

RESEARCH ARTICLE

The Role of Fiscal Policy in a Natural Disaster-Prone Economy

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Abstract: Theoretical work done on the macroeconomic impact of natural disasters has neglected the role of fiscal policy in stabilizing other sectors of the economy. Although inclusion of a public sector with a fiscal authority in macroeconomic models is common in the literature, most of these models assume that government expenditures are unproductive in that they do not accrue to anyone but the government. In reality, for a model that incorporates natural disaster and foreign aid, having a productive fiscal authority that produces public goods and services, as well as infrastructure, is necessary to capture the real effects of foreign aid in alleviating the adverse effects of natural disaster to an economy. The study has found that fiscal policy can address the long-term real effects of a natural disaster shock to household consumption.

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JEL Classifications: E32, E37, E52, E58

Previous theoretical macroeconomic studies on the effect of natural disasters have so far examined a small open economy with the assumption that government expenditures are unproductive (see Keen & Pakko, 2011; Lim, 2017). However, such an assumption is unrealistic under the context of natural disaster, where the government engages in recovery and rehabilitation efforts to alleviate those in affected areas. In addition, Lim (2017) has also indicated that monetary policy alone cannot mitigate the long-term effect of a natural disaster on household consumption. The objective of this paper is to expand the role of fiscal policy by allowing government expenditures to have productive¹ use, which benefits the private sector in the small open economy.

Productive Government Expenditures

Much of the literature focusing on the effects of fiscal policy considers government expenditures as consisting entirely of unproductive expenditure on goods, overlooking the benefits of government spending on society. Such benefits often come in the form of public goods and services that, because of market failure, are not readily provided by the private sector markets, and are instead provided by the public sector. Government spending on public goods and services can be broadly divided into two categories according to the roles they play in the economy: household utility-enhancing public goods, as initially developed by Baxter and King (1993),

and productivity-enhancing government investments, introduced by Barro (1990). This paper extends the analysis made from previous studies by incorporating both types of public goods and services to a small open economy DSGE model. Similar to Christiano, Eichenbaum, and Rebelo (2011), household utility-enhancing public goods is assumed to enter the household lifetime expected utility function in an additively separable manner, as follows

$$\mathbb{E}_t \sum_{s=0}^{\infty} \beta^{t+s} \left[\ln C_{t+s} - \frac{\vartheta}{1+\psi} (L_{t+s})^{1+\psi} + \frac{1}{1-\eta} \left(\frac{M_{t+s}(j)}{P_{t+s}} \right)^{1-\eta} + \frac{\Xi}{1-\xi} (G_{t+s}^U)^{1-\xi} \right] \quad (1)$$

where, C_{t+s} , L_{t+s} , and M_{t+s}/P_{t+s} are household consumption, labor, and real money holdings, respectively; β is the discount parameter of the household; Ξ is the preference parameter of the household to utility-enhancing public goods; and ξ measures the relative importance of public goods to household utility. Conveniently, the additively separable specification for G_t^U does not change the other necessary first-order conditions derived from Lim (2007). The optimal level of G_t^U is determined by setting marginal utility of G_t^U equal to the marginal utility of consumption, given as

$$\Xi C_t = (G_t^U)^{-\xi} \quad (2)$$

which characterizes household demand for public goods and services. Following Carvalho and Martins (2011), public goods and services provided freely by the public sector also enhance productivity in the domestic intermediate goods market. The production of domestic intermediate good is determined by the following production function²:

$$Y_t^d = Z_t (G_t^y)^\chi (K_t')^\alpha L_t^{1-\alpha} \quad (3)$$

where G_t^y is the undisrupted productivity-enhancing public goods and the parameter $\chi \in [0,1]$ measures the influence of public goods on intermediate goods production.

As in Carvalho and Martins (2011), government expenditures on productivity-enhancing public goods is assumed to evolve exogenously according to an AR(1) process. The domestic firm still faces constant returns to scale in the two private factors and increasing returns to scale in all three factors of production due to the positive externality of public goods and services. Demand for private factors is unaffected by

the inclusion of G_t^y ; however, the marginal cost of production is now given by

$$\Psi_t' = \frac{1}{Z_t (G_t^y)^\chi} \frac{R_t^\alpha W_t^{1-\alpha}}{(1-\alpha)^{1-\alpha} \alpha^\alpha} \quad (4)$$

The public sector is still assumed to finance its expenditures on public goods and services. Hence, the market clearing condition in the market for public goods and services is given by

$$G_t = G_t^U + G_t^Y \quad (5)$$

where G_t^y is productivity-enhancing public goods.

To synergize the literature of productive government expenditures with the DSGE literature on natural disasters, productivity-enhancing public goods, such as government infrastructures and basic government services, are assumed to be disrupted during periods of calamity such that

$$\tilde{G}_t^y = \tilde{G}_t^Y - \gamma \tilde{D}_t \quad (6)$$

where measures the elasticity of productivity-enhancing public goods to natural disasters. Similar to Lim (2017), the fiscal policy rule is governed by equation $P_t G_t = PG + (e_t A_t - eA)$. Therefore, in the aftermath of a natural disaster, the surge of foreign aid increases both categories of productive government expenditures. This reflects the foreign aid funded recovery and rehabilitation efforts of the Philippine government following a major calamity.

Policy Simulations

Having detailed the expanded role of fiscal policy, this paper aims to evaluate the findings of Lim (2017).

