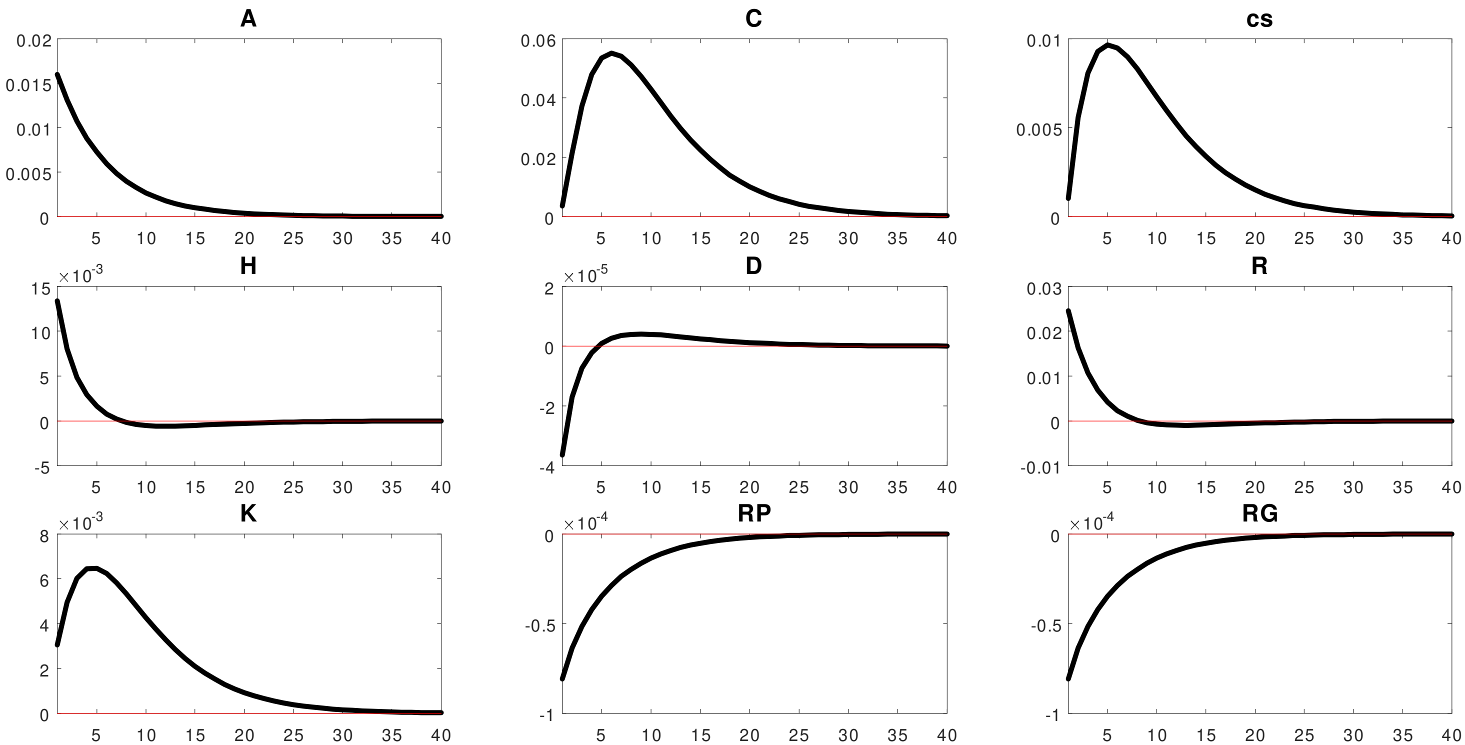

Figure 5: Impulse responses for a single period $\widehat{A}$ shock

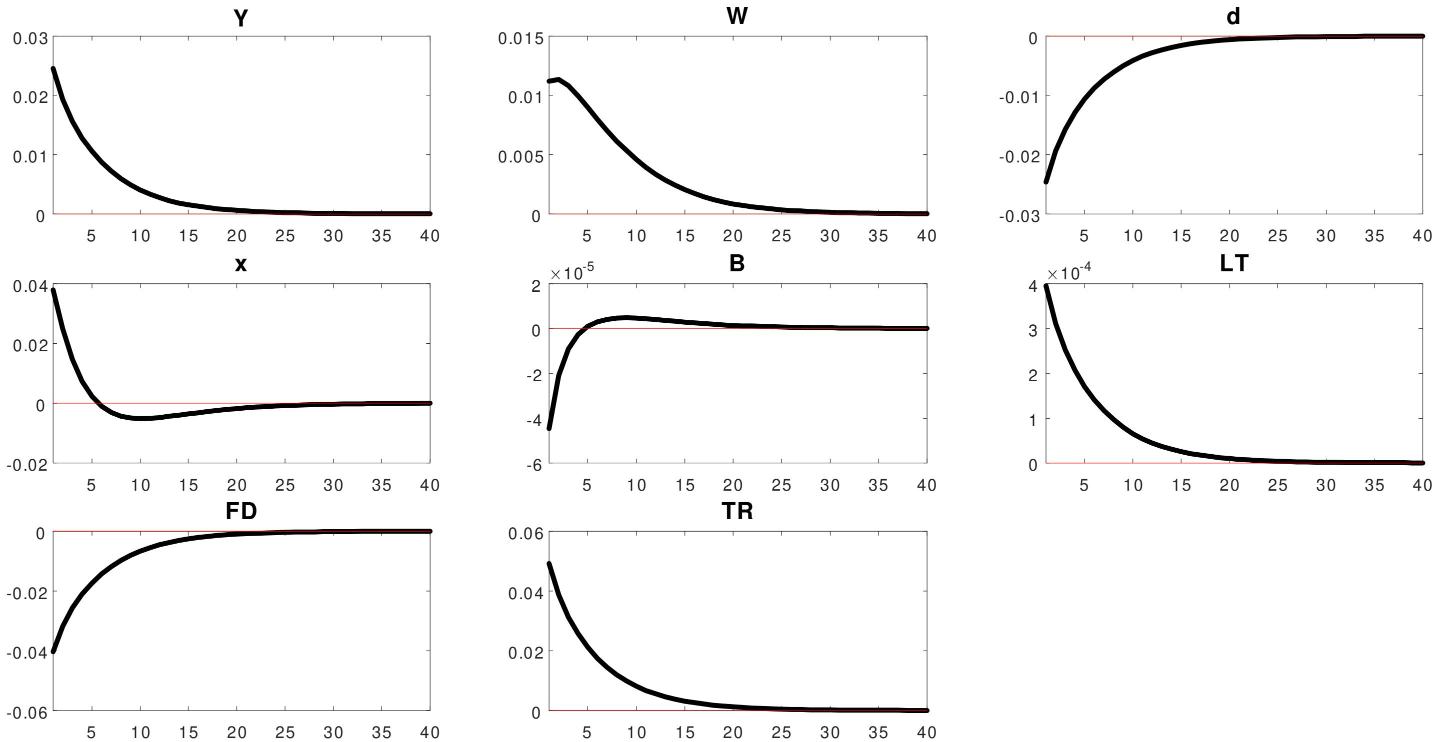

Figure 5: Impulse responses for a single period $\widehat{A}$ shock

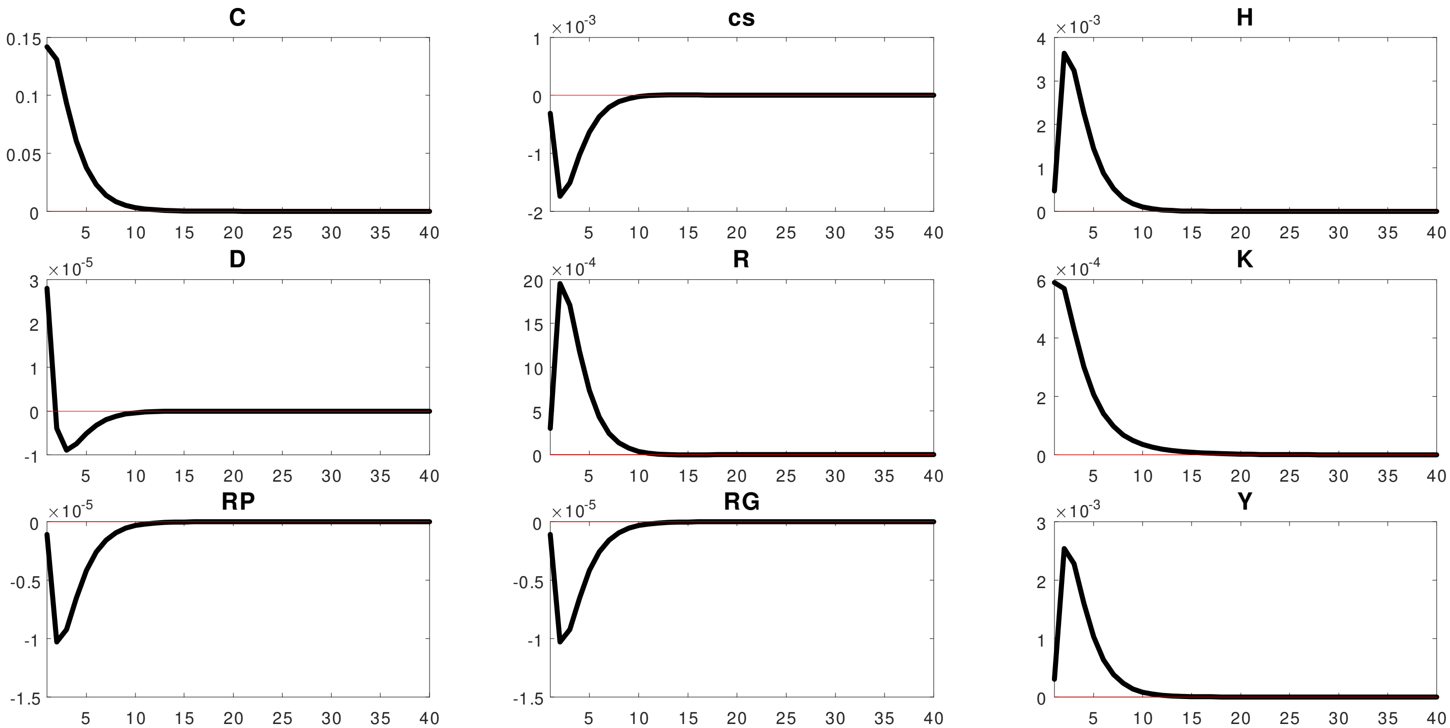

Figure 6a: Impulse responses for a single period $\widehat{G}$ shock for $\zeta = 0.8$, and $\tau_w = \tau_k = 0.1$

