Washington Center
for Equitable Growth

1500 K Street NW, Suite 850
Washington, DC 20005

Working paper series

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March 2017

http://equitablegrowth.org/working-papers/fiscal-policy-stabilization-purchases-or-transfers/

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Abstract

Both government purchases and transfers figure prominently in the use of fiscal policy for counteracting recessions. However, existing representative agent models including the neoclassical and New Keynesian benchmark rule out transfers by assumption. This paper explains the factors that determine the size of fiscal multipliers in a variant of the Curdia and Woodford (2010) model where transfers now matter. I establish an equivalence between deficit-financed fiscal policy and balanced-budget fiscal policy with transfers. Absent wealth effects on labor supply, the transfer multiplier is zero when prices are flexible, and transfers are redundant to monetary policy when prices are sticky. The transfer multiplier is most relevant at the zero lower bound where the size of the multiplier is increasing in the debt elasticity of the credit spread and fiscal policy can influence the duration of a zero lower bound episode. These results are quantitatively unchanged after incorporating wealth effects on labor supply.

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I would like to thank Gauti Eggertsson, Ricardo Reis, and Michael Woodford for helpful discussions, and Nicolas Crouzet, Laura Feiveson, John Leahy, Guido Lorenzoni, Guilherme Martins, Alisdair McKay, Steven Pennings, Bruce Preston, Stephanie Schmitt-Grohe, Dmitriy Sergeyev, seminar participants at the Federal Reserve Board and Boston University, two anonymous referees and the editor, John Williams, for useful comments. The views expressed here reflect those of the author and do not represent the views of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

1 Introduction

The Great Recession has brought renewed attention to the possibility of using fiscal policy to counteract recessions. Policymakers in developed nations have adopted a series of historically large fiscal interventions in an attempt to raise output, reduce unemployment, and stabilize consumption and investment. In the US, in addition to increases in government purchases, policymakers have also relied heavily on transfers of various forms - to individuals, institutions, and state and local governments - as instruments of fiscal policy. Table 1 provides the Congressional Budget Office breakdown of the various components of the Recovery Act and estimates for the associated policy multiplier. Transfers account for more than half of the expenditures in the Recovery Act.

Table 1: Outlays and Estimated Policy Multipliers for American Recovery and Reinvestment Act

Category	Estimated Multiplier (High)	Estimated Multiplier (Low)	Outlays
Purchases of goods and services by the federal government	2.5	1.0	\$88 bn
Transfers to state and local governments for infrastructure	2.5	1.0	\$44 bn
Transfers to state and local governments not for infrastructure	1.9	0.7	\$215 bn
Transfers to persons	2.2	0.8	\$100 bn
One-time Social Security payments	1.2	0.2	\$18 bn
Two-year tax cuts for lower and middle income persons	1.7	0.5	\$168 bn
One-year tax cuts for higher income persons (AMT fix)	0.5	0.1	\$70 bn

Recent work has shown that households display a sizable propensity to consume out of transfers. Empirical work by Johnson, Parker and Souleles (2006) demonstrate that an economically significant portion of tax rebates (intended as stimulus) are spent. The authors track changes in consumption in the Consumer Expenditures Survey and use the timing of rebates as a source of exogenous variation. Similarly, Agarwal, Liu and Souleles (2007) examine the effect of the 2001 tax rebates on consumption and saving using credit card data, finding dynamic effects on both credit card balances and spending over the subsequent year.

While the empirical evidence provides suggestive evidence that transfers may be an effective form of stimulus, macroeconomic models are needed to determine conditions under which transfers can counteract recessions. An extensive literature has analyzed the determinants of the government purchases multiplier. As summarized in Woodford (2011), this literature emphasizes the importance of wealth effects, interactions of monetary and fiscal policy, and the sizable multiplier at the zero lower bound. Woodford (2011) and other models of fiscal multipliers assume a representative agent where Ricardian equivalence rules out any output or employment effects of transfers, redistribution, or changes in the public debt by assumption. Comparatively little work has focused on determinants

of the transfers multiplier in non-representative agent settings. This paper seeks to address that gap.

In this paper, I examine the determinants of the transfers multiplier in a New Keynesian borrower-lender model along the lines of Curdia and Woodford (2010). The model features patient and impatient households, with the latter serving as the borrowers in this economy. The borrowing rate depends on a credit spread that increases with the aggregate level of debt outstanding. I examine fiscal multipliers under both flexible prices and sticky prices to isolate the channels through which fiscal policy affects output and employment. My approach follows the approach in Woodford (2011), modeling credit frictions in reduced form in order to facilitate analytical expressions for transfer multipliers and cleanly illustrate the channels that determine the effect of transfers on output and employment.[1]

My analysis reveals that several insights from the literature on government purchases carries over to a multiple agent setting that admits a role for transfers. The key findings are that the transfer multiplier is only substantial at the zero lower bound and only if credit spreads are sufficiently responsive to changes in overall debt. In contrast to representative agent ZLB models, fiscal policy - both government spending and transfers - at the zero lower bound can shorten the duration of ZLB episodes via debt deleveraging. These findings carry implications for models that think about both the long-term and short-term effects of transfers emphasizing the labor supply effects in the former and the nature of financial frictions in the latter.

Under flexible prices, transfers only affect output and employment through a wealth effect on labor supply. If preferences or the structure of labor markets eliminate wealth effects on labor supply, neither purchases nor transfers will have any effect on output or employment.

Even in the presence of wealth effects, the deviations from the zero multiplier in the representative agent benchmark are small for plausible calibrations. The transfers multiplier is close to zero as wealth effects lead to offsetting movements in hours worked by the households that provide and receive the transfer. We provide conditions under which these labor supply effects are perfectly offsetting and the transfer multiplier is zero. Importantly, these results suggest that the secular increase in transfer payments in the US and other advanced countries in the postwar period should have no long-run effect on employment.[2]

[1] The reduced form credit spread function used here can be microfounded in various ways: as predictable fraction of loans that cannot be collected due to fraud as in Curdia and Woodford (2010) or Benigno, Eggertsson and Romei (2014). Alternatively, the same expression can be derived by modeling a banking sector subject to a regulatory capital constraint as also considered in Benigno, Eggertsson and Romei (2014).

[2] I am, of course, ignoring growth effects of any distortionary taxation used to finance these transfers.

Under sticky prices, fiscal policy now generally has both a supply effect (via wealth effect on labor supply) and a demand effect (via countercyclical markups). In the special case of no wealth effects, a Phillips curve can be derived in terms of output and inflation. So long as a central bank is free to adjust the nominal rate, the central bank may implement any combination of output and inflation irrespective of the stance of fiscal policy. In this sense, fiscal policy and transfers are irrelevant for determining aggregate output or inflation since monetary policy is free to undo any effect of fiscal policy. More generally, the tradeoff between purchases and transfers will depend on the monetary policy rule. In the presence of wealth effects, purchases or transfers may lower wages and shift the Phillips curve. Under a Taylor rule and a standard calibration, transfers continue to have small effects on output and employment relative to purchases. The primacy of monetary policy in determining the effect of fiscal policy is analogous to the conclusions of Curdia and Woodford (2010). The presence of a credit spread and intermediation alters the implementation of monetary policy (rule) but not the feasible set (Phillips curve).

When the zero lower bound on the nominal interest rate is binding, the choice between purchases and transfers becomes relevant and monetary policy cannot substitute for fiscal policy. Moreover, the behavior of the credit spread and its dependence on endogenous variables will determine the merits of purchases versus transfers. In the model, an exogenous shock to the credit spread causes the zero lower bound to bind. Under the calibration considered, purchases act directly to increase output and inflation while transfers work indirectly by allowing for a faster reduction in private sector debt, thereby lowering spreads. Both types of policies allow a faster escape from the zero lower bound relative to no intervention due to the endogenous effect of debt reduction on credit spreads, and consumption multipliers for each policy are typically positive. A credit spread that is more sensitive to changes in private sector debt (higher debt elasticity) raises the transfer multiplier.

The debt elasticity of the credit spread plays a key role in determining the transfer multiplier and the choice between transfers and government purchases. An increase in the debt elasticity boosts the transfer multiplier through two channels. A higher debt elasticity raises the marginal propensity to consume out of temporary income for the borrower household increasing the demand effect from transfers. Additionally, with a high debt elasticity, credit spreads fall lowering the cost of borrowing and further increasing borrower income. This credit market effect is unique to this environment and is not present in models with rule of thumb households.

Table 2 summarizes the main results for the transfers multiplier and government spending multiplier under the cases considered. We focus on the consumption multiplier as the main object

Table 2: Summary of consumption multipliers (on impact)

Panel A: No wealth effects	*Transfer*	*Gov. spending*
Flexible prices	0	0
Sticky prices and no ZLB	< 0	< 0
Sticky prices and ZLB	> 0	> 0
Panel B: Wealth effects	*Transfer*	*Gov. spending*
Flexible prices	< 0	< 0
Sticky prices and no ZLB	> 0	< 0
Sticky prices and ZLB	> 0	> 0

of interest; that is, does aggregate consumption increase on impact after a fiscal expansion? With flexible prices, multipliers are either zero or negative (due to wealth effects). With sticky prices, multipliers generally depend on the stance of monetary policy with a transfer multiplier positive in the calibration considered with wealth effects. At the ZLB, consumption multipliers are positive, with government spending multipliers typically exceeding the transfer multiplier.

The paper is organized as follows: Section 2 briefly summarizes related literature on fiscal policy in a non-representative agent setting. Section 3 presents the model and introduces credit spreads and fiscal policy. Section 4 compares purchases and transfers in the case of no wealth effects on labor supply. Alternatively, Section 5 considers purchases and transfers in the presence of wealth effects. Section 6 examines the effect of purchases and transfers at the zero lower bound and Section 7 concludes.[3]

2 Related Literature

This paper contributes to several distinct strands of literature that examine fiscal policy in non-representative agent settings. A literature beginning with Mankiw (2000) examines fiscal policy in models with rule of thumb agents - agents who do not participate in financial markets and simply consume their income each period. Gali, Lopez-Salido and Valles (2007) examine the effect of rule-of-thumb consumers on the government purchases multiplier and find that the presence of these agents can boost the multiplier above one.[4] The model considered here is closely related to the model of Bilbiie, Monacelli and Perotti (2013) that compares pure redistribution to deficit financed

[3]The online appendix relates the credit spread model considered here to models with rule-of-thumb households, models with borrowing constraints, and overlapping generations models.

[4]Nominal rigidities and labor market frictions in their model have substantial effects on the government purchases multiplier even in the absence of rule-of-thumb consumers.

tax rebates. They also find that labor supply effects offset when prices are flexible, but transfers may be an effective fiscal policy when prices are sticky. This paper considers a more general credit friction and analyzes transfers at the zero lower bound (the case in which fiscal policy turns out to be most salient).

The research question explored in this paper is probably closest to Giambattista and Pennings (2016) who also analyze determinants of the transfer multiplier both away and at the zero lower bound in a model with rule of thumb agents. The model considered here is more general by allowing for borrowers to adjust their consumption/saving decisions after a change in fiscal policy.[5] This choice is motivated by the fact that the vast majority of US households have access to some form of credit. Moreover, this model matches the empirical evidence that shows a persistent consumption response after tax rebates as documented in Agarwal, Liu and Souleles (2007). In any case, the model considered here nests rule of thumb behavior as a limiting case. As the debt elasticity of the credit spread approaches infinity, the marginal propensity to consume for borrowers approaches one. A key insight, relative to literature of fiscal multipliers with rule of thumb agents, is that, transfer multiplier may be quite small even at the ZLB when interest rates are fairly debt inelastic.

A small literature has studied the conduct of fiscal policy for stabilization purposes in quantitative heterogenous agent models with incomplete markets. Heathcote (2005) considers the short-run effect of tax cuts in a model with idiosyncratic income risk, finding a fairly small tax cut multiplier. Similarly, Oh and Reis (2012) consider the effect of targeted transfers as fiscal stimulus and find very low transfer multipliers. In their model, labor supply responses by donor and recipient households largely offset. Recent work by Athreya, Owens and Schwartzman (2014) also emphasizes the importance of the labor supply margin for determining multipliers. Structural models studied in McKay and Reis (2016) and Coenen et al. (2012) examine the impact of both government purchases and transfers. In comparison to these models, the model considered here is fairly tractable and allows me to isolate and identify mechanisms at work in these more complex settings. In particular, the behavior of transfers at the zero lower bound is also easier to analyze in this environment.