Two simulations have been undertaken in the study: one with the assumption of unproductive government expenditure, and another where government expenditure is assumed to be productive. In addition, Lim (2017) has found that the optimal monetary policy under a natural disaster shock is one with open-economy considerations, such as a foreign exchange intervention; hence, this study follows this type of monetary policy response when conducting simulation exercises. Calibration for the preexisting structural parameters remain essentially the same as established in Lim (2017). For the parameters involved with productive government expenditures, the study follows the values set by Christiano et al. (2011) and Carvalho and Martins (2011). Table 1 summarizes the public sector related parameter values used in the simulation exercises conducted within the study.

The simulated responses of the same macroeconomic indicators to an unanticipated natural disaster shock are

presented in Figure 1, where dashed lines represent impulse responses with productive government expenditure and solid lines represent the case wherein government expenditures are unproductive.³ From Figure 1, the economy contracts, as expected, following a natural disaster shock, as seen by the fall in the final aggregate output, and aggregate household consumption and labor. The responses of inflation, exchange rate, and the interest rate remain the same as those from Lim (2017), where the recommended policy response to natural disaster is an expansionary monetary policy. As discussed in Lim (2017), lowering the interest rate not only leads to expansionary output production but also insulates the domestic currency from Dutch disease effects, such as an appreciation due to an increase in foreign aid received by the country.

Figure 1 also indicates that the assumption of productive government expenditures enables consumption to converge close to its steady state; while

Table 1
Parameter Calibration

Parameter	Symbol	Value
Household Preference for Public Goods	Ξ	1.50
Household Public Goods Elasticity	ξ	2.00
Share of Public Goods to Production	χ	0.15
Disaster Elasticity to Public Goods	γ	1.00

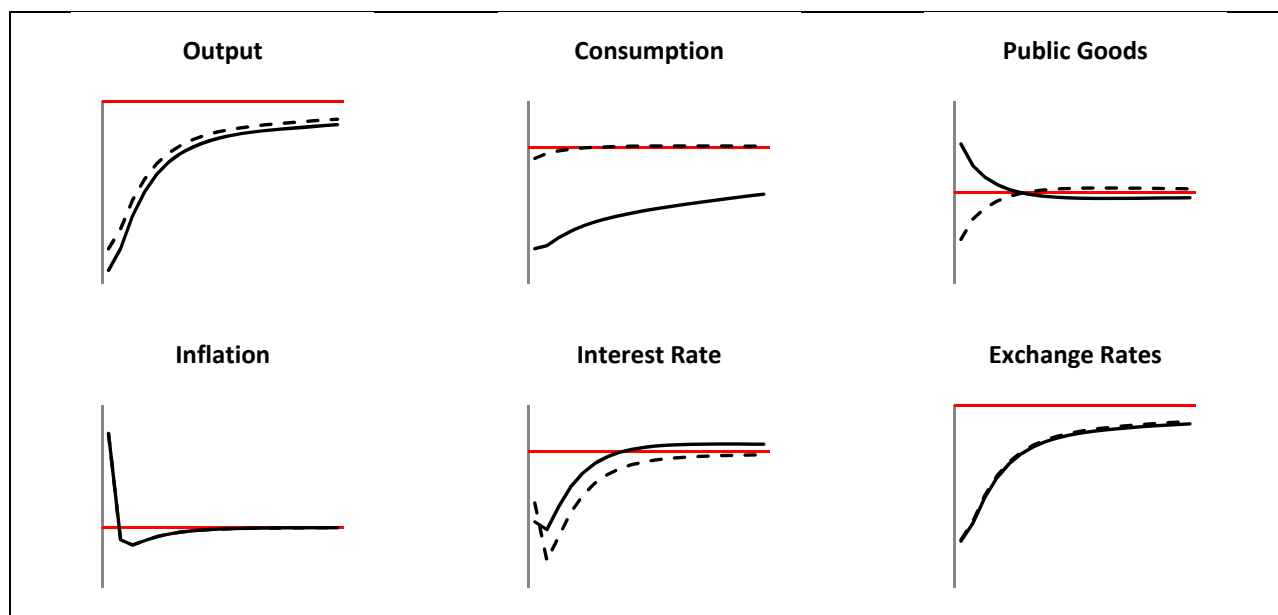


Figure 1. Impulse response function graphs for natural disaster shocks

in the unproductive case, we see that consumption remains below its initial steady state value. In contrast to Lim (2007), the level of public goods also falls at the onset of the natural disaster emulating the reported damages to public infrastructures, such as roads and bridges, which disrupt economic activity following a major calamity. However, the level of public goods converges back to its steady state due to the foreign aid funded rehabilitation accrued to households and productive sectors of the economy. This is the mechanism that allows the aggregate household consumption to go back to its pre-disaster levels and eventually show the benefits of humanitarian aid provided by foreign nations to the affected communities.

Concluding Remarks

This study has extended the role of fiscal policy in a natural disaster-prone economy by allowing government expenditures to be productive. Further assumptions made are connecting foreign aid from the public sector to the private sector through utility-enhancing public goods, as well as the assumption that natural disasters also negatively affect or disrupt the flow of public goods to the private sector. Allowing government expenditures to benefit the households and domestic production provides a more realistic nature to the small open economy DSGE model developed in Lim (2017) and connects the foreign aid received from the foreign sector to the private sector. Thus, this fiscal policy mechanism is able to address the long-term real effects of a natural disaster shock to household consumption.

Endnotes

¹ For a detailed survey of the literature on productive government expenditures, see Irmen and Kuehnel (2009).

² Although in most papers, such as Baxter and King (1993) and Leeper, Walker, and Yang (2010), productive government spending appears as an incremental investment in a stock of public capital, Roulleau-Pasdeloup (2013) has shown that the dynamics of the model under a flow of productivity-enhancing public goods can be a good approximation to the ones that would be obtained in a model with a stock of public capital.

³ Impulse response graphs generated with unproductive government expenditure are obtained by setting the parameter values in Table 1 all to zero.

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