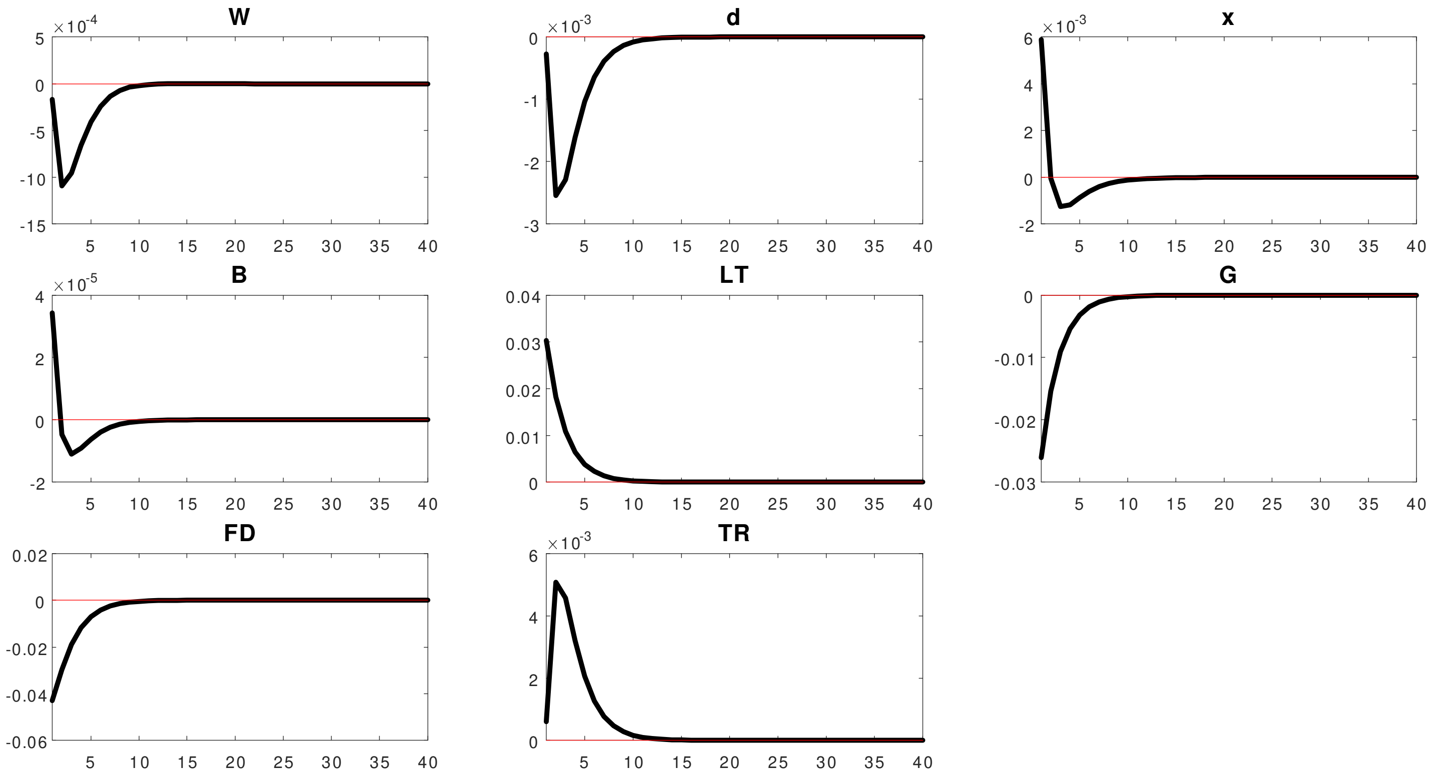

Figure 6a: Impulse responses for a single period $\widehat{G}$ shock for $\zeta = 0.8$, and $\tau_w = \tau_k = 0.1$