This paper also relates to a literature examining the effect of credit shocks at the zero lower bound like Eggertsson and Krugman (2012) and Guerrieri and Lorenzoni (2011) that show how deleveraging shocks cause a binding zero lower bound. A key contribution of this paper is a quantitative analysis of the transfer multiplier at the zero lower bound. The credit friction considered

[5] A log-linear analysis of a model with borrowing constraints behaves in the same way as models with rule of thumb agents

here is more general than a permanent tightening of a borrowing limit considered in other work. Like the rule of thumb case, the fiscal multipliers obtained in Eggertsson and Krugman (2012) are a special case of my model as the debt elasticity approaches infinity. Importantly, since credit spreads are partly determined endogenously, the time to exit the zero lower bound is endogenous to fiscal policy in contrast to Eggertsson and Krugman (2012) or representative agent treatments of fiscal multipliers at the zero lower bound. Recent work by Benigno, Eggertsson and Romei (2014) also finds that monetary and fiscal policy can shorten the duration of a zero lower bound episode in a borrower-lender model with credit spreads.

Finally, this paper has implications for recent work by Kaplan and Violante (2014) that considers household consumption and saving decisions in the presence of illiquid assets. Their model replicates the fairly high observed marginal propensity to consume out of tax rebates. In contrast to their work and other microfounded models of the consumption function, this paper considers a simple credit spread as the financial friction. This simplification allows for the analysis of the transfer multiplier in general equilibrium. In comparison, income is exogenous in Kaplan and Violante (2014) and the real interest rate is held constant. As I will argue, the insights about the determinants of the transfer multiplier discussed here carry over in environments with more complex microfoundations.

3 Model

The model consists of two types of households, monopolistically competitive firms, a monetary authority that sets the deposit rate as its policy instrument, and a fiscal authority. To generate borrowing and lending in steady state, the lender and borrower household are assumed to differ in their rates of time preference. An equilibrium credit spread is introduced to ensure that both agent's Euler equations are satisfied in steady state.

The model of patient and impatient agents used here draws on the borrower-saver model used in Campbell and Hercowitz (2005), Iacoviello (2005), and Monacelli (2009) where different rates of time preference among households allow for borrowing and lending in steady state. Differing rates of time preference are a staple in financial accelerator models such as Bernanke, Gertler and Gilchrist (1999), but these models typically go further and link the discount rate to the structure of production. The two-agent model facilitates the introduction of sticky prices and monetary policy to examine aggregate demand effects, and allows for the use of log-linearization to understand the key mechanisms at work.

3.1 Households

A measure $1-\eta$ of patient households chooses consumption and real savings to maximize discounted expected utility:

$$\begin{aligned} \max_{\{C_t^s, N_t^s, D_t\}} \quad & E \sum_{t=0}^{\infty} \beta^t U\left(C_t^s, N_t^s\right) \\ \text{subject to } C_t^s &= W_t N_t^s + \frac{1+i_{t-1}^d}{\Pi_t} D_{t-1} - D_t + \Pi_t^f - T_t \end{aligned}$$

where D_t is real savings of the patient household, Π_t is the gross inflation rate, and Π_t^f are any profits from the real or financial sectors.[6] The government may collect non-distortionary lump sum taxes T_t (possibly negative when considering tax rebates) that are levied uniformly across households. The period utility function $U(C, N)$ is twice continuously differentiable, increasing, and concave in consumption: $U_c(C, N) > 0$, $U_{cc}(C, N) < 0$ and decreasing and convex in hours: $U_n(C, N) < 0$, $U_{nn}(C, N) < 0$. While patient households could choose to borrow, for sufficiently small shocks, the interest rate on borrowings would be too high and the patient household only saves.

A measure η of impatient household chooses consumption and real borrowings to maximize discounted expected utility:

$$\begin{aligned} \max_{\{C_t^b, N_t^b, B_t\}} \quad & E_0 \sum_{t=0}^{\infty} \beta_b^t U\left(C_t^b, N_t^b\right) \\ \text{subject to } C_t^b &= W_t N_t^b + B_t - \frac{1+i_{t-1}^b}{\Pi_t} B_{t-1} - T_t \end{aligned}$$

where B_t is the real borrowings of the impatient household. The impatient household's discount rate $\beta_b < \beta$ ensures that the household chooses not to save and to only borrow in the neighborhood of the steady state. The impatient household's optimality conditions are analogous to those of the

[6] If equity in the firms and intermediaries were traded and short-selling ruled out, the patient household would accumulate all shares in steady state. For sufficiently small shocks, the assumption that patient households own all shares would continue to hold in the stochastic economy.

patient household and standard:

$$\lambda_t^i = U_c\left(C_t^i, N_t^i\right) \quad (1)$$

$$\lambda_t^i W_t = -U_n\left(C_t^i, N_t^i\right) \quad (2)$$

$$\lambda_t^s = \beta E_t \lambda_{t+1}^s \frac{1+i_t^d}{\Pi_{t+1}} \quad (3)$$

$$\lambda_t^b = \beta_b E_t \lambda_{t+1}^b \frac{1+i_t^b}{\Pi_{t+1}} \quad (4)$$

for $i \epsilon \{s, b\}$ in equations (1) and (2) and λ_t^i is the marginal utility for household i. The difference between the borrowing rate and the deposit rate allows both agents Euler equations to be satisfied in the non-stochastic steady state, with the interest rates determined by the patient and impatient household's discount rates.

Aggregate consumption C_t and labor supply N_t^{sup} are simply the weighted sum of each household's consumption and labor supply:

$$C_t = \eta C_t^b + (1-\eta) C_t^s \quad (5)$$

$$N_t^{sup} = \eta N_t^b + (1-\eta) N_t^s \quad (6)$$

As my analysis demonstrates, wealth effects play a critical role in determining the effect of fiscal policy on output, employment and consumption.

Definition 1. *Wealth effects are absent from household labor supply if the household's labor supply has the following representation:*

$$W_t = v_i\left(N_t^i\right)$$

for some function v_i that is increasing.

Wealth effects on labor supply are eliminated under the preference specification considered by Greenwood, Hercowitz and Huffman (1988):

$$U(C, N) = \frac{\left(C - \gamma N^{1+\frac{1}{\varphi}}\right)^{1-\sigma}}{1-\sigma}$$

where φ is the Frisch elasticity of labor supply. Under GHH preferences, labor supply takes the

form shown in the definition:

$$W_t = \gamma \left(1 + \frac{1}{\varphi}\right) \left(N_t^i\right)^{1/\varphi}$$

Aside from GHH preferences, wealth effects on labor supply would also be absent in a model with labor market rigidities. Under a rigid real wage, the labor supply relation no longer holds for each household:

$$W_t > \frac{-U_h\left(C_t^i, N_t^i\right)}{U_c\left(C_t^i, N_t^i\right)}$$

for $i \epsilon \{s, b\}$. In a model where wages remained constant - the case of perfect wage rigidity considered by (Blanchard and Gali, 2010) and Shimer (2012) - fiscal multipliers are determined exclusively by firm's labor demand condition. Under wage rigidity, household's labor supply can be represented (locally) by a constant function $v_i\left(N_t^i\right) = c = \overline{W}$ satisfying the definition of no wealth effects; in words, the labor supply curve is horizontal.

To obtain an aggregate labor supply curve and an aggregate IS curve, I must log-linearize the household's labor supply and Euler equations. In the general case with wealth effects, labor supply is a function of the aggregate wage and the household's consumption:

$$w_t = \frac{1}{\varphi_i} n_t^i + \frac{1}{\sigma_i} c_t^i$$

for $i \epsilon \{s, b\}$ where the lower case variables represent log deviations from steady state, φ_i is the household's Frisch elasticity and σ_i is the household's intertemporal elasticity of substitution. Solving for each agent's labor supply n_t^i, aggregate labor supply is the weighted sum of each agent's log-linearized labor supply (where the weight is the steady state share of employment for each household). Similarly, an aggregate IS equation can be obtained by a weighted sum of each agent's log-linearized Euler equation:

$$w_t = \frac{1}{\tilde{\varphi}} n_t + l_b \frac{\varphi_b}{\tilde{\varphi}\sigma_b} c_t^b + (1 - l_b) \frac{\varphi_s}{\tilde{\varphi}\sigma_s} c_t^s \tag{7}$$

$$c_t = E_t c_{t+1} + s_b \sigma_b i_t^b + (1 - s_b) \sigma_s i_t^d - \tilde{\sigma} E_t \pi_{t+1} \tag{8}$$

with $l_b = \eta \overline{N}_b / \overline{N}$ and $s_b = \eta \overline{C}_b / \overline{C}$. The parameters $\tilde{\varphi} = l_b \varphi_b + (1 - l_b) \varphi_s$ and $\tilde{\sigma} = s_b \sigma_b + (1 - s_b) \sigma_s$ are the appropriate weighted aggregate Frisch elasticity and aggregate intertemporal elasticity of substitution respectively. Relative to a standard representative household model, the labor supply curve depends on the distribution of consumption (as opposed to just the level of consumption) and the IS curve depends on the real borrowing rate (in addition to the real deposit rate).

3.2 Credit Spreads

The credit spread - the difference between the borrowing rate and deposit rate - is treated as a reduced form equation:

$$\frac{1+i_t^b}{1+i_t^d} = 1+\omega_t = E_t\Gamma\left(B_t, W_{t+1}N_{t+1}^b, Z_t\right) \tag{9}$$

The function Γ is assumed to be weakly increasing in its first and last arguments and weakly decreasing in its middle argument. The assumption that the spread is increasing with the level of household debt B_t is needed to ensure determinacy of the rational expectations equilibrium and is analogous to the stationarity conditions needed in small open economy models.[7] The effect of expected borrower income, $W_{t+1}N_{t+1}^b$ on credit spreads is consistent with the observed countercyclicality of credit spreads and the fact that spreads lead the business cycle.

The shock Z_t is an exogenous financial shock that can increase spreads. The financial shock may be interpreted as either a shock to the supply or demand side of the credit market. On the supply side, if financial intermediaries' capacity to raise funds is constrained by their own net worth, a depletion of equity due to an unexpected loss on the asset side of the balance sheet will cause an increase in borrowing rates. Alternatively, on the demand side, a shock to borrower collateral can likewise make borrowers less creditworthy thereby raising spreads. In particular, in a model with housing as collateral, a shock to house prices would reduce the value of collateral and raise credit spreads for the borrower household.

The log-linearized credit spread can be summarized by two parameters: the elasticity of the spread to private borrowings and the elasticity of the spread to borrower income with $\chi_b > 0$ and $\chi_n \geq 0$:

$$\omega_t = \chi_b b_t - \chi_n E_t\left(w_{t+1} + n_{t+1}^b\right) + z_t$$

A debt elasticity greater than or equal to zero is needed to ensure determinacy. If $\chi_b = 0$, then private sector debt follows a random walk. The credit spread may rise due to an exogenous increase in z_t or may rise due to some fundamental shock that drives up the level of debt or decreases borrower's household income. The log-linearized credit spread is flexible enough to incorporate the type of interest rate spreads seen in a broad class of models. When $\chi_n = 0$, the model exhibits a debt elastic spread as in standard small open economy models. When $\chi_b = \chi_n > 0$, the credit spread varies with the degree of indebtedness relative to next period income. This case is in the spirit of a financial accelerator model like Bernanke, Gertler and Gilchrist (1999) where the credit

[7] See discussion in Schmitt-Grohé and Uribe (2003).

spread depends on firm leverage.[8] Finally, when $\chi_n > \chi_b > 0$, the credit spread may be described as income elastic strengthening comovement with the business cycle. As noted earlier, we will show that when χ_b becomes very large, borrower households act like rule-of-thumb households exhibiting a marginal propensity to consume of one out of temporary income. In this way, the credit spread model is more general then the cases considered in related work by Giambattista and Pennings (2016) and Eggertsson and Krugman (2012).

The credit spread here is introduced in a reduced form way to facilitate the analysis of the transfer multiplier in a tractable way. A model with household income shocks and default would be a far more appealing microfoundation but would greatly complicate adding factors like pricing frictions and the zero lower bound that are critical for determining the macroeconomic effect of transfers on output.

If the dependence of the credit spread on future borrower income is dropped, then this model of the credit spread has the same microfoundations as Curdia and Woodford (2010). The authors offered two possible interpretations for the credit spread and its dependence on aggregate borrowing. Firstly, the spread function may reflect real costs of intermediation that are increasing in the level of borrowing.[9] Alternatively, the credit spread could reflect predictable losses from making loans to fraudulent borrowers. Credit spreads would rise with aggregate borrowing if monitoring becomes more difficult with more loans outstanding.[10] Building on Curdia and Woodford (2010), Benigno, Eggertsson and Romei (2014) also derive the debt-elastic credit spread used here that can be interpreted as emerging from default risk or capital requirements for financial intermediaries.

3.3 Fiscal and Monetary Policy

The instruments of fiscal policy consist of a set of uniform nondistortionary taxes, government consumption, and transfers. The fiscal authority may also run a budget deficit subject to a fiscal rule that ensures that the debt returns to its steady state level and subject to an intertemporal

[8] In principle, one might think that credit spreads depend on a households' net worth that should be a function of the present value of all income sources. Recessions would raise spreads in this case by reducing the present value of household income. Depending on the persistence of shocks, the decline in the present value of household income may be *greater* than simple next period income.

[9] For example, some fraction of patient households would operate the financial intermediaries and collect labor income in return for making loans.

[10] The microfoundations for the dependence of the credit spread on borrower income are harder to justify in this setting. However, the debt elasticity is a far more important parameter than the income elasticity of the credit spread. Assuming $\chi_n = 0$ does not greatly change results.

solvency condition:

$$
\begin{aligned}
G_t &= B_t^g - \frac{1+i_{t-1}^d}{\Pi_t} B_{t-1}^g + T_t && (10)\\
T_t &= \phi_b \left(B_{t-1}^g - \overline{B}_g \right) - reb_t && (11)\\
0 &= lim_{T\to\infty} E_t \frac{P_t}{P_T} \frac{B_T^g}{\prod_t^T (1+i_{t-1}^d)} && (12)
\end{aligned}
$$

where reb_t is a lump sum tax rebate delivered to all households. The instruments of fiscal policy are government purchases G_t and a reduction in lump sum taxes reb_t. The government's cost of funds is the policy rate i_t^d, not the borrowing rate i_t^b. This assumption best fits larger economies like the United States where the government controls the currency. For small open economies and countries in a currency union (such as the Eurozone), the rate at which the government borrows may carry a premium to the policy rate.

The monetary authority is assumed to set a rule for monetary policy so long as its instrument of policy, the deposit rate i_t^d, is not constrained by the zero lower bound. I will consider when monetary policy follows a standard Taylor rule (without interest rate smoothing) or pursues perfect inflation stabilization away from the zero lower bound:

$$
\begin{aligned}
\left(\frac{i_t^d}{\overline{r}_d} \right) &= (\Pi_t)^{\phi_\pi} \left(\frac{Y_t}{Y_t^n} \right)^{\phi_y} && (13)\\
\Pi_t &= 1 && (14)
\end{aligned}
$$

where $\overline{r}_d = \frac{\bar{i}_d}{\overline{\Pi}}$. When monetary policy is constrained by the zero lower bound, I assume that the deposit rate is set at zero or inflation is perfectly stabilized.

3.4 Firms

Monopolistically competitive firms set prices periodically and hire labor in each period to produce a differentiated good. Cost-minimization for firms and production function play a key role in examining the effects of various fiscal policy shocks and are given below:

$$
\begin{aligned}
MC_t &= \frac{W_t N_t}{\alpha Y_t} && (15)\\
Y_t &= N_t^\alpha && (16)
\end{aligned}
$$

where α is the labor share, N_t is labor demand and MC_t is the firm's marginal cost which varies over time depending on the rate of inflation and the stance of monetary policy.

Prices are reset via Calvo price setting where θ is the likelihood of firm to reset its prices in the current period. When $\theta = 1$, prices are set each period, monopolistic competitive firms set prices as a fixed markup over marginal costs:

$$\frac{P_{it}}{P_t} = \frac{\nu}{\nu - 1} MC_t$$

where ν is the elasticity of substitution among final goods in the Dixit-Stiglitz aggregator. If the initial price level is unity, then prices will be normalized to unity, and marginal costs will be fixed at all periods $MC_t = \overline{MC} = 1/\mu_p$ where $\mu_p = \frac{\nu}{\nu - 1}$. When $\theta < 1$, firms will set prices on the basis of future expected marginal costs. The firms prices problem and the behavior of the price level are summarized by the following equations:

$$\begin{aligned} F_t &= \mu_p \lambda_t^s MC_t Y_t + \theta \beta E_t \Pi_{t+1}^{\nu} F_{t+1} \\ K_t &= \lambda_t^s Y_t + \theta \beta E_t \Pi_{t+1}^{\nu - 1} K_{t+1} \\ 1 &= \theta \Pi_t^{\nu - 1} + (1 - \theta) \left(\frac{K_t}{F_t} \right)^{\nu - 1} \end{aligned}$$

where K_t and F_t are expressions reflecting the present value of future marginal costs and future production. These expressions emerge from the firm's optimality condition when resetting prices. Firms are owned by the saver households and therefore future marginal costs are discounted by the saver household's stochastic discount factor λ_t^s.

When prices are flexible, marginal costs are fixed and, to a log-linear approximation, $mc_t = 0$. When prices are sticky, a log-linear approximation to the firm's pricing problem around a zero inflation steady state delivers the standard New Keynesian Phillips curve:

$$\pi_t = \kappa mc_t + \beta E_t \pi_{t+1}$$

where $\kappa = \frac{(1-\theta)(1-\theta\beta)}{\theta}$.

3.5 Equilibrium

Asset market clearing requires that real saving equals real borrowing:

$$\eta B_t + B_t^g = (1-\eta)\, D_t$$

Combining the households' budget constraints and the government's budget constraint and firm profits implies an aggregate resource constraint of the form:

$$Y_t = C_t + G_t \tag{17}$$

Labor market clearing requires that labor supply equal labor demand:

$$N_t = N_t^{sup} = \eta N_t^b + (1-\eta)\, N_t^s \tag{18}$$

Definition 2. *An equilibrium is a set of allocations* $\{Y_t,\, N_t,\, C_t^s,\, C_t^b,\, N_t^s,\, N_t^b,\, \lambda_t^s,\, \lambda_t^b,\, B_t,\, F_t,\, K_t\}$, *a price process for* $\{W_t,\, \Pi_t,\, i_t^d,\, i_t^b,\, MC_t\}$, *a fiscal policy* $\{B_t^g,\, T_t,\, G_t,\, reb_t\}$, *and initial values for private debt* B_{-1} *and public debt* B_{-1}^g *that jointly satisfy the equilibrium conditions listed in the online appendix.*

The fiscal policy considered consists of government purchases and tax rebates, as opposed to transfers. However, deficit-financing of these fiscal policies is equivalent to a transfer from saver to borrower households and back again.

Proposition 1. *Consider an equilibrium under a deficit financed fiscal policy* $\{B_t^g,\, T_t,\, G_t,\, reb_t\}$. *There exists a set of household-specific taxes* T_t^b *and* T_t^s *that implement the same equilibrium and satisfies a balanced budget:* $G_t = \eta T_t^b + (1-\eta)\, T_t^s$

Proof. Since the saver household purchases the issuance of government debt, the saver's budget constraint may be expressed using the asset market clearing condition and substituting out for taxes using the government's budget constraint (10):

$$\begin{aligned} C_t^s + \frac{1}{1-\eta}\left(\eta B_t + B_t^g\right) &= W_t N_t^b + \Pi_t^f + \frac{1+i_{t-1}^d}{\Pi_t}\frac{1}{1-\eta}\left(\eta B_{t-1} + B_{t-1}^g\right) \\ &\quad + B_t^g - \frac{1+i_{t-1}^d}{\Pi_t} B_{t-1}^g - G_t \end{aligned}$$

Rearranging, we may define saver specific tax T_t^s:

$$\begin{aligned} C_t^s + \frac{\eta}{1-\eta} B_t &= W_t N_t^b + \Pi_t^f + \frac{1+i_{t-1}^d}{\Pi_t} \frac{\eta}{1-\eta} B_{t-1} - T_t^s \\ T_t^s &= \frac{\eta}{1-\eta} \left(B_t^g - \frac{1+i_{t-1}^d}{\Pi_t} B_{t-1}^g \right) + G_t \end{aligned}$$

For the borrower household, we may define the borrower specific tax $T_t^b = G_t - \left(B_t^g - \frac{1+i_{t-1}^d}{\Pi_t} B_{t-1}^g \right)$. It is readily verified that the household specific taxes satisfy the balanced budget constraint. ■

The proposition illustrates an equivalence relation between deficit-financing and transfers between agents. As the budget deficit increases, taxes fall for the borrower household and rise for the saver. A tax rebate represents a pure transfer from savers to borrowers despite the fact that both households receive the tax rebate. A deficit financed increase in purchases represents a combination of both transfers and purchases.

However, the transfer cannot be one way. As the debt is stabilized or decreased, the transfer reverses - borrowers make a transfer back to savers. Thus, in general, the converse of the proposition will not hold. A fiscal authority that can levy household specific taxes can implement a richer set of policies than a fiscal authority constrained to uniform taxation and deficit financing. For example, a one-way transfer cannot be implemented as a deficit-financed rebate. Moreover, the capacity of the fiscal authority to engineer transfers depends on the initial level of debt - with high levels of public debt, an increase in transfers requires an increase to higher debt levels where the overall transfer will be blunted by the size of interest payments.

4 Case of No Wealth Effects on Labor Supply

In this section, I examine the effect of purchases and transfers in a setting where household preferences or the structure of labor markets eliminate wealth effects on labor supply. The absence of wealth effects eliminates any effect of fiscal policy on aggregate supply. With prices set freely each period, firms' incentives to hire labor are not changed because neither its marginal costs nor its production technology are affected by the change in fiscal policy. When prices are changed only periodically, changes in fiscal policy will have an effect on aggregate demand. When prices are fixed, producers must meet demand at posted prices raising marginal costs. However, the monetary authority is always free to tighten interest rates and dampen demand so long as it is not constrained

by the zero lower bound.

4.1 Flexible Prices

When producers are free to set prices each period, prices are a constant markup over marginal costs. Since price is normalized to unity, marginal costs are constant: $\overline{MC} = \frac{1}{\mu_p}$ in all periods.

Proposition 2. *If prices are flexible and labor supply depends only on the wage for both households (Definition 1), then output and employment are determined independently of fiscal policy.*

Proof. For each household, labor supply is determined by (2):

$$W_t = v_i\left(N_t^i\right)$$

for $i\epsilon\{s, b\}$. Under the assumptions in Section 3, the function v is increasing. Therefore, it's inverse exists and combining the labor supply equation with labor market clearing:

$$N_t = \eta v_b^{-1}\left(W_t\right) + \left(1-\eta\right) v_s^{-1}\left(W_t\right)$$

Using the firm's production function (11) and labor demand condition (10), wages can be expressed in terms of employment:

$$W_t = \alpha\overline{MC} N_t^{\alpha-1}$$

Replacing wages, aggregate employment is determined independent of fiscal policy. The production function implies that output is also determined independent of fiscal policy. ■

Importantly, the irrelevance of fiscal policy holds irrespective of any of the properties of the credit spread and would continue to obtain in a model with other types of financial frictions (such as borrowing constraints) or a larger number of agents, so long as the labor supply relation holds for each agent. Using the economy's resource constraint (17), it follows that a tax rebate or transfer has no effect on aggregate consumption while an increase in government purchases is offset by an equivalent decrease in consumption. Significantly, the insights of the representative agent model are unchanged in the multiple agent setting.

4.2 Sticky Prices

Under sticky prices, marginal costs are no longer constant and fiscal shocks will affect output and employment through the aggregate demand channel. However, monetary policy can also affect output and employment via the aggregate demand channel, and, since the feasible set of combinations of output and inflation is unchanged by the presence of credit spreads, monetary policy and fiscal policy are redundant.

To show that the Phillips curve is unchanged, I use a log-linear approximation to the equilibrium conditions to obtain the output inflation tradeoff. Under GHH preferences, the household's log-linearized labor supply conditions imply:

$$w_t = \frac{1}{\nu} n_t^i$$

for $i \epsilon \{s, b\}$. Aggregating using a log-linearized version of (18) and eliminating w_t using (15):

$$mc_t = n_t - y_t + \frac{1}{\nu} n_t$$

Eliminating n_t using the log-linearized production function (16) and using the equation for mc_t, the standard New Keynesian Phillips curve is obtained:

$$\pi_t = \frac{\kappa}{\alpha}\left(1 - \alpha + \frac{1}{\nu}\right) y_t + \beta E_t \pi_{t+1}$$

The case of wage rigidity is simply the case of $\nu \to \infty$:

$$\pi_t = \frac{\kappa}{\alpha}(1 - \alpha) y_t + \beta E_t \pi_{t+1}$$

If monetary policy seeks to stabilize some combination of output and inflation, the targeting rule for optimal monetary policy will be unaffected by the presence of credit spreads or their variability. Formally, if the central bank chooses a path of π_t, y_t to minimize a loss function of the form:

$$\mathcal{L} = E_0 \sum_{t=0}^{\infty} \beta^t \left(\pi_t^2 + \lambda y_t^2\right)$$

subject to the Phillips curve given above, then the target criterion is the standard one:

$$\pi_t + \frac{\lambda}{\vartheta}(y_t - y_{t-1}) = 0$$

where ϑ is the slope of the Phillips curve.[11] Importantly, the loss function here is ad hoc rather than microfounded - a second-order approximation of average utility in this economy would in general depend on differences in marginal utilities across households due to the presence of credit frictions (see Curdia and Woodford (2010) for an analysis of optimal monetary policy).

However, ignoring distributional concerns and assuming that monetary policy is primarily concerned about aggregate outcomes, the presence of credit spreads does not affect the set of feasible inflation and output combinations faced by the central bank. The primacy of monetary policy in determining the effect of fiscal shocks is similar to the conclusions in Woodford (2011). He showed that the government purchases multiplier could be larger or smaller than the neoclassical multiplier depending on how aggressively monetary policy responds to inflation.

Though, the inflation/output tradeoff is unchanged by credit spreads, the implementation of monetary policy will be affected. In general, setting the correct policy rate i_t^d to implement a targeting criterion will require the monetary authority to take into account changes in the credit spread. A log-linear approximation to the household's Euler equations (1) and (3) - (4) and a log-linear approximation to the resource constraint (17) can be used to derive an aggregate IS curve:

$$i_t^d = E_t\pi_{t+1} - \frac{1}{s_c\tilde{\sigma}}(y_t - g_t - E_t(y_{t+1} - g_{t+1})) - \frac{s_b\sigma_b}{\tilde{\sigma}}\omega_t$$

where ω_t is the credit spread, σ_b is the borrower household's intertemporal elasticity of substitution, $\tilde{\sigma}$ is a weighted average of households intertemporal elasticity of substitution, s_b is the share of borrower's consumption in total consumption in steady state, and s_c is the share of private consumption in total output in steady state. Fiscal policy will directly affect the determination of interest rates through government purchases and also affect interest rates via the spread. So long as the zero lower bound on nominal interest rates is not binding, there exists a path of interest rates consistent with the target path of output and inflation set by the monetary authority. Any changes in fiscal policy can be accommodated by suitable adjustment of the interest rate. Since a path of output implies a path of employment, monetary policy and fiscal policy are redundant in

[11] The optimal targeting criterion features output instead of the output gap because the natural rate of output is simply steady state output.

determining those quantities when the zero lower bound is not binding.

4.3 Consumption and Saving Behavior

Importantly, monetary policy and fiscal policy cannot achieve the same equilibrium allocations and are not equivalent in terms of the distribution of consumption between saver and borrower households. Fiscal policy may still have a role in achieving some distribution of consumption or level of private debt, and fiscal policy in general will have consequences for household wealth even if output is unchanged.

In the case of rigid real wages, setting $\chi_n = 0$, and if prices are flexible or monetary policy stabilizes inflation (i.e. $\pi_t = 0$ for all t), analytical solutions can be obtained for consumption of the borrower household:

$$c_t^b = \zeta_a a_{t-1} + \zeta_\tau tax_t \tag{19}$$

where $a_{t-1} = b_{t-1} + i_{t-1}^d + \omega_{t-1}$, ζ_a is the response of borrower consumption to the endogenous state variable a_{t-1}, and ζ_τ is the response of consumption to an exogenous tax increase. The state variable a_{t-1} captures the total repayments that must be made by the borrower household in the current period (i.e. debt inclusive of interest payments).

When the debt elasticity of the credit spread is zero ($\chi_b = 0$), consumption responds minimally to temporary tax rebates with most of the proceeds used to pay down debt:

$$\zeta_a = -\bar{i}\frac{\bar{b}}{\bar{c}_b} \tag{20}$$

$$\zeta_\tau = -\frac{\bar{y}}{\bar{c}_b}\frac{\bar{i}}{1-\rho+\bar{i}} \tag{21}$$

where ρ is the persistence of the tax shock. If the borrower fully spent a tax rebate, then $\zeta_\tau = \frac{\bar{y}}{\bar{c}_b}$. As can be seen, borrowers have a marginal propensity to consume of unity only if the rebate is permanent (i.e $\rho = 1$). If $\rho = 0$, then the multiplier is small because the steady state borrowing rate $\bar{i}$ is small. As the coefficient ζ_a reveals, consumption is not particularly responsive to changes in household debt for small value of $\bar{i}$.

An explicit solution can also be obtained in the case that $\chi_b \to \infty$. The coefficients determining

the response of consumption to repayments and taxes are given below:

$$\zeta_a = -\left(1+\bar{i}\right)\frac{\bar{b}}{\bar{c}_b} \tag{22}$$

$$\zeta_\tau = -\frac{\bar{y}}{\bar{c}_b} \tag{23}$$

As can be seen, the response of borrower consumption to a decrease in taxes ζ_τ is the same as in the case of rule-of-thumb behavior. This coefficient does not depend on the persistence of the tax rebate. Likewise, borrower consumption is also strongly responsive to changes in debt repayments.

While the impact effect of a tax rebate is the same as in the case of rule-of-thumb behavior, temporary tax rebates have a larger dynamic multiplier due to effects on the evolution of the endogenous state variable a_t. Even a tax rebate that lasts only one period will have a persistent effect on borrower consumption by lowering future borrowing rates. While $b_t = 0$ at all points in time when the debt elasticity is infinite, the credit spread falls in the future thereby crowding in consumption. This credit market channel is not present in models with rule-of-thumb agents or in models with simple borrowing constraints. Put differently, borrower consumption rises not only today but in future periods in response to a one-period transfer; in the rule-of-thumb case, borrower consumption would only rise in the periods when the transfer is received.

5 Case of Wealth Effects on Labor Supply

As the previous section illustrates, in the absence of wealth effects the transfer multiplier is either zero or entirely determined by the stance of monetary policy. Various parameters that govern the behavior of credit spreads are not directly relevant for the effect of fiscal policy on output.

In this section, I shift to the more conventional case of considering fiscal policy in the presence of wealth effects. In this case, analytical conclusions are less readily available and a quantitative analysis is required. These results show that, under standard parameterizations, the transfer multiplier is close to zero when prices are flexible and fairly modest when prices are sticky.

5.1 No Credit Friction Benchmark

To allow for wealth effects on labor supply, I consider standard preferences where the level of consumption affects agent's labor supply. To a log linear approximation, each agent's labor supply

condition relates the wage to hours worked and consumption:

$$w_t = \frac{1}{\varphi_i} n_t^i + \frac{1}{\sigma_i} c_t^i$$

for $i \epsilon \{s, b\}$, where φ_i is the Frisch elasticity of hours with respect to the wage and σ_i is the elasticity of intertemporal substitution. The labor supply approximation given above holds irrespective of whether utility is separable in consumption and hours.

To examine how credit spreads affect fiscal multipliers, it is useful to first derive a benchmark with no credit frictions for comparison. In this setting, marginal utilities (in log-deviations) must be equalized across agents implying that $c_t^s = c_t^b = c_t$. Solving each agent's labor supply equation in terms of n_t^i and aggregating labor using (18), an aggregate labor supply relation can be derived:

$$\begin{aligned} w_t &= \frac{1}{\tilde{\varphi}} n_t + \frac{1}{\tilde{\sigma}} c_t \\ \tilde{\varphi} &= l_b \varphi_b + (1 - l_b) \varphi_s \\ \tilde{\sigma} &= \frac{\tilde{\varphi}}{\left(l_b \frac{\varphi_b}{\sigma_b} + (1 - l_b) \frac{\varphi_s}{\sigma_s} \right)} \end{aligned}$$

where l_b is the share of borrower's hours in total hours worked. Given this aggregate labor supply condition, the output multiplier can be obtained by solving for consumption and the wage in terms of output (assume flexible prices so that $mc_t = 0$) and substituting into the resource constraint (17):

$$y_t = \frac{\alpha}{\alpha + s_c \tilde{\sigma} \left(1 - \alpha + \frac{1}{\tilde{\varphi}} \right)} g_t$$

where s_c is the share of consumption in GDP and $\tilde{\varphi}$ is the average Frisch elasticity and $\tilde{\sigma}$ is a weighted intertemporal elasticity of substitution. Government spending increases output via a negative wealth effect, but the government spending multiplier is necessarily less than one. Transfers and deficit-financing have no effect on output. Aside from differences in the definition of the intertemporal elasticity of substitution and the Frisch elasticity, this expression for output is the same as would obtain in a representative agent setting.

The no credit frictions case also admits a representation for the Phillips curve. Eliminating mc_t using the labor demand equation (15) and eliminating n_t using the production function (16)

provides a Phillips curve representation:

$$\pi_t = \kappa \left(w_t + \frac{1-\alpha}{\alpha} y_t \right) + \beta E_t \pi_{t+1}$$

Using the resource constraint (17) to eliminate c_t and the production function, wages can be expressed in terms of output and government purchases. Replacing the wage in the Phillips curve provides the relationship between output and inflation:

$$\pi_t = \frac{\kappa}{\alpha} \left(\frac{1}{\tilde{\varphi}} + \frac{1}{s_c \tilde{\sigma}} + 1 - \alpha \right) y_t - \frac{\kappa}{s_c \tilde{\sigma}} g_t + \beta E_t \pi_{t+1}$$

An increase in government purchases shifts back the Phillips curve by increasing labor supply and lowering wages - purchases raise the natural rate of output. Transfers and tax rebates have no effect on the Phillips curve.

5.2 Flexible Prices

In the case of a model with credit spreads, the labor supply relations can be solved for consumption c_t^i in terms of the wage w_t and hours worked n_t^i for each agent. Substituting into the resource constraint and eliminating the wage using (15), output can be expressed in terms of purchases and hours worked by each agent:

$$\begin{aligned} y_t &= \frac{\alpha}{\alpha + s_c \overline{\sigma}(1-\alpha)} g_t \\ &\quad - \frac{s_c}{\alpha + s_c \overline{\sigma}(1-\alpha)} \left(\frac{s_b \sigma_b}{\varphi_b} n_t^b + \frac{(1-s_b)\sigma_s}{\varphi_s} n_t^s \right) \end{aligned}$$

where $\overline{\sigma} = s_b \sigma_b + (1-s_b)\sigma_s$ is a weighted average elasticity of intertemporal substitution and other parameters as defined earlier.

The expression for output can be further simplified by solving for n_t^b from labor market clearing (18), giving output as a function of government purchases and the saver household's labor supply:

$$\begin{aligned} y_t &= \frac{\alpha}{\alpha + s_c \overline{\sigma}(1-\alpha) + s_c \frac{s_b \sigma_b}{l_b \varphi_b}} g_t \\ &\quad + \frac{\alpha s_c}{\alpha + s_c \overline{\sigma}(1-\alpha) + s_c \frac{s_b \sigma_b}{l_b \varphi_b}} \left(\frac{(1-l_b)}{l_b} \frac{s_b \sigma_b}{\varphi_b} - \frac{(1-s_b)\,\sigma_s}{\varphi_s} \right) n_t^s \end{aligned}$$

Proposition 3. *Transfers and the means of financing any government expenditure have no effect*

on output and employment if any of the following conditions hold:

1. *Preferences are linear in hours worked as in Hansen (1985) and Rogerson (1988)*
2. *Labor supply by households is coordinated:* $n_t^s = n_t^b$
3. *Preferences satisfy the following condition:*

$$\frac{1-l_b}{l_b}\frac{\varphi_s}{\varphi_b} = \frac{1-s_b}{s_b}\frac{\sigma_s}{\sigma_b}$$

Proof. In the first case, as the Frisch elasticities $\varphi_s = \varphi_b \to \infty$, the coefficient on the second term in the expression for output goes to zero, and output is only affected by purchases. In the second case, hours worked by the saver hours equal aggregate hours: $n_t^s = n_t = \frac{1}{\alpha} y_t$ and output is solely a function of purchases. In the last case, the coefficient on hours of the saver household is zero. ■

The proposition illustrates that, even with wealth effects on labor supply, transfers and deficit-financing may have little effect on output or employment. The deviations from the frictionless benchmark stem solely from the second term in the output expression. If households are sufficiently homogenous - that is, if household do not differ appreciably in underlying parameters and shares of consumption and hours, the coefficient on the second term is likely to be small. If this coefficient is positive, fiscal policies that strengthen the negative wealth effect on the saver household will boost the output multiplier relative to the benchmark case. In particular transfers away from the saver household should boost multipliers. However, if the coefficient is negative, fiscal policies that boost the negative wealth effect on borrowers will increase multipliers.

5.3 Sticky Prices

In the case of sticky prices, fiscal policy has both a supply effect that reduces marginal costs and an demand effect that raises marginal costs. Monetary policy does not face a stable Phillips curve relation between inflation and output, and the choice of fiscal policy may shift the Phillips curve in favorable or unfavorable ways. As before, the Phillips curve can be expressed in terms of both output and wages:

$$\pi_t = \kappa \left(w_t + \frac{1-\alpha}{\alpha} y_t \right) + \beta E_t \pi_{t+1}$$

However, unlike the frictionless case, wages cannot generally be expressed in terms of aggregate output.

Table 3: Calibration summary

Parameter description	Parameter	Value	Parameter Description	Parameter	Value
Intertemporal elasticity	σ_i	1	Deposit rate	$\bar{i}_d$	$1.02^{0.25}$
Frisch elasticity	φ_i	2	Borrowing rate	$\bar{i}_b$	$1.06^{0.25}$
Calvo parameter	θ	0.75	Borrower share	η	50%
Markup	μ_p	0.25	Debt elasticity	χ_b	0.1
Wage bill	$\overline{WN}/\overline{Y}$	0.70	Income elasticity	χ_n	0
Gov't purchases	$\overline{G}/\overline{Y}$	0.20	Taylor rule (inflation)	ϕ_π	1.5
Debt/GDP	$\overline{B}_g/\overline{Y}$	2	Taylor rule (output)	ϕ_y	0.25
Household debt	$\overline{B}/\overline{WN}_b$	4	Fiscal rule	ϕ_b	0.2

In the cases considered in the previous proposition, transfers have no effect on aggregate output and therefore the Phillips curve can be represented solely in terms of inflation, output, and government purchases as in the benchmark case. Since transfers do not shift the Phillips curve, credit spreads do not affect the Phillips curve and the output-inflation tradeoff is unchanged. As before, households labor supply equations can be aggregated into an aggregate labor supply equation:

$$w_t = \frac{1}{s_c\tilde{\sigma}}\left(y_t - g_t\right) + \frac{1}{\tilde{\sigma}}\left(\frac{s_b\sigma_b}{\varphi_b}n_t^b + \frac{(1-s_b)\sigma_s}{\varphi_s}n_t^s\right)$$

where the first term gives the wealth effect on labor supply and the second term gives the substitution effect. Because government purchases act to directly lower the wage while transfers cause offsetting movements in hours between households, purchases have a greater downward effect on wages. A reduction in wages will provide the monetary authority with a more favorable output and inflation tradeoff and allow for a less restrictive monetary policy. In this sense, one can conjecture that purchases may be better than transfers for boosting output and employment since they allow monetary policy greater scope for accommodation.

5.4 Calibration

As I have shown, in the presence of wealth effects on labor supply, fiscal policy will feature both supply and demand channels. To assess the degree to which credit frictions matter, I calibrate the model with wealth effects and examine the effect of deficit-financed purchases and tax rebates. While each deficit-financed policy can be expressed as a balanced budget combination of purchases and transfers, the deficit-financed policies considered here are closest to fiscal policy in practice and

avoid issues of incentive compatibility.[12]

The baseline calibration assumes standard separable utility function of the form

$$U(C,N) = \frac{C^{1-\sigma^{-1}}}{1-\sigma^{-1}} - \nu N^{1+\varphi^{-1}}$$

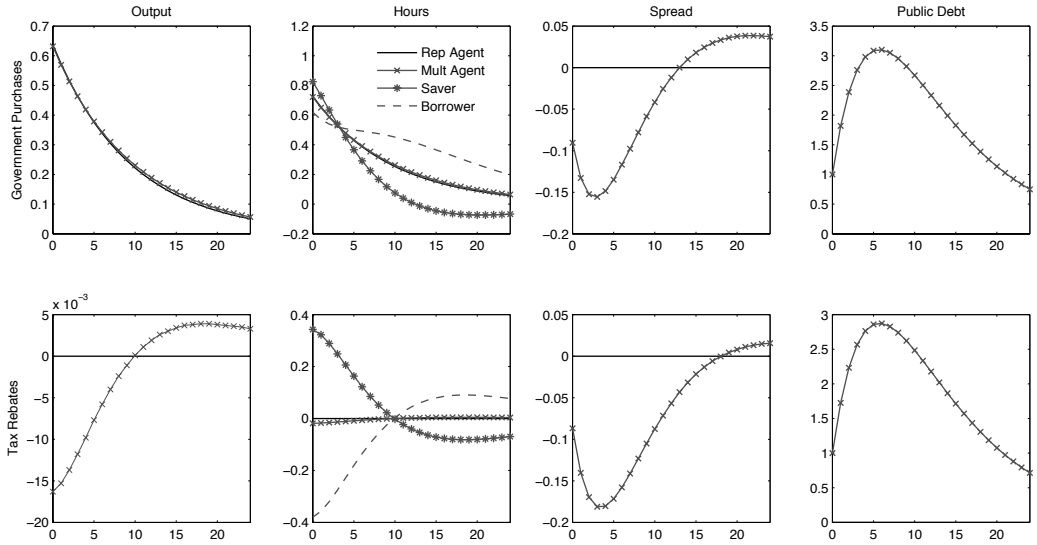
with standard values for the Frisch elasticities and intertemporal elasticities of substitution. In the baseline calibration these values are equal across agents with $\varphi_b = \varphi_s = 2$ and $\sigma_b = \sigma_s = 1$. In steady state, output $\overline{Y}$ is normalized to 1 and the disutility of labor supply for each household ν_s and ν_b is set to ensure that each household supplies labor such that $\overline{N}_b = \overline{N}_s = 1$. The markup due to monopolistic competition is set at 25% and the labor share α is set to ensure that the wage bill is equal to 70% of GDP, consistent with U.S. data. The Calvo parameter θ is set to 0.75 so that firms change prices every 4 quarters on average. The rates of time preference β and β_b are set to target an annual deposit rate of 2% and an annual borrowing rate of 6%.[13] The disutilities of labor supply, the rates of time preference, and the markup do not enter the log-linearized equilibrium conditions and, therefore, do not affect the dynamics of the model. In steady state, the consumption of the borrower household is less than that of the saver household since the saver household earns both wage income and profits from the firm. Government spending is 20% of GDP in steady state. The steady state public debt is 50% of GDP consistent with recent U.S. levels. The response parameter in the fiscal rule ϕ_b is close to the rule used in Gali, Lopez-Salido and Valles (2007), which is based on VAR estimates for U.S. data. In steady state, the household debt for the borrower household is equal to annual household income consistent with data on household wealth from the Survey on Consumer Finances.

The nonstandard parameters for the model include the credit spread parameters χ_b and χ_n that control, respectively, the endogenous response of spreads to private sector debt and expected borrower income and the share of borrower households η in the economy. In the baseline case, I will consider a debt-elastic spread such that $\chi_b = 0.1$ and $\chi_n = 0$ - a calibration that implies a 1% increase in debt raises spreads by roughly 50 basis points. In general, a regression of spreads on measures of indebtedness and income in aggregate data is unlikely to accurately estimate these elasticities given that common shocks may induce a comovement of income and spreads even though $\chi_n = 0$. As shown in Section 6, the financial shock z_t causes income and spreads to comove even

[12] In the case of household specific taxes and transfers, household have an incentive to mask their type and represent themselves as borrowers or lenders based on the proposed fiscal policy.

[13] The implied credit spread is somewhat conservative to take into borrowing cost for collateralized household loans like mortgages. In any case, these rates of time preference do not affect the log-linearized dynamics.

Figure 1: Deficit-financed purchases and tax cuts



with $\chi_n = 0$. As it turns out, these credit spread elasticities have little effect on the experiments here suggesting that spreads may have a fairly small effect on fiscal policy transmission away from the zero lower bound. The share of borrower household η is set to 50% as in Curdia and Woodford (2010); this parameter has no obvious analogue in the data and is selected conservatively to minimize heterogeneity. The calibration values are summarized in Table 3.

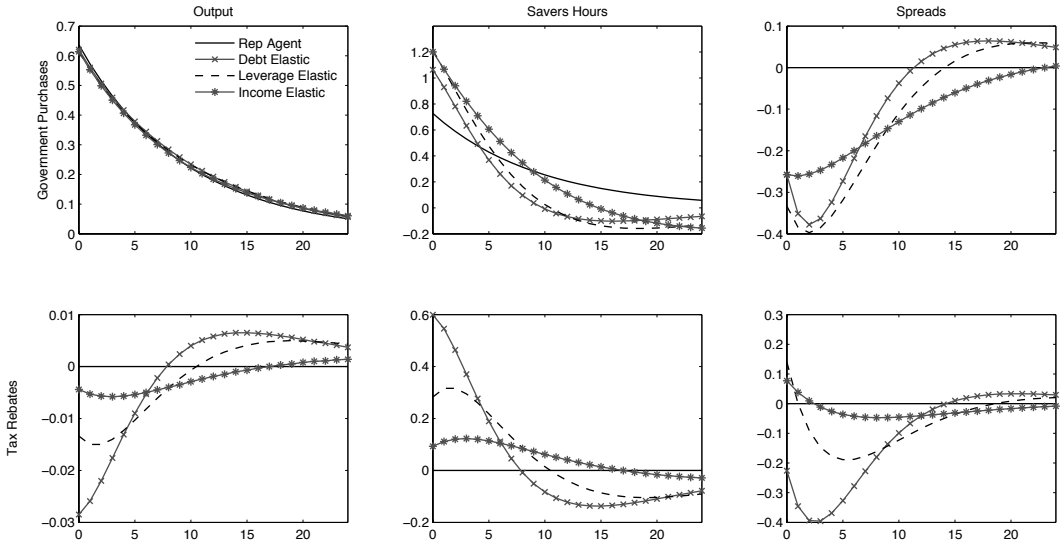
5.5 Fiscal Policy Experiments and Sensitivity

The first experiment in Figure 1 considers the effect of a 1% of GDP increase in government purchases (top panel) and a 1% of GDP increase in tax rebates (bottom panel), each with a persistence of $\rho = 0.9$. The figure also shows the response of the no credit frictions economy with parameters as defined in Section 5.1. The fiscal authority runs a budget deficit and taxes follow a fiscal rule - taxes adjust upwards to return the public debt to its steady state level. Prices are reset each period and, therefore, firm markups are constant.

In this environment, the effect of purchases and rebates is driven by wealth effects on labor supply. Under the baseline calibration where the Frisch elasticity and intertemporal elasticity of substitution are equal, the only source of heterogeneity is the share of borrower consumption $s_b < \frac{1}{2}$ since the borrower household pays interest to the intermediary and does not receive any profits from firms.[14] Under this calibration, the coefficient on saver's hours (in the output expression Section 5.2)

[14]Steady state government purchases are financed by a tax on patient households to reduce differences in steady

Figure 2: Alternative credit spread elasticities

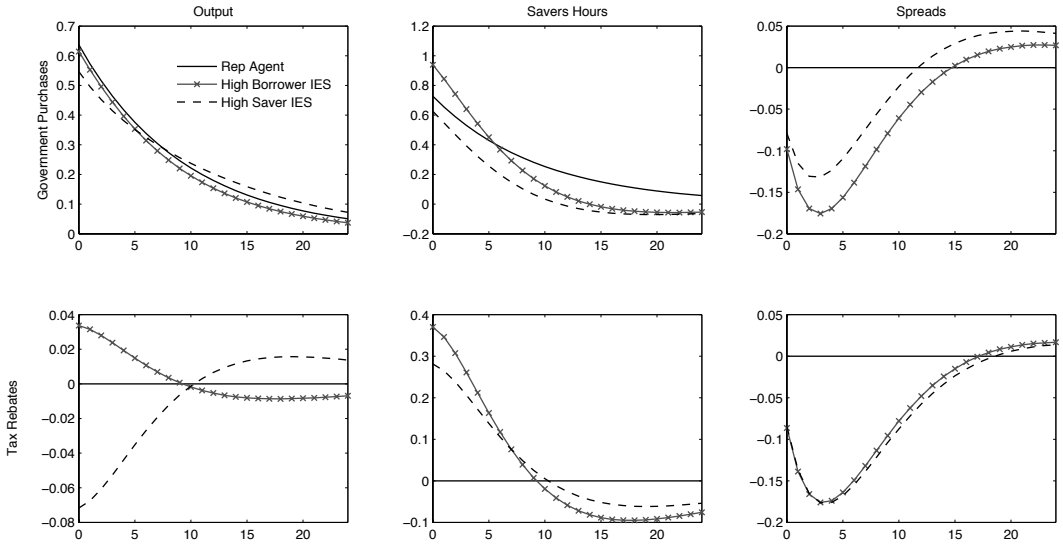


is negative. As a result, the tax rebate multiplier is slightly negative - the fall in hours worked by the borrower household is not fully offset by the rise in hours by the saver household. The transfer acts to dampen aggregate incentives to work. Likewise, the government purchases multiplier on output is slightly lower than the frictionless benchmark since the labor supply effects for the borrower are dampened by the increase in the deficit. As the second column shows, the response in hours worked by each household is quite different reflecting the transfer component of fiscal policy. However, these movements wash out in the aggregate - the difference in aggregate hours between the benchmark model and the model with credit frictions is miniscule. The dynamics of public debt illustrate the degree of transfers from the saver household - periods of increasing debt represent net transfers to borrowers, while periods of stabilizing and falling debt represent transfers from borrowers back to savers. Importantly, these policies do not imply the same debt dynamics since changes in the interest rate have an effect on debt accumulation in a calibration with a positive steady state level of debt. With zero debt and a linear approximation, both policies would imply the same path of the public debt. Government purchases have larger output multipliers than tax rebates simply because purchases have a larger wealth effect on labor supply. Output and employment rise as the wage falls due to the increased willingness of both households to work.

Figures 2 and 3 examine how sensitive these results are to the credit spread elasticities χ_b and

state levels of consumption (through a tax on capital holdings). However, it is assumed that both household pay taxes proportional to their size in the economy to finance government purchases in excess of steady state levels. In steady state, $\overline{C}_s/\overline{C}_b \sim 1.3$.

Figure 3: Alternative intertemporal elasticities of substitution

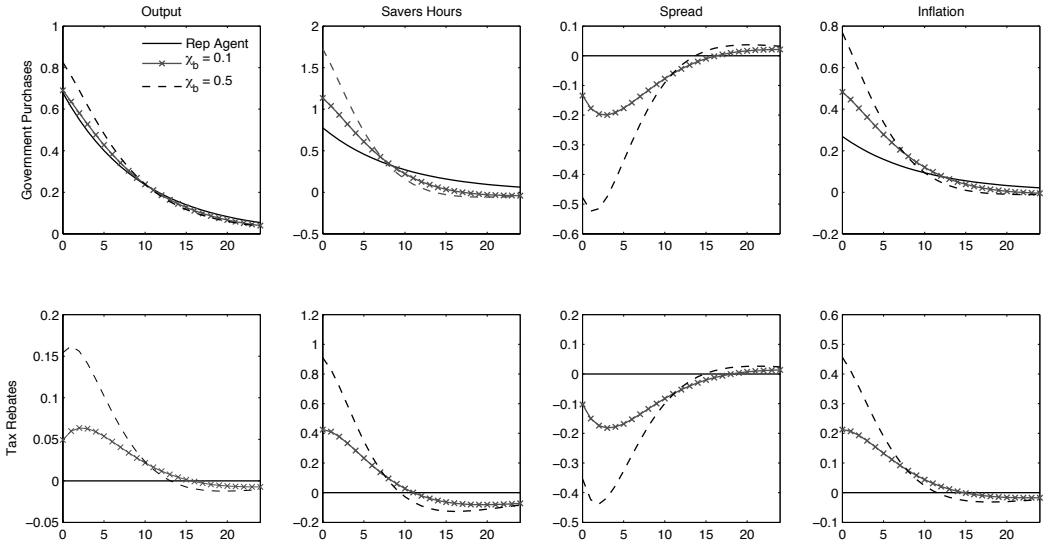


χ_n and to heterogeneity in wealth effects across households by adjusting the relative intertemporal elasticities of substitution. Figure 2 show that different models of the spread have little effect on the deviations of output multipliers from the benchmark case - in particular that tax rebate multiplier is still negative and close to zero. Figure 2 considers three cases: debt elastic spreads ($\chi_b = 0.5,\ \chi_n = 0$), leverage elastic spread ($\chi_b = \chi_n = 0.5$), and income elastic spread ($\chi_b = 0.1,\ \chi_n = 0.5$). In all cases, the purchases and rebate multipliers deviates by less than 5% from the frictionless benchmark. In each case, the behavior of hours and spreads differs, but the aggregate effect on output, hours, wages, and consumption are all close to the frictionless benchmark. The second column shows that saver's hours respond strongly to the tax rebate shock, but the borrower's response almost fully offsets this rise in hours resulting in little net effect.

Figure 3 examines the effect of variations in the relative intertemporal elasticity of substitution holding the average intertemporal elasticity fixed at $\tilde{\sigma} = 1$ where $\tilde{\sigma}$ is as defined in Section 5.2. In the case of "high borrower elasticity," wealth effects for the borrower household are diminished by choosing an intertemporal elasticity of substitution three times higher than that of the saver household. Alternatively, in the case of "high saver elasticity," the borrower household has an intertemporal elasticity of substitution one-third the size of the saver household and, therefore, the borrower's labor supply is more sensitive to changes in wealth. When the borrower household exhibits smaller wealth effects, the tax rebate multiplier becomes positive.[15] Savers respond to the

[15]Relatively stronger wealth effects for saver household could be justified on the grounds that wealthier households

Figure 4: Deficit-financed purchases and tax rebates under a Taylor rule



negative wealth shock by working harder while borrowers reduce their hours but by less than in the baseline case. As a result, aggregate hours and output rises. The opposite occurs in the case of high saver elasticity for the same reason. As before, the government purchases multiplier is an order of magnitude higher than the tax rebate multiplier simply because of the stronger wealth effects on aggregate labor supply under purchases.

Figure 4 relaxes the assumption of flexible prices and examines the effect of an increase in purchases and tax rebates when monetary policy follows a Taylor rule. To ensure that a tax rebate is expansionary, the calibration used in Figure 4 assumes the case of a high borrower elasticity of intertemporal substitution - that is, $\sigma_b/\sigma_s = 3$. As the experiment demonstrates, fiscal multipliers rise sizably under an operative aggregate demand channel. Moreover, a more elastic credit spread raises multipliers further - when the elasticity of the spread to debt rises from $\chi_b = 0.1$ to $\chi_b = 0.5$, the output multiplier on purchases rises from 0.69 to 0.82. Likewise, the output multiplier for tax rebates rises from 0.05 to 0.15. The falling credit spread dampens the transmission of monetary policy as the rise in the deposit rate is not fully incorporated into the borrowing rate (since spreads are falling). However, as noted earlier, bigger multipliers come only at the cost of higher inflation as seen in the last column. This rise in inflation is due to the fact that the Phillips curve has not shifted, and larger multipliers are the product of an accommodative stance of monetary policy. As before, the purchases multiplier is an order of magnitude larger than the transfers multiplier.

have greater scope to adjust their labor supply than poorer households.

However, if monetary policy responds asymmetrically to different fiscal shocks, it is possible to obtain cases where the tax rebate multiplier is as high or higher than the purchases multiplier. Finally, purchases are preferred to tax rebates in the sense that purchases generate a larger rise in output and employment for a given amount of inflation. The negative wealth effect of purchases raises labor supply, reduces marginal costs, and improves the Phillips curve tradeoff.

6 Zero Lower Bound

In this section, I examine how credit spread shocks may cause the zero lower bound to bind and consider the effect of government purchases and transfers on output and consumption. Consistent with results obtained under representative agent models, the government purchases multiplier is above unity at the zero lower bound. Additionally, transfers (implemented by tax rebates) may be similarly effective as purchases in stabilizing output and consumption. The choice among policies depends on the endogenous feedback of debt and income on the credit spread, particular the debt elasticity of the credit spread.

Representative agent models typically rely on preference shocks or other reduced form shocks to the natural rate of interest to cause the zero lower bound to bind. However, in a model with multiple agents, disruptions to the financial system that raise the credit spread may also cause the zero lower bound to bind. As shown in Section 4, an aggregate IS equation can be obtained by summing the agent's Euler equations:

$$i_t^d = E_t\pi_{t+1} - \frac{1}{s_c\tilde{\sigma}}\left(y_t - g_t - E_t\left(y_{t+1} - g_{t+1}\right)\right) - \frac{s_b\sigma_b}{\tilde{\sigma}}\omega_t$$

Any shock to the credit spread ω_t will drive down the interest rate when monetary policy seeks to maintain $y_t = \pi_t = 0$, and for sufficiently large shocks, the interest rate will fall to the zero bound. The reduced form credit spread depends endogenously on debt and borrower income and, exogenously, on a financial shock. Any underlying shock that drives up debt and/or decreases borrower income may reduce the deposit rate, but I will consider an exogenous financial shock as the shock that causes the zero lower bound to bind.

The special case of real wage rigidity and a credit spread with zero debt elasticity ($\chi_b = 0$) illustrates the role of purchases versus transfers in determining output and inflation. Under these conditions, output and inflation are solely determined by the Phillips curve and the intertemporal

IS curve:

$$\begin{aligned}\pi_t &= \kappa\frac{(1-\alpha)}{\alpha}y_t + \beta E_t\pi_{t+1}\\ y_t &= E_t\left(y_{t+1}\right) + E_t\left(g_{t+1}-g_t\right) - s_c\overline{\sigma}\left(i_t^d - E_t\pi_{t+1}\right) - s_c s_b\sigma_b\left(z_t - \frac{\chi_n}{\alpha}E_t y_{t+1}\right)\end{aligned}$$

where the credit spread is replaced by the log-linearized version of (9). By setting the debt elasticity of the spread to zero, the law of motion for debt and the distribution of consumption between saver and borrower households is decoupled from the determination inflation and output. Consider zero lower bound episode that is caused by a temporary increase in z_t to $\overline{z}$ that reverts to zero with probability $1-\rho$ in each period causing the zero lower bound to bind: $i_t^d = -\overline{r}$. Given the absence of a state variables, this two-equation system is forward-looking and multipliers may be computed explicitly as in Woodford (2010):

$$\begin{aligned}y_{zlb} &= \nu_g\overline{g} - \zeta\\ \nu_g &= \frac{(1-\rho)(1-\beta\rho)}{(1-\beta\rho)\left(1-\rho-s_c s_b\sigma_b\rho\frac{\chi_n}{\alpha}\right) - s_c\overline{\sigma}\frac{\kappa}{\alpha}(1-\alpha)\rho}\\ \zeta &= \frac{s_c(1-\rho)\left(s_b\sigma_b\overline{z} - \overline{\sigma r}\right)}{(1-\beta\rho)\left(1-\rho-s_c s_b\sigma_b\rho\frac{\chi_n}{\alpha}\right) - s_c\overline{\sigma}\frac{\kappa}{\alpha}(1-\alpha)\rho}\end{aligned}$$

The constant term gives the decrease in output in the absence of any policy intervention and under the assumption that monetary policy ensures that $y_t = \pi_t = 0$ after the financial shock dissipates.[16] If the credit spread does not respond (or responds weakly) to changes in private debt, transfers and tax rebates have no effect on output and inflation and are ineffective as fiscal stimulus. Government purchases are effective in counteracting the effects of a financial shock, but the mechanism is essentially the same as any representative agent model of government purchases at the zero lower bound. The means of financing the increase in purchases are irrelevant. In fact, the multiplier is identical to the multiplier in Woodford (2011) except for the endogenous effect of output on the spread through χ_n. When $\chi_n > 0$, the multiplier on government purchases is higher as is the negative effect of the financial shock.

The polar case of an infinite debt elasticity does not lend itself to an analytical solution at the zero lower bound like $\chi_b = 0$, but it is still possible to show how a higher debt elasticity raises the transfer multiplier. In particular, with rigid real wages and a labor share equal to unity,

[16] A solution exists only if the persistence of the financial shocks is such that the denominator of ν_g is positive.

consumption by the borrower is given by the following expression:

$$c_t^b = \frac{\bar{w}\bar{n}_b}{\bar{c}_b} y_t + \frac{\bar{b}}{\bar{c}_b} \frac{1}{1+\chi_b} a_t - (1+\bar{i}) \frac{\bar{b}}{\bar{c}_b} a_{t-1} - \frac{\bar{y}}{\bar{c}_b} tax_t \tag{24}$$

As the debt elasticity approaches infinity, the coefficient on a_t goes to zero and the borrower's consumption depends positively on current output and negatively on taxes. A tax cut will directly boost household consumption and indirectly boost consumption by raising income (the first term in the expression). This mechanism is borne out in the quantitative analysis that follows.

