Fiscal Policy and Financial Frictions

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(Preliminary)

Abstract

I examine the interaction between fiscal policy and credit spreads in a New Keynesian-DSGE model where the probability of default of heterogeneous firms and the costly-state verification due to asymmetric information between borrowers and the lender lead to increasing credit spreads faced by financially constrained firms. In this context increased borrowing to expand production increases the threshold productivity level below which firms choose to default, and thus, entails higher risk premium. However, when government spending contributes to aggregate production, the threshold level of default and, thus, the probability of default, decrease, leading to a lower risk premium. Moreover, using a SVAR methodology on US data, I show that after a positive shock to government spending, credit spreads drop up to 14 basis points. This negative relationship can be attributed to the negative effect that government spending has on the default probability since after a positive shock to government spending net interest margins, which are spreads corrected for losses from default, do not change significantly. Moreover, when decomposing government spending into government investment and government consumption, the analysis shows that it is in particular government investment that has a negative effect on the spreads as opposed to government consumption.

Keywords: Fiscal stimulus, Fiscal Policy, Credit Frictions, Multipliers.

JEL Classification Numbers: E32, E62, H50

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1 Introduction

Does fiscal policy affect the degree of financial frictions? This paper provides both theoretical and empirical evidence that when government spending is not considered as wasteful resources it alleviates the cost of external financing faced by credit constrained firms.

The recent financial crisis has revealed the role of fiscal policy as a countercyclical instrument to stabilize the economy. In order to prevent an even greater drop in output, many countries have developed fiscal packages to prevent the bankruptcy of the private sector.

For example, Germany and the UK injected 50 billion Euros and 50 billion pounds respectively, into their banks. Sweden, France, and Iceland followed similar strategies. In the US the Congress accepted a capital injection package to the, Ford, GM, and Chrysler car industries to save them from bankruptcy. Additionally, the Congress passed a fiscal stimulus package the American Recovery and Reinvestment Act $^1$ of 787 billions in 2009. Two thirds of the package consisted of increases in government spending and transfers, while the rest was covered by tax cuts.

The purpose of this package was to speed up recovery and increase output. Based on its perceived effectiveness and implication the ARRA found great advocates as well as opponents on its effectiveness and implications. Opponents were skeptical that an expansionary fiscal policy would further increase the deficit while not reaching reaching its high expectations. Moreover, they maintained that it would become a “permanent fixture of the economy,” as was stated in a recent critique by Paul Krugman.

On the other hand, proponents of this policy contended that this fiscal package would prevent the overall economy from going even deeper into recession. It is argued that even though the package, and in general an expansionary fiscal policy, may have some short term effects, which may have a negative impact like an increase in the deficit, there are several long term outcomes that need to be considered.

The purpose of this paper is to provide a theoretical and empirical support of the effectiveness of fiscal policy as a countercyclical tool and propose a mechