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The Fiscal Multiplier and Spillover in a Global Liquidity Trap*

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Abstract

We consider the fiscal multiplier and spillover in an environment in which two countries are caught simultaneously in a liquidity trap. Using an optimizing two-country sticky price model, we show that the fiscal multiplier and spillover are contrary to those predicted in textbook economics. For the country with government expenditure, the fiscal multiplier exceeds one, the currency depreciates, and the terms of trade worsen. The fiscal spillover is negative if the intertemporal elasticity of substitution in consumption is less than one and positive if the parameter is greater than one. Incomplete stabilization of marginal costs due to the existence of the zero lower bound is a crucial factor in understanding the effects of fiscal policy in open economies.

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1 Introduction

The liquidity trap has become an issue of global concern. The economic downturn following the financial turmoil that first began to emerge in 2007 has resulted in monetary policy with virtually a zero lower bound on nominal interest rates simultaneously in a number of countries, including Japan, the United Kingdom, and the United States. As a result, many countries are attempting to stimulate aggregate demand and production via fiscal expansion.

In this paper, we theoretically investigate the effects of fiscal policy in which two countries are caught simultaneously in a liquidity trap, and compare the results with that under normal circumstances. Using a standard two-country sticky price model, we analyze the fiscal multiplier—the extent to which one country's government expenditure increases production in that country—and the fiscal spillover—the extent to which one country's government expenditure boosts production in the other country. We examine whether fiscal expansion yields a beggar-thy-neighbor situation.

According to textbook economics, fiscal expansion under flexible exchange rates is ineffective, because of the following mechanism (Dornbusch, Fisher, and Startz, 2008). In the Mundell-Fleming model (Mundell, 1967), where the economy is characterized by flexible exchange rates, fixed domestic prices, and perfect capital mobility, fiscal expansion builds up upward pressure on interest rates in the home country. Subsequently, the exchange rate appreciates. That offsets the increase in demand for home-produced goods by crowding out exports. Such conventional wisdom, however, may be overturned in a liquidity trap. This is because in the liquidity trap, nominal interest rates are kept low despite fiscal expansion. Low interest rates prevent the exchange rate from appreciating. The economic activity in the home country is thus stimulated rather than dampened.

Using a standard two-country sticky price model, we demonstrate that the size of multipliers and the sign (positive or negative) associated with the spillover are contrary to those predicted in textbook economics, without the zero lower bound, and under flexible price equilibrium. In a global liquidity trap, the fiscal multiplier exceeds one. The country with government expenditure finds that its currency depreciates and its terms of trade

worsen. That induces an increase in employment and therefore output. The fiscal spillover is negative if the intertemporal elasticity of substitution in consumption is less than one and positive if the parameter is greater than one.

Incomplete stabilization of marginal costs due to the existence of the zero lower bound is a crucial factor in understanding the effects of fiscal policy in open economies. Thanks to this, government spending in the home country raises the marginal costs of home-produced goods, which increases expected inflation rates and decreases real interest rates. Intertemporal optimization causes consumption to increase, so that the fiscal multiplier exceeds one. While government spending continues, the price of home-produced goods increases more than that of foreign-produced goods. Expecting that two countries are at symmetric equilibrium when government spending ends, the home currency depreciates and the home terms of trade worsen on impact when government spending begins. That shifts demand for goods from foreign-produced goods to home-produced ones. The fiscal spillover thus may become negative depending on the intertemporal elasticity of substitution in consumption.

Reflecting Japan's experience around 2000 as well as the global financial crisis that began in the summer of 2007, several studies analyze the role of fiscal policy in a liquidity trap. Christiano (2004) demonstrates that the fiscal multiplier exceeds one in the presence of the zero lower bound.[1] A number of papers have examined his results using richer frameworks with nonlinearity, different monetary policy, and/or various shocks and policy measures.[2] Our model does not deal with some of their developments, but instead the fiscal multiplier and spillover in a global liquidity trap, which have not been studied in the

[1] Regarding monetary policy, Fujiwara, Nakajima, Sudo, and Teranishi (2009) investigate the optimal monetary policy when two countries are simultaneously caught in a liquidity trap in the form of a commitment policy. For a closed economy model, see also Reifschneider and Williams (2000), Kato and Nishiyama (2005), Eggertsson and Woodford (2003), Jung, Teranishi, and Watanabe (2005), Adam and Billi (2006, 2007), and Nakov (2008). For an extension to an open economy model, see Svensson (2001, 2003), Coenen and Wieland (2003), and Nakajima (2008).

In relation to the fiscal theory of the price level, see Benhabib, Schmitt-Grohe, and Uribe (2002) and Iwamura, Kudo, and Watanabe (2005).

[2] See Bodenstien, Erceg, and Guerrieri (2009), Braun (2009), Christiano, Eichenbaum, and Rebelo (2009), Eggertsson (2009), and Woodford (2010).

previous literature.

Recently, Corsetti, Meier, and Muller (2009) and Freedman, Kumhof, Laxton, and Lee (2009) evaluate the fiscal multiplier and spillover in a similar context. Their analyses suggest that a low interest rate environment is the key to yielding a greater fiscal multiplier and changing the sign associated with the fiscal spillover. Their models are, however, not strictly a model of a zero lower bound on nominal interest rates, and the method of maintaining low interest rates seems controversial. For example, Corsetti, Meier, and Muller (2009) establish a low interest rate environment by proposing a fiscal expansion policy that is followed by a reduction in spending over time. Our setup of considering a low interest rate environment by means of the zero lower bound is natural, and the bound is now realized. Moreover, while their analysis is numerical, we can show analytically the degree of the fiscal multiplier and the sign of the spillover. It helps us understand the underlying mechanism and determine the sensitivity of our results to the intertemporal elasticity of substitution in consumption.[3]

The structure of the paper is as follows. Section 2 introduces a standard two-country sticky price model. In Section 3, we analyze the fiscal multiplier and spillover without the presence of the zero lower bound. In Section 4, we analyze the fiscal multiplier and spillover in the presence of the zero lower bound. Section 5 concludes.

2 Model

2.1 Model Setup

Our two-country sticky price model is a conventional one, similar to that used in Clarida, Gali, and Gertler (2002), Benigno and Benigno (2003), and Fujiwara, Nakajima, Sudo, and Teranishi (2009). The economy consists of a home country H and a foreign country F. Labor is not mobile and it is used to produce a continuum of differentiated goods on the unit intervals $[0, 1]$ in both countries.

[3] A number of empirical studies also exist regarding the international as well as the domestic transmission of fiscal shocks (e.g., Perotti (2007), Corsetti and Muller (2008), Kim and Roubini (2008), and Feyrer and Shambaugh (2009)). In the international context, questions are related to whether we observe twin deficits: budget deficits and current account deficits, and their empirical results are mixed.

Regarding a representative household, consumption indices in both countries represent bundles of differentiated home-produced goods and foreign-produced goods. We denote the weight for the bundle of home-produced goods by n and for foreign-produced goods by $1-n$. We can use n to interpret as the relative size of the home country. The intratemporal elasticity of substitution between home and foreign goods is one. Household preferences are governed by factors common to the two countries: discount factor $0 < \beta_t < 1$, the inverse of the intertemporal elasticity of substitution in consumption σ, and the Frisch elasticity of labor supply ω. The discount factor is stochastic and is the origin of the liquidity trap. We call this natural rate shock.[4]

Regarding firms, Y and Y^* represent the production of a good that is produced by representative competing firms in the home country and the foreign country, respectively. An intermediate good is produced by a continuous number of monopolists using labor. Each monopolist maximizes its profits subject to its demand curve and the Calvo-type price friction where θ is the probability that the monopolist cannot reoptimize its price. We assume producer currency pricing and the law of one price. We denote the aggregate price (inflation rate) of domestic goods and foreign goods as P_H (π_H) and P_F^* (π_F^*), respectively. S_t represents a nominal exchange rate denoting the number of home currency units per unit of foreign currency.

For monetary policy, following Christiano (2004), we assume that domestic and foreign central banks conduct an optimal discretionary policy to stabilize inflation. i_H and i_F indicate nominal interest rates in the home country and in the foreign country, respectively.

Finally, for fiscal policy, G represents government expenditure in the home country and g_y represents the steady state ratio of government expenditure to output. The government buys only domestic goods. It yields the deviation of the terms of trade from its steady-state level.[5]

A detailed formulation is shown in the Appendix.

[4] Here, we are following Christiano (2004) and Christiano, Eichenbaum, and Rebelo (2009).

[5] For simplicity, we neglect government expenditure in the foreign country. Given symmetry, it is straightforward to analyze this, except for the size of home country n. The effect of government expenditure in both countries can be analyzed easily, too, by summing the effect of government expenditure in the home country and that in the foreign country, as long as the first-order approximation holds.

2.2 Linearized System of Equations

Using the above setup, we can derive the log-linearlized system of equations with respect to the four variables of $\hat{Y}$, $\hat{Y}^*$, $\hat{\pi}_H$, and $\hat{\pi}^*_F$, as follows:

$$\begin{aligned}\hat{Y}_t &= -\frac{1-g\_y}{\sigma}\left\{\tilde{i}_t - [n+\sigma(1-n)]\,\tilde{\pi}_{H,t+1} + (\sigma-1)(1-n)\,\tilde{\pi}^*_{F,t+1} + \hat{\beta}_t\right\} \\ &\quad +\hat{Y}_{t+1} - \Delta\hat{G}_{t+1}. \qquad (1)\end{aligned}$$

$$\hat{Y}^*_t = -\frac{1}{\sigma}\left[\tilde{i}^*_t - (1-n+\sigma n)\,\tilde{\pi}^*_{F,t+1} + n(\sigma-1)\,\tilde{\pi}_{H,t+1} + \hat{\beta}_t\right] + \hat{Y}^*_{t+1}. \qquad (2)$$

$$\begin{aligned}&\tilde{\pi}_{H,t} = \beta\tilde{\pi}_{H,t+1} \\ &+\frac{(1-\theta)(1-\theta\beta)}{\theta}\left\{\left[\omega + \frac{1-n+\sigma n}{1-g\_y}\right]\hat{Y}_t + (\sigma-1)(1-n)\,\hat{Y}^*_t - \frac{1-n+\sigma n}{1-g\_y}\hat{G}_t\right\}. \qquad (3)\end{aligned}$$

$$\begin{aligned}&\tilde{\pi}^*_{F,t} = \beta\tilde{\pi}^*_{F,t+1} \\ &+\frac{(1-\theta)(1-\theta\beta)}{\theta}\left\{[1+\omega+(\sigma-1)(1-n)]\,\hat{Y}^*_t + \frac{n(\sigma-1)}{1-g\_y}\widehat{Y}_t - \frac{n(\sigma-1)}{1-g\_y}\hat{G}_t\right\}. \qquad (4)\end{aligned}$$

The circumflex ($\hat{}$) indicates the log-linearized deviation of the variable from its steady state, with the exception of $\hat{G}_t = (G_t - G)/Y$. The first two equations represent IS curves with respect to domestic goods and foreign goods, respectively. Deducting $\hat{G}_t$ from $\hat{Y}_t$, the IS curves indicate the Euler equations with respect to consumption. The last two equations represent New Keynesian Phillips curves with respect to inflation in the home country and in the foreign country, respectively. Government spending influences the marginal costs of domestic and foreign goods via the resource constraint and the labor market equilibrium condition.

3 Fiscal Multiplier and Spillover under Normal Circumstances

We first consider a case in which neither central bank is constrained by the zero lower bound of nominal interest rates. With producer currency pricing, there are only two kinds of aggregate inflation. Therefore, irrespective of the inflation index to be targeted, two policies in two countries are enough to stabilize inflation in two countries.[6] Further, as

[6] Note that CPI inflation rates, namely inflation rates based on the welfare based price index, are the same in both countries. Under the complete international financial market and the settings of preferences in this paper, there exists only one real interest rate. According to the Fisher equation, inflation expectations are also the same in both countries.

shown by Clarida, Gali, and Gertler (2002), and Benigno and Benigno (2003), since price stability of producer prices is the optimal discretion and the commitment monetary policy, central banks achieve zero inflation in both countries.[7] Under this optimal monetary policy, marginal costs expressed in the first term of the right-hand side of the Phillips curves in equations (3) and (4) become zero. Analysis in this section can be considered to use the simple international real business cycle model without capital, namely the flexible price equilibrium.