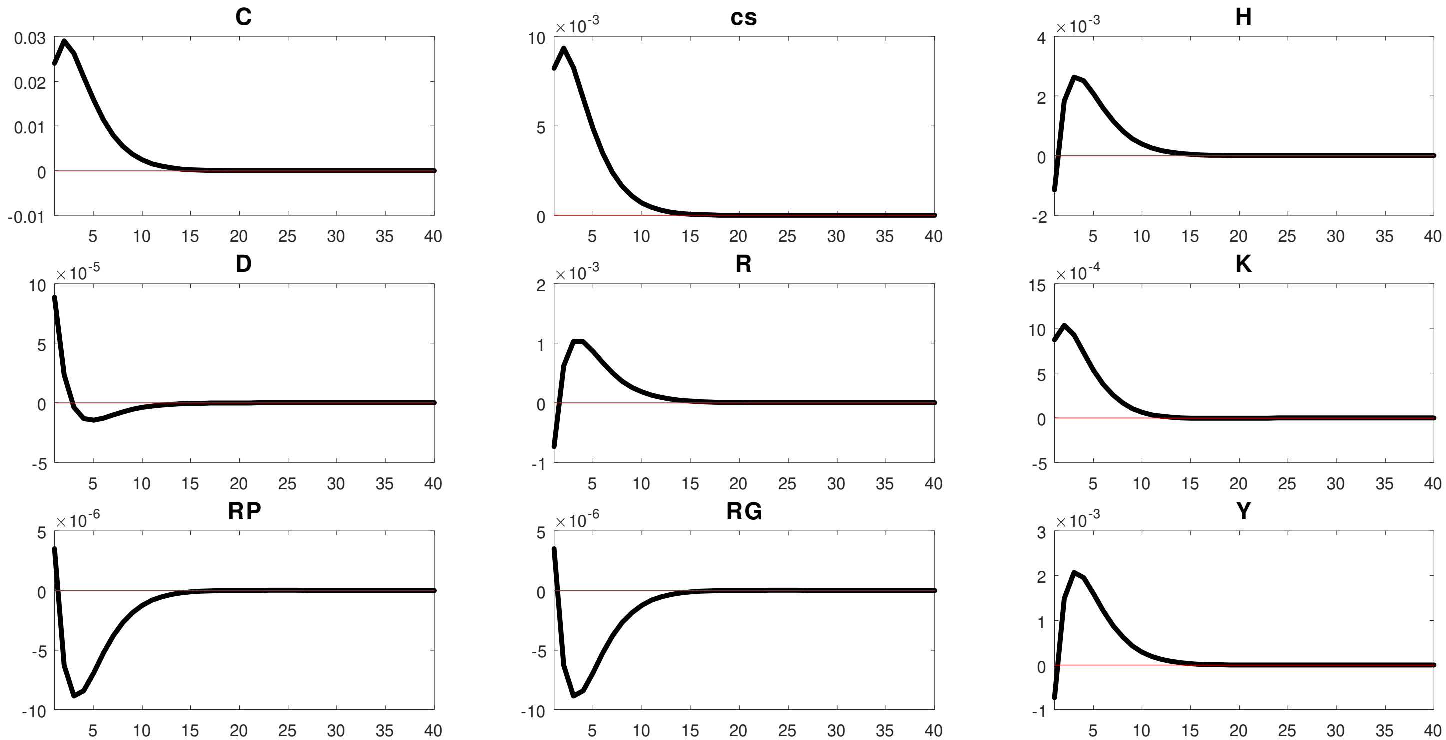

Figure 6b: Impulse responses for a single period $\widehat{G}$ shock for $\zeta = 0.3$, and $\tau_w = \tau_k = 0.1$