This simple example highlights how transfers operate through the credit spread. To the extent that transfers decrease the credit spread by lowering household indebtedness, transfers will have a positive multiplier. This analysis suggests that deficit-financed government purchases will be preferred to purchases financed by taxes because the transfer component of the policy further reduces credit spreads; indeed, this result holds in the numerical examples considered in the next section. Moreover, since transfers only operate through the spread, the transfers multiplier is unlikely to exceed the government purchases multiplier unless purchases worsen the rise in spreads. In the calibrated examples considered next, purchases reduce private sector indebtedness and the credit spread.

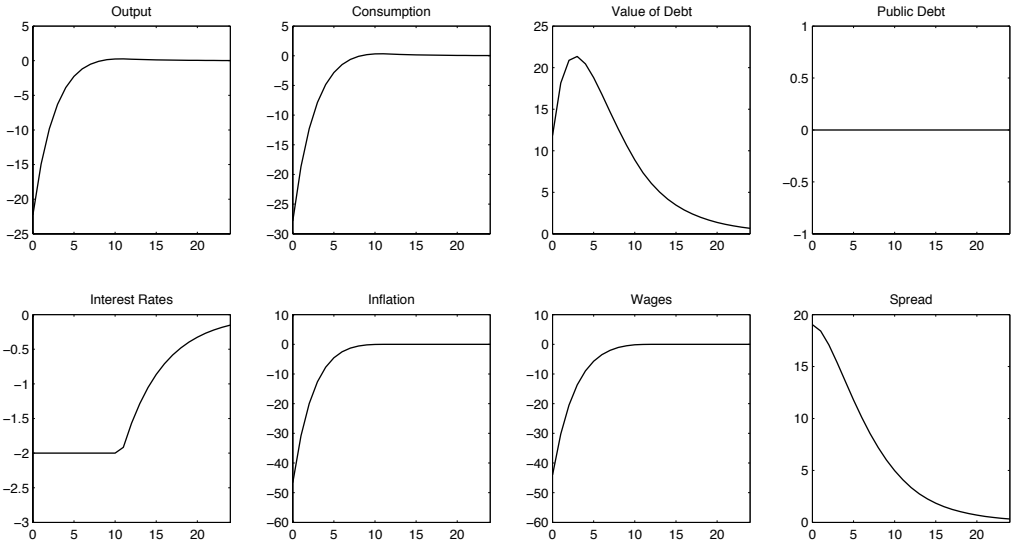
The experiment here roughly attempts to capture the type of disruption experienced in the U.S. after the collapse of Lehman Brothers in 2008. The model and calibration are the same as considered in the previous section, however, for simplicity, that monetary authority is assumed to follow perfect inflation stabilization $\pi_t = 0$ for all periods after the zero lower bound ceases to bind. While monetary policy may, in principle, mitigate the effects of the financial shock by committing to higher future inflation (as discussed extensively in Eggertsson and Woodford (2003)), I assume that time inconsistency diminishes the effectiveness of these commitments. Additionally, steady state public debt is assumed to be zero to ensure that each policy implies the same path for the public debt (to a linear approximation) and the shock generates no movements in debt or taxes beyond the dynamics implied by the fiscal rule.

6.1 No Policy Intervention

Figure 5 shows the effect of a financial shock that raises (annualized) credit spreads 16 percentage points.[17] The model is solved using the solution algorithm described in the appendix of Eggertsson

[17] The actual rise in the credit spread is larger because of the endogenous component due to the increase in private sector debt.

Figure 5: Financial shock with flexible wages



and Woodford (2003) and the financial shock is assumed dissipate with a persistence of $\rho = 0.8$.[18] The time at which the economy exits the zero lower bound depends on the endogenous behavior of private sector debt and the value of the elasticity χ_b. For high elasticities, a faster rate of deleveraging will cause the credit spread to fall faster hastening the exit from the zero lower bound. However, as shown in Figure 5, agents actually increase their debt loads since the elasticity of the spread to debt is fairly low ($\chi_b = 0.1$).

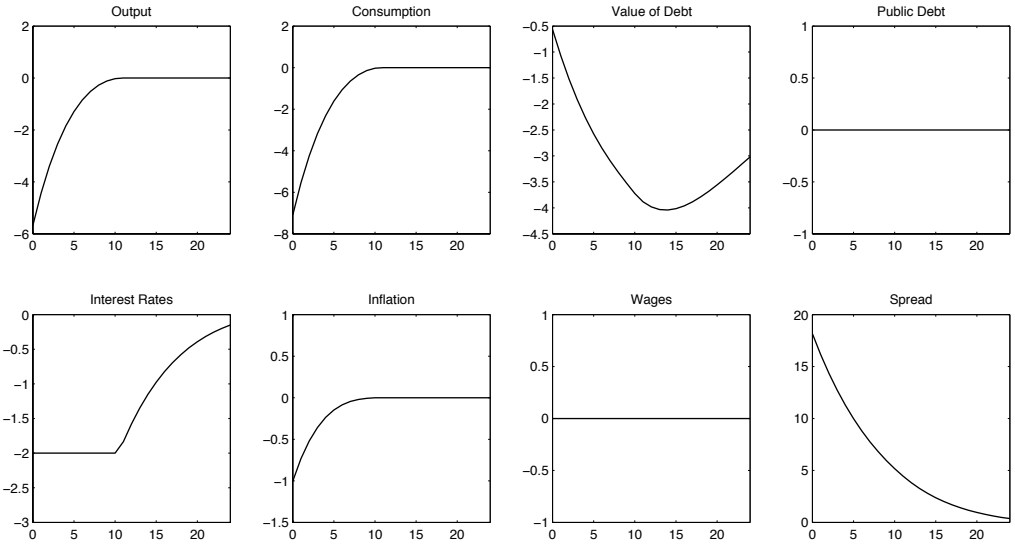
A 16 percentage point financial shock raises credit spreads by 20 percentage points and leads to a very large fall in output and consumption in excess of 20%. The negative wealth effect drives down wages 40% and the fall in demand and wages combines to cause a very steep deflation. The zero lower bound episode lasts for 10 quarters or two and half years, and rates gradually normalize as debt and spreads fall. After the ZLB ceases to bind, inflation remains at zero and output is marginally positive due to wealth effects that keep wages lower than their steady state level.

Given the role of wealth effects in leading to a counterfactually sharp fall in wages and inflation, I also consider a similar shock in a model without wealth effects on labor supply. In the presence of a perfectly rigid wage, changes in household wealth have no effect on output or employment. Figure 6 provides the impulse responses to a larger 20 percentage point financial shock.[19] Under

[18] Note that we do not assume that the shock reverts with some probability in each period, but rather the shock decays geometrically with $\rho = 0.8$. This assumption simplifies the solution but also allows fiscal policy to have an effect on when the economy exits the zero lower bound episode.

[19] The large size of the credit spread shock is made to target a drop in output of roughly the magnitude experienced

Figure 6: Financial shock with perfectly rigid real wages



rigid wages, the fall in output and inflation are significantly dampened with output falling 6% and (annualized) inflation falling 1% on impact - values that are comparable to the U.S. output and inflation response in the fourth quarter of 2008. The rigid wage model has the advantage of delivering much more realistic quantitative responses for output and inflation.[20] The zero lower bound ceases to bind in 12 quarters and, since the Phillips curve is independent of spreads, output, consumption and inflation jump to their steady state levels. Households deleverage throughout the crisis period and only begin to releverage after three years; interest rates remain below their steady state level for the entire period of 24 quarters or six years.

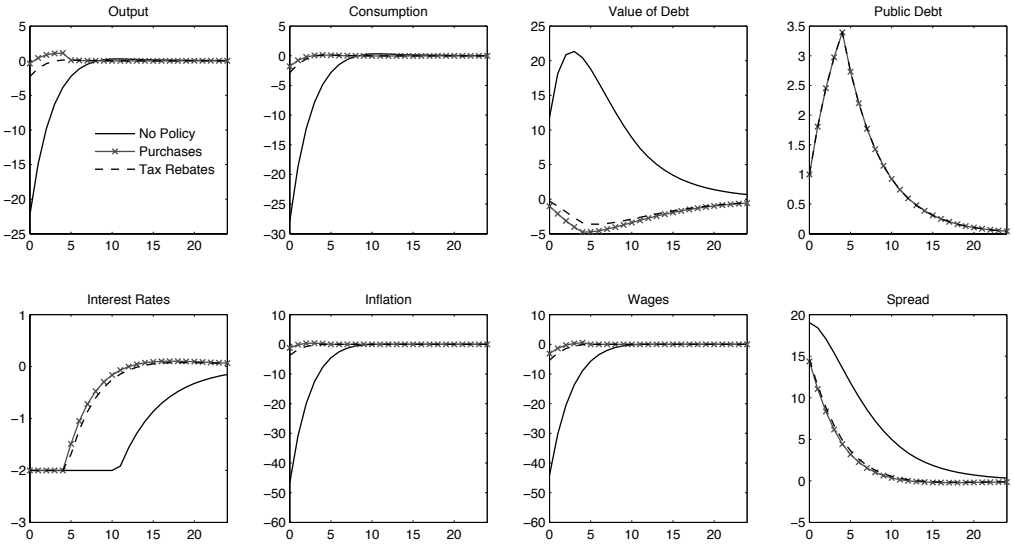
6.2 Policy Intervention

I consider deficit financed fiscal policies where the intervention ends as soon as the zero lower bound ceases to bind. Fiscal policy may either raise government purchases or reduce taxes by some level so long as the zero lower bound binds. The choice of a flexible or rigid wage has significant implications for the efficacy of policy. Figure 7 shows the effect of a 1% of GDP increase in government purchases and a 1% decrease in taxes for all periods that the zero lower bound binds. Small policy interventions have very large effects relative to no intervention. For both government

in the US during the Great Recession.

[20] Downward nominal wage rigidity has been offered as an explanation for the absence of a high levels of deflation despite high unemployment rates in the US and Europe.

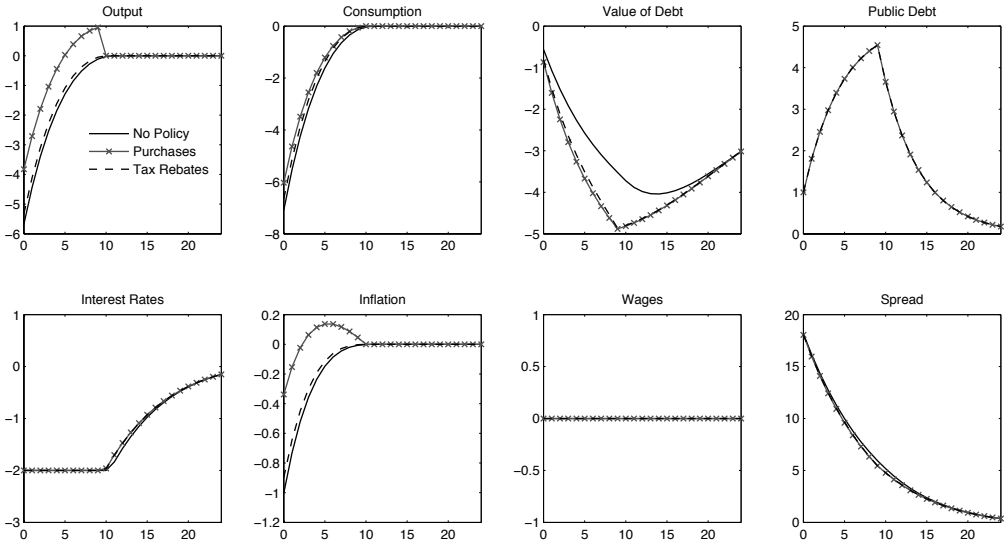
Figure 7: Deficit-financed purchases and tax rebates in flexible wage model



purchases and tax rebates, the economy exits the zero lower bound within a year instead of 2.5 years. Under the tax rebate, the fall in output is 2.5% versus a 22% fall absent intervention. For government purchases, the fall in output only lasts a quarter with output falling by only 0.5%. Instead of continuing to increase leverage, households deleverage between 3% and 5% and the intervention reduces the rise in spreads by 1/3. Deficit-financed purchases are preferred to tax rebates both in terms of output and consumption. Purchases act more directly to raise output and inflation, reducing the real interest rate faced by saver households and "crowding-in" consumption.