As a result, the fiscal multiplier associated with government spending in the home country is given by:

$$\frac{d\hat{Y}_t}{d\hat{G}_t} = 1 - \frac{\omega(1-g\_y)\left\{1+\omega+(\sigma-1)(1-n)\right\}}{\left\{\omega(1-g\_y)+1-n+\sigma n\right\}\left\{1+\omega+(\sigma-1)(1-n)\right\}+(\sigma-1)^2 n(1-n)}.$$

Clearly, the fiscal multiplier is lower than one. Compared to the fiscal multiplier in a closed economy model in Christiano (2004)

$$\frac{d\hat{Y}_t}{d\hat{G}_t}|_{\text{closed}} = \frac{\sigma}{\omega(1-g\_y)+\sigma},$$

we can see:

$$\begin{aligned} & \text{sign}\left\{\frac{d\hat{Y}_t}{d\hat{G}_t} - \frac{d\hat{Y}_t}{d\hat{G}_t}|_{\text{closed}}\right\} \\ = \; & -(\sigma-1)(1-n)\left[1+\omega+(\sigma-1)(1-2n)\right]. \end{aligned}$$

The two multipliers naturally become equal when $n = 1$, that is, when the relative size of the home country is infinite. The inverse of the intertemporal elasticity of substitution in consumption σ influences the relative size of the fiscal multiplier to that in a closed economy. When $\sigma > 1$, the fiscal multiplier is smaller than it is in a closed economy. When $0 < \sigma < 1$, the fiscal multiplier becomes larger than that in a closed economy. When $\sigma = 1$, as shown by Clarida, Gali, and Gertler (2002), the two countries become insular. Hence, the fiscal multiplier equals that in a closed economy, irrespective of the size of n.

[7] The optimal targeting rule of the home central bank is static and does not contain any foreign variables. This is because we do not include any distortionary shock, such as the cost-push shock examined in Clarida, Gali, and Gertler (2002). Therefore, there is no trade-off in stabilizing between price and output.

The fiscal spillover of the home country's government spending in the foreign country is given by:

$$\frac{d\hat{Y}_t^*}{d\hat{G}_t} = \frac{\omega n(\sigma-1)}{\{\omega(1-g\_y)+1-n+\sigma n\}\{1+\omega+(\sigma-1)(1-n)\}+(\sigma-1)^2 n(1-n)}.$$

The fiscal spillover is positive if $\sigma > 1$ and negative if $0 < \sigma < 1$. If $\sigma = 1$, the two countries become insular and there is no spillover. Of course, there is no spillover in a closed economy model.

The intuition behind this result can be understood as follows. The key is the effects from the terms of trade ToT. The terms of trade are denoted by

$$ToT_t = \frac{S_t P_{F,t}^*}{P_{H,t}} = \frac{Y_t - G_t}{Y_t^*}, \tag{5}$$

which is log-linearized as:

$$\widehat{ToT}_t = \frac{\hat{Y}_t - \hat{G}_t}{1-g\_y} - \hat{Y}_t^*. \tag{6}$$

Government spending directly increases production and employment in the home country. That yields an upward pressure on home prices, and to prevent this, monetary policy is tightened and real interest rates rise. Monetary tightening generates home exchange rate appreciation and improves the terms of trade as shown in equation (5). As Clarida, Gali, and Gertler (2002) and Fujiwara, Nakajima, Sudo, and Teranishi (2009) point out, the terms of trade have two opposing effects on real marginal costs MC_t. This is clear from the equation below, which is derived by combining the resource constraint and the labor market equilibrium condition

$$\begin{aligned} MC_t &= h_t^{\omega} C_t^{\sigma} ToT_t^{1-n} \\ &= h_t^{\omega} \left(ToT^{-(1-n)} \Delta_t h_t \right)^{\sigma} ToT_t^{1-n}, \end{aligned} \tag{7}$$

where h_t and C_t represent is home employment and home consumption spent by a household in the home country. Δ_t is the relative price dispersion term given by:

$$\Delta_t \equiv \left\{ \int_0^1 \left[\frac{P_{H,t}(i)}{P_{H,t}} \right]^{-\varepsilon} \mathrm{d}i \right\}^{-1}.$$

This equation implies that, first, by affecting output prices, the improvement in the terms of trade directly decreases real marginal costs in the home country.[8] On the other hand, it

[8] This is the *terms of trade effects* according to Clarida, Gali, and Gertler (2002).

increases real marginal costs in the foreign country. To completely stabilize inflation rates so that real marginal costs become constant, home employment needs to increase while foreign employment needs to decrease. Second, the improvement in the terms of trade induces production switching from domestic to foreign goods. Given domestic output, that requires a rise in output in the foreign country. Total consumption rises in both countries, and due to risk sharing, both domestic and foreign consumption rise by the same amount. The rise in domestic consumption raises real marginal costs in the home country, and to offset the rise in prices, home employment needs to decrease.[9] Its size grows with σ.

Consequently, if $\sigma > 1$, the first channel is dominated by the second channel. Home employment decreases, which makes the fiscal multiplier smaller than that in a closed economy. Foreign employment increases, which yields positive fiscal spillover. If $0 < \sigma < 1$, the first channel dominates the second channel. Home employment increases, which makes the fiscal multiplier larger than that in a closed economy. Foreign employment decreases, which yields negative fiscal spillover. If $\sigma = 1$, the two channels offset each other. The fiscal multiplier equals that in a closed economy and the fiscal spillover becomes zero, since the two countries are insular.[10]

It is worth noting that the implications for welfare are different. Higher production means higher employment. That has the effect of decreasing welfare, while because of perfect risk sharing, consumption in the two countries is the same.[11] Recall that, if $\sigma > 1$, the fiscal multiplier is lower and fiscal spillover is higher compared with the case of a closed economy. Therefore, if $\sigma > 1$, government spending produces superior social outcomes for the country than would be seen in the case of a closed economy, because households in the

[9] This is the *risk sharing effects* according to Clarida, Gali, and Gertler (2002).

[10] The sensitivity to σ depends on the form of utility. For example, Greenwood, Hercowitz, and Huffman (1988) use the following utility function:

$$\frac{1}{1-\sigma}\left(C_t - \chi\frac{h_t^{1+\omega}}{1+\omega}\right)^{1-\sigma}.$$

That function, not additively separable, abstracts the income effect on labor. Real marginal costs are independent of σ.

[11] Note that we do not assume any utility gain from government expenditure. For an analysis on the optimal level of government expenditure with a small utility gain from it, see Christiano, Eichenbaum, and Rebelo (2009).

foreign country work more to produce more goods. That leads to *the beggar-thy-neighbor* problem. Also note that, as Tille (2001) and Benigno and Benigno (2003) point out, welfare implications are highly dependent on other parameters, such as the intratemporal elasticity of substitution between home and foreign goods, which in this paper is assumed to be 1. Therefore, whether σ is larger or smaller than unity is crucial in the analyses of this paper.

4 Fiscal Multiplier and Spillover in a Global Liquidity Trap

We next consider a case in which the zero lower bound constrains central banks. The central bank cannot achieve complete price stability because of the trade-off stemming from the zero lower bound. We follow Christiano (2004) and Christiano, Eichenbaum, and Rebelo (2009). The natural rate shock $\hat{\beta}_t$ drops at periods $t = 1, \cdots, T-1$, and returns to zero at period T. Central banks pursue optimal discretionary policy to stabilize inflation. For simplicity, we further assume that government spending in the home country G_t is implemented for only two periods, at $t = 1$ and $t = 2$.[12] Note that, in this paper, we do not need to discern corporative and noncorporative cases because the natural rate shock is common to both countries.

Using lag-operator L, we arrange equations (1) to (4). Since we assume that government spending in the home country G_t is implemented for only two periods, at $t = 1$ and $t = 2$, first-order approximation up to L^{-1} is sufficient. The fiscal multiplier is approximated up to the first order:

$$\begin{aligned}\hat{Y}_t &= -\left[1 + L^{-1} + \frac{(1-\theta)(1-\theta\beta)}{\theta}\left\{\frac{\{n+\sigma(1-n)\}\omega}{\sigma} + \frac{1}{1-g\_y}\right\}L^{-1}\right]\frac{\tilde{\imath}_t + \hat{\beta}_t}{\sigma} \\ &\quad + \frac{(1-\theta)(1-\theta\beta)}{\theta}\frac{(\sigma-1)(1-n)\omega}{\sigma^2}L^{-1}(\tilde{\imath}^*_t + \hat{\beta}_t) \\ &\quad + \left[1 + \frac{(1-\theta)(1-\theta\beta)}{\theta}\frac{\{n+\sigma(1-n)\}\omega}{\sigma}L^{-1}\right]\hat{G}_t.\end{aligned}$$