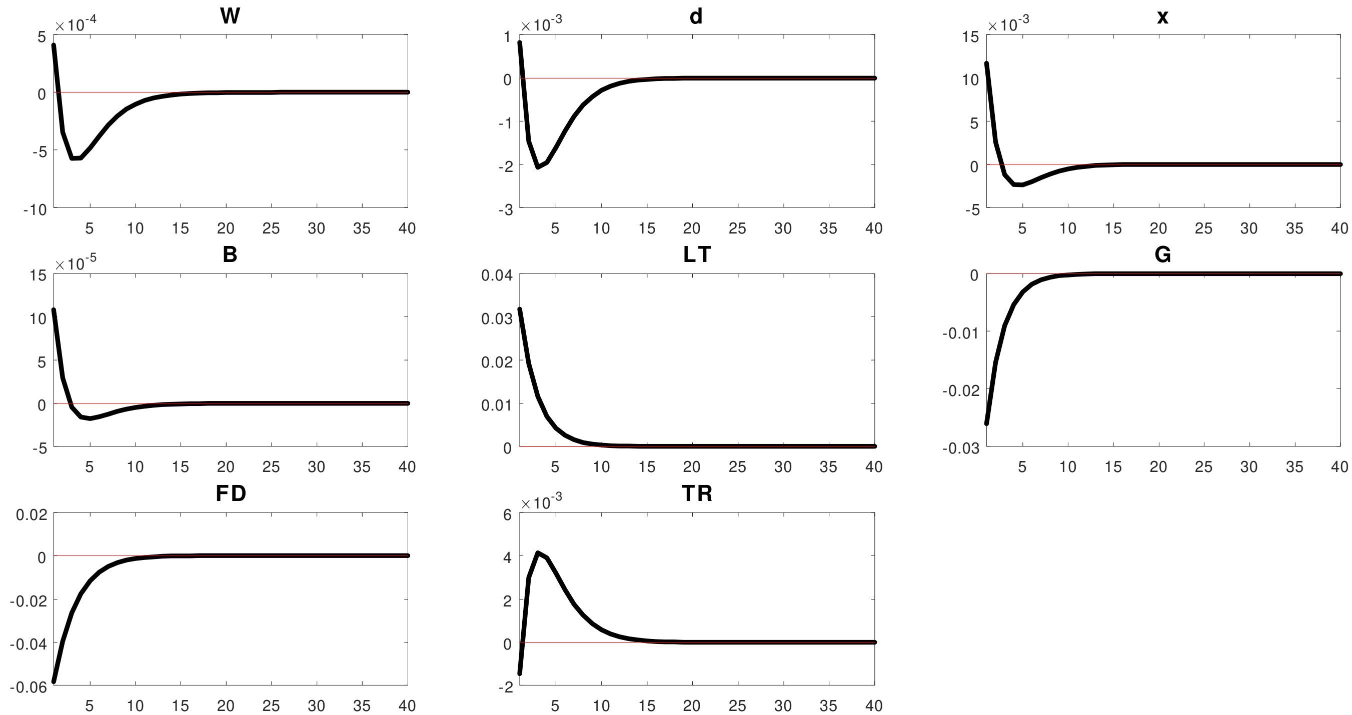

Figure 6b: Impulse responses for a single period $\widehat{G}$ shock for $\zeta = 0.3$, and $\tau_w = \tau_k = 0.1$