Figure 8 shows the much more limited effect of a 1% increase in purchases and tax rebates in the rigid wage model. Both policies are successful in boosting both output and consumption relative to a policy of inaction, but these policies carry much smaller multipliers than in the case of flexible wages. Government purchases limit the fall in output to 3.8% and rebates limit the fall in output to 5.3% relative to the 5.7% fall absent any intervention. Purchases, once again, act more directly to boost inflation and raise the consumption profile of the saver household while the borrowers consumption path is a function primarily of the credit spread. Output and inflation actually rise above their steady state values before jumping to those values once the zero lower bound stops binding. Relative to no intervention, the economy exits the zero lower bound only one period earlier.

Figure 8: Deficit-financed purchases and tax rebates in rigid wage model



6.3 Role of Credit Spreads

The choice between purchases and transfers/tax rebates depends, in part, on which policy is more effective in reducing credit spreads. Since the solution for the model at the zero lower bound is nonlinear, the model response to various fiscal shocks will not be invariant to the size of the shock. In other words, a 2% of GDP deficit-financed increase in purchases is not simply a scaled version of the 1% of GDP experiment; therefore, a fiscal multiplier is not readily defined. Moreover, given that the model features endogenous state variables, the response of various variables of interest will depend on the persistence and shape of the fiscal response, even if the total size of the fiscal intervention is held constant. However, to provide insight into the role of credit spreads, I consider a simple metric for computing output multipliers:

$$M_t = \frac{\sum_{t=0}^{24} \left(y_t^{pol} - y_t^{nopol} \right)}{\sum_{t=0}^{24} x_t}$$

where y_t^{pol} is the response of output, in log-deviations, under a particular fiscal intervention, y_t^{nopol} is the response of output under no intervention, and x_t is the total expenditure on the policy. The multiplier is a equally weighted sum over 24 quarters (6 years) of the deviations of output from the path it would have taken absent any intervention, conditional on the same underlying shock.

Two natural variables of interest are output (which is also employment in this model) and

aggregate consumption. To isolate the effect of variations in the debt and income elasticity of the credit spread, I consider fiscal interventions of the following form: a 1% of GDP increase in government purchases financed by current taxes or a 1% transfer from saver to borrower households in all periods. The underlying shock is a 5 percentage point increase in the financial shock that decays deterministically at rate $\rho = 0.9$, and fiscal interventions end once the zero lower bound stops binding. Since it delivers the most realistic impulse responses, only the model with perfect wage rigidity is considered.

Table 4 provides output and consumption multipliers and the time to exit for different values of the debt and income elasticity parameters in the credit spread. As Table 4 shows, the output multiplier on government purchases exceeds the output multiplier on transfers, though transfers may be more effective in boosting aggregate consumption than government purchases. The effectiveness of transfers relative to purchases rises with the debt-elasticity of the credit spread χ_b, and the time to exit the zero lower bound falls with χ_b.[21] As suggested by the analysis earlier, a higher debt elasticity operates through two channels to boost the transfer multiplier. Higher debt elasticities raise the marginal propensity to consumer for borrower households - these household spend more of an temporary income they receive. Secondly, a higher debt elasticity lowers future borrowing costs. This credit market effect, which is not present in environments with rule of thumb agents, ensures that transfers have persistent effects. Transfer allow a faster decrease in credit spreads relative government purchases thereby increasing borrower consumption and increasing the relative effectiveness of transfers.

An increase in the income-elasticity of the credit spread χ_n (shown on the right-hand side of Table 4) tends to magnify the effect of either type of fiscal intervention with output multipliers approaching the values estimated by the Congressional Budget Office. The time to exit the zero lower bound increases because the fall in output from the financial shock feeds back into the credit spread, amplifying its effect. The amplification of both the underlying shock and the effect of fiscal policy is consistent with the analytical results shown earlier. Despite the importance of the debt and income elasticity parameters for fiscal policy, a simple regression of credit spread measures on output and private sector borrowing is unlikely to accurately estimate these parameters since the

[21] Evidence from Edelberg (2006) suggest very low elasticities of risk premia on consumer loans with respect to debt and borrowing. Using data from the Survey on Consumer Finances, even for large differences in income and personal debt, spreads vary by less than two percentage points. A naive extrapolation suggests elasticity of spreads with respect to borrowing and income of less than 0.01 - an order of magnitude lower than shown in the numerical experiments in this section. However, given the extensive use of non-price tools such as credit limits, downpayments, and credit history in rationing credit, these elasticities should be viewed as a lower bound rather than an upper bound on credit spread elasticities.

Table 4: Output and consumption multipliers

$\chi_n = 0.0$	$\chi_b = 0.0$	$\chi_b = 0.1$	$\chi_b = 0.2$	$\chi_b = 0.3$	$\chi_n = 0.2$	$\chi_b = 0.0$	$\chi_b = 0.1$	$\chi_b = 0.2$	$\chi_b = 0.3$
Purchases	= 1%	of GDP							
Exit	16 qtr	15 qtr	14 qtr	13 qtr	Exit	17 qtr	16 qtr	15 qtr	14 qtr
Output	1.35	1.22	1.19	1.15	Output	2.53	2.37	2.12	1.92
Consumption	0.35	0.22	0.19	0.15	Consumption	1.53	1.37	1.12	0.92
Transfers	= 1%	of GDP							
Exit	16 qtr	14 qtr	13 qtr	12 qtr	Exit	17 qtr	15 qtr	14 qtr	12 qtr
Output	0.00	0.26	0.29	0.30	Output	0.00	0.48	0.50	0.52
Consumption	0.00	0.26	0.29	0.30	Consumption	0.00	0.48	0.50	0.52

error term is likely to be highly correlated with output and borrowing.

7 Conclusion

Existing representative agent models with complete markets, rule out any role for transfers, tax rebates, or deficit-financing as tools for stabilizing business cycles. This paper analyzes a borrower-lender model with credit spreads to examine transfers as an instrument of fiscal policy and compare transfers to government purchases. I showed that deficit-financed policies such as an increase in purchases or temporary lump sum tax rebates financed budget deficits can be expressed as a combination of two fiscal instruments: purchases and transfers, and I distinguished between two important channels for these instruments: aggregate supply and aggregate demand. I find, in general, that government purchases are a more effective means of boosting output and employment than transfers/tax rebates, primarily because of its large wealth effects on labor supply.

The aggregate supply channel for fiscal policy is the wealth effect on labor supply. Purchases or transfers will boost output only to the extent that the policy increases labor supply. In the absence of wealth effects, the aggregate supply channel is inoperative and neither purchases nor transfers have any effect on output. In the presence of wealth effects, purchases increase output by making both agents poorer, but transfers (as implemented by tax rebates) have little effect on aggregate labor supply. On the whole, the aggregate supply channel favors purchases over transfers for boosting output and employment.

The aggregate demand channel for fiscal policy stems from countercyclical markups due to sticky prices. While both fiscal policy instruments can boost demand, monetary policy can undo or amplify any fiscal shock. When monetary policy is unconstrained, fiscal policy is redundant for aggregate demand management. While fiscal policy may play a role in the distribution of

production or consumption, monetary policy is sufficient to manage the inflation-output tradeoff. However, when monetary policy is constrained, fiscal policy becomes the sole tool for managing aggregate demand. As a result, the choice between purchases and transfers or some combination thereof is not inconsequential. As the numerical experiments in Section 6 illustrate, both tools of fiscal policy can have substantial effects on aggregate demand at the zero lower bound, and the choice between these policies will depend on the details of the credit spread. However, the low estimated elasticities of credit spreads to borrowing and income as reported in Edelberg (2006) suggest that tax rebates and transfers are unlikely to match government purchases in boosting output, employment or consumption. Endogenizing the credit spread will be another important extension given the dependence of policy on the behavior of the credit spread. These extensions are ongoing research.

References

Agarwal, Sumit, Chunlin Liu, and Nicholas S. Souleles. 2007. "The reaction of consumer spending and debt to tax rebates - evidence from consumer credit data." *Journal of Political Economy*, 115(6): 986–1019.

Athreya, Kartik, Andrew Owens, and Felipe Schwartzman. 2014. "Does redistribution increase output? The centrality of labor supply." Federal Reserve Bank of Richmond WP.

Benigno, Pierpaolo, Gauti B. Eggertsson, and Federica Romei. 2014. "Dynamic debt deleveraging and optimal monetary policy." National Bureau of Economic Research 20556.

Bernanke, Ben S., Mark Gertler, and Simon Gilchrist. 1999. "The financial accelerator in a quantitative business cycle framework." *Handbook of Macroeconomics*, 1: 1341–1393.

Bilbiie, Florian, Tommaso Monacelli, and Roberto Perotti. 2013. "Public debt and redistribution with borrowing constraints." *Economic Journal*, 123(566): 64–98.

Blanchard, Olivier, and Jordi Gali. 2010. "Labor markets and monetary policy: A New Keynesian model with unemployment." *American Economic Journal: Macroeconomics*, 2(2): 1–30.

Campbell, Jeffery R., and Zvi Hercowitz. 2005. "The role of collateralized household debt in macroeconomic stabilization." National Bureau of Economic Research 11330.

Coenen, Günter, Christopher J Erceg, Charles Freedman, Davide Furceri, Michael Kumhof, René Lalonde, Douglas Laxton, Jesper Lindé, Annabelle Mourougane, Dirk Muir, et al. 2012. "Effects of fiscal stimulus in structural models." *American Economic Journal: Macroeconomics*, 4(1): 22–68.

Curdia, Vasco, and Michael Woodford. 2010. "Credit spreads and fiscal policy." *Journal of Money, Credit and Banking*, 42(6): 3–35.

Edelberg, Wendy. 2006. "Risk-based pricing of interest rates for consumer loans." *Journal of Monetary Economics*, 53(8): 2283–2298.

Eggertsson, Gauti B., and Michael Woodford. 2003. "The zero bound on interest rates and optimal monetary policy." *Brookings Papers on Economic Activity*, 34(1): 139–234.

Eggertsson, Gauti B., and Paul Krugman. 2012. "Debt, Deleveraging, and the Liquidity Trap: A Fisher-Minsky-Koo Approach." *Quarterly Journal of Economics*, 127(3): 1469–1513.

Gali, Jordi, David Lopez-Salido, and Javier Valles. 2007. "Understanding the effects of government spending on consumption." *Journal of the European Economic Association*, 5(1): 227–270.

Giambattista, Eric, and Steven Pennings. 2016. "Government transfer multiplier." Mimeo. World Bank.

Greenwood, Jeremy, Zvi Hercowitz, and Gregory W. Huffman. 1988. "Investment, capacity utilization, and the real business cycle." *American Economic Review*, 78(3): 402–417.

Guerrieri, Veronica, and Guido Lorenzoni. 2011. "Credit crises, precautionary savings, and the liquidity trap." National Bureau of Economic Research 17583.

Hansen, Gary D. 1985. "Indivisible labor and the business cycle." *Journal of Monetary Economics*, 16(3): 309–327.

Heathcote, Jonathan. 2005. "Fiscal policy with heterogeneous agents and incomplete markets." *Review of Economic Studies*, 72(1): 161–188.

Iacoviello, Matteo. 2005. "House prices, borrowing constraints, and monetary policy in the business cycle." *American Economic Review*, 739–764.

Johnson, David S., Jonathan A. Parker, and Nicholas S. Souleles. 2006. "Household expenditure and the income tax rebates of 2001." *American Economic Review*, 96(5): 1589–1610.

Kaplan, Greg, and Gianluca Violante. 2014. "A model of the consumption response to fiscal stimulus payments." *Econometrica*, 82(4): 1199–1239.

Mankiw, N. Gregory. 2000. "The savers-spenders theory of fiscal policy." *American Economic Review, Papers and Proceedings*, 90(2): 120–125.

McKay, Alisdair, and Ricardo Reis. 2016. "The role of automatic stabilizers in the US business cycle." *Econometrica*, 84(1): 141–194.

Monacelli, Tommaso. 2009. "New Keynesian models, durable goods, and collateral constraints." *Journal of Monetary Economics*, 56(2): 242–254.

Oh, Hyunseung, and Ricardo Reis. 2012. "Targeted transfers and the fiscal response to the Great Recession." *Journal of Monetary Economics*, 59(S): S50–S64.

Rogerson, Richard. 1988. "Indivisible labor, lotteries and equilibrium." *Journal of Monetary Economics*, 21(1): 3–16.

Schmitt-Grohé, Stephanie, and Martin Uribe. 2003. "Closing small open economy models." *Journal of International Economics*, 61: 163–85.

Shimer, Robert. 2012. "Wage rigidities and jobless recoveries." *Journal of Monetary Economics*, 59(S): S65–S77.

Woodford, Michael. 2011. "Simple analytics of the government expenditure multiplier." *American Economic Journal: Macroeconomics*, 3(1): 1–35.