The coefficients on $\hat{G}_t$ and $\hat{G}_{t+1}$ represent the fiscal multiplier. The above equation suggests that completely temporary government spending $\hat{G}_t$ has a multiplier of one. It already

[12] Extending the periods of government spending does not change our main results. Also for simplicity, we focus on the fiscal multiplier and spillover only on the initial date. We can compute those on the future dates following Christiano (2004), but the analysis becomes less intuitive.

exceeds the multiplier in the previous section. Government spending in the next period $\hat{G}_{t+1}$ has a multiplier of:

$$\frac{(1-\theta)(1-\theta\beta)}{\theta}\frac{\{n+\sigma(1-n)\}\omega}{\sigma}.$$

Multi-period government spending increases the fiscal multiplier. As σ falls, the fiscal multiplier becomes larger.

According to Christiano (2004), the fiscal multiplier in a closed economy is 1 for $\hat{G}_t$. A one-time government expenditure has a multiplier of the same amplitude. The fiscal multiplier in a closed economy for $\hat{G}_{t+1}$ is given by:

$$\frac{(1-\theta)(1-\theta\beta)}{\theta}\frac{\omega}{\sigma}.$$

If $\sigma > 1$, the fiscal multiplier in an open economy is larger than it is in a closed economy. If $0 < \sigma < 1$, the fiscal multiplier is smaller than that in a closed economy. If $\sigma = 1$, the fiscal multiplier equals that in a closed economy, since the two countries become insular. Interestingly, the results here are quite contrary to those obtained in the previous section.

The fiscal spillover is given by:

$$\begin{aligned}\hat{Y}_t^* &= -\frac{1+L^{-1}+\frac{(1-\theta)(1-\theta\beta)}{\theta}\{1+\omega(1-n+\sigma n)/\sigma\}L^{-1}}{\sigma}(\tilde{i}_t^*+\hat{\beta}_t)\\ &\quad+\frac{(1-\theta)(1-\theta\beta)}{\theta}\frac{(\sigma-1)n\omega}{\sigma^2}L^{-1}(\tilde{i}_t+\hat{\beta}_t)\\ &\quad-\frac{(1-\theta)(1-\theta\beta)}{\theta}\frac{(\sigma-1)n\omega}{\sigma}L^{-1}\hat{G}_t.\end{aligned}$$

The coefficients on $\hat{G}_t$ and $\hat{G}_{t+1}$ are zero and

$$-\frac{(1-\theta)(1-\theta\beta)}{\theta}\frac{(\sigma-1)n\omega}{\sigma},$$

respectively. Completely temporary government spending $\hat{G}_t$ has no spillover while government spending for the next period $\hat{G}_{t+1}$ has negative (positive) spillover if $\sigma > (<)1$. If $\sigma = 1$, there is no spillover. As n rises, the absolute size of spillover tends to increase. The signs of the spillover computed here are the opposite of those obtained under normal circumstances.

Incomplete stabilization of marginal costs due to the existence of the zero lower bound is a crucial factor in the high fiscal multiplier. Government spending directly increases

production and employment in the home country. That yields an upward pressure on home prices. Because of the zero lower bound, inflation rates and marginal costs are not stabilized.[13] They increase, and real interest rates drop. Intertemporal optimization causes consumption to increase. That yields a greater fiscal multiplier than that in the previous section. The increase in consumption is larger as σ is lower.

The sign associated with fiscal spillover is determined for the following reason. Government spending has two opposing effects. First, it shifts demand for goods from foreign-produced goods to home-produced goods. When government spending ends, the terms of trade are at equilibrium: the price of home-produced goods is as expensive as that of foreign-produced goods. While government spending continues, the price of home-produced goods increases more than that of foreign-produced goods. Therefore, when government spending begins, the terms of trade worsen: home-produced goods are relatively cheaper than foreign-produced goods. It increases demand for home-produced goods, and decreases demand for foreign-produced goods. Second, the increase in expected inflation rates lowers real interest rates and increases demand for foreign-produced goods. The second effect becomes weaker, as the inverse of the intertemporal elasticity of substitution in consumption, σ, becomes greater. If σ is greater (less) than one, the first effect dominates (is dominated by) the second channel. Fiscal spillover becomes negative (positive).

More precise mechanism runs as follows. For completely temporary government spending, domestic production rises by the same amount while home consumption does not change. Real marginal costs rise, which increases prices of home-produced goods on impact. In the foreign economy, production and consumption do not change, so prices of foreign-produced goods measured in the foreign currency do not change. The terms of trade do not change because the currency of the home country depreciates on impact. The fact that the nominal exchange rates change may seem contradictory with the uncovered interest parity condition, given that nominal interest rates in both countries are bound at

[13] The importance of the fluctuations in marginal costs on the fiscal multiplier is also pointed out by Braun (2009) and implicitly by Christiano, Eichenbaum, and Rebelo (2009). If monetary policy is conducted following the Taylor type rule and induces incomplete stabilization, multipliers become larger in this case than under complete price stability.

zero. Yet, it is not contradictory at all: the expected change in nominal exchange rates remains unchanged. Also note that because the government spending is completely temporary, the expected inflation rates in two countries do not change. That makes real interest rates and consumption unchanged in both countries.

Consider a case in which there is government spending at $t = 2$ as well as at $t = 1$. Backward induction addresses the underlying mechanism. The economy at $t = 2$ is close to the economy when there is completely temporary government spending at $t = 1$. The terms of trade are at equilibrium at $t = 2$. Prices of home-produced goods rise by $\tilde{\pi}_{H,2}$ while prices of foreign-produced goods do not change. The only difference is in the nominal exchange rates. From $t = 1$ to $t = 2$, nominal exchange rates do not move due to the uncovered interest parity condition and the zero nominal interest rates in both countries. It suggests that the terms of trade at $t = 1$ are positive by $\tilde{\pi}_{H,2}$, meaning that the terms of trade worsen at $t = 1$ for the home country. From equation (6), we have:

$$\tilde{\pi}_{H,2} = \frac{\hat{Y}_1 - \hat{G}_1}{1 - g\_y} - \hat{Y}_1^*. \tag{8}$$

Worsening of the terms of trade increases home-produced goods but decreases foreign-produced goods. On the other hand, because of a rise in the home-produced good at $t = 2$, the aggregate inflation rate in the home country rises by $n\tilde{\pi}_{H,2}$, which lowers the real interest rate by $n\tilde{\pi}_{H,2}$ at $t = 1$. Due to intertemporal optimization, that increases aggregate consumption in the two countries as:

$$\frac{n\tilde{\pi}_{H,2}}{\sigma} = n\frac{\hat{Y}_1 - \hat{G}_1}{1 - g\_y} + (1 - n)\hat{Y}_1^*. \tag{9}$$

A decrease in the real interest rate increases both home-produced goods and foreign-produced goods. Clearly, these two equations suggest that, for $0 < \sigma < 1$, $\hat{Y}_1^*$ increases, while for $\sigma > 1$, $\hat{Y}_1^*$ decreases.[14] As σ is larger, the effect of the real interest rate on $\hat{Y}_1^*$ becomes smaller. The increase in $\hat{Y}_1^*$ is dominated by the decrease in $\hat{Y}_1^*$ stemming from the worsening (improvement) of the terms of trade for the home (foreign) country. The fiscal spillover thus becomes negative for a large σ.

[14] Regarding exchange rates, the validity of the uncovered interest parity condition has often been called into question. Our results are, however, robust to the uncovered interest parity condition because there are no interest rate differences between two countries.

Regarding welfare, a lower fiscal multiplier or higher spillover is better for the country where the government spending takes place. Therefore, if $\sigma > 1$, government spending is socially worse for the country with government spending than in a closed economy, since households in the foreign country work less to produce less goods. It does not yield the *beggar-thy-neighbor* problem, but ends up with *beggar-thy-self*.

The findings in this paper are summarized in Table 1. Numbers show the actual multi-

Table 1: Summary

		Multiplier		Spillover	
		$0 < \sigma < 1$	$\sigma > 1$	$0 < \sigma < 1$	$\sigma > 1$
Normal	$\hat{G}_t$	+, <1 (+)	+, <1 (−)	− (−)	+ (+)
ZLB	$\hat{G}_t$	1 (0)	1 (0)	0 (0)	0 (0)
ZLB	$\hat{G}_{t+1}$	+ (−)	+ (+)	+ (+)	− (−)

plier or spillover. Signs inside brackets represent a comparison of the fiscal multiplier and spillover with those of a closed economy: + (-) implies that the multiplier or spillover is larger (smaller) than in the closed economy. As equation (7) illustrates, incomplete stabilization of marginal costs due to the existence of the zero lower bound is a crucial factor in understanding the effects of fiscal policy in open economies.

5 Conclusion

In this paper, we find that fiscal multiplier exceeds one in a global liquidity trap. The reason for this is that reflecting worsening terms of trade, employment and output must increase in the country with government expenditure. On the other hand, the fiscal spillover is negative if the intertemporal elasticity of substitution in consumption is less than one and positive if the parameter is greater than one. The size of the multiplier and the sign (positive or negative) associated with the spillover are quite contrary to those in the undergraduate textbook, those without the zero lower bound, and those under the flexible price equilibrium. Incomplete stabilization of marginal costs due to the existence of the zero lower bound is crucial in understanding the effects of fiscal policy in open economies.

We have so far considered only symmetric cases. A further question could be, in a situation where only the foreign country is constrained by the zero lower bound, how does government expenditure in the home country influence the foreign country's economy. Acknowledging that there are many possible policies, such as noncorporative and corporative policies, arising from differing objectives of two countries, we attempt to assume that a central bank in the home country aims to stabilize the real marginal cost of the goods produced in the home country. We find that the results are the mixture of those in the two sections. The fiscal multiplier is less than one for completely temporary government spending. The fiscal spillover is negative (positive) if $\sigma > (<)1$.

Another issue is how the government spending is used. A part of the government spending may contribute directly to a household's utility. Government spending may be used to purchase not only home goods but also foreign goods. Local producer pricing instead of producer currency pricing may alter our results. The validity of uncovered interest parity becomes crucial when we consider asymmetric cases between two countries. These issues will be addressed in future research.

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A Model

We describe the model only for the home country.

A.1 Household

In the home country, a representative home consumer maximizes

$$\frac{C_t^{1-\sigma}}{1-\sigma} - \chi \frac{h_t^{1+\omega}}{1+\omega},$$

subject to the budget constraint:

$$P_t C_t + \mathrm{E}_t \left(Q_{t,t+1} D_{t+1} \right) + B_{t+1} = W_t h_t + D_t + \left(1 + i_{t-1} \right) B_t + \Pi_t - T.$$

The consumption bundle is defined by

$$C_t = \left(\frac{C_{H,t}}{n} \right)^n \left(\frac{C_{F,t}}{1-n} \right)^{1-n},$$

and the utility based aggregate price index (CPI) is described as:

$$P_t = P_{H,t}^n P_{F,t}^{1-n}.$$

A.2 Firms

We assume a linear production function with labor as the only input:

$$Y_t \left(j \right) = h_t \left(j \right).$$

The resource constraint is:

$$nY_t(j) = nC_{H,t}(j) + (1-n)\,C^*_{H,t}(j).$$

The preferences are set as

$$C_{H,t} + G_t = \left[\int_0^1 C_{H,t}(j)^{1-\frac{1}{\varepsilon}}\,\mathrm{d}j\right]^{\frac{\varepsilon}{\varepsilon-1}},$$

and

$$C^*_{H,t} = \left[\int_0^1 C^*_{H,t}(j)^{1-\frac{1}{\varepsilon}}\,\mathrm{d}j\right]^{\frac{\varepsilon}{\varepsilon-1}}.$$

We assume Calvo-type price setting. The price of domestic goods sold in the foreign country is described simply as:

$$P^*_{H,t} = \frac{P_{H,t}}{S_t}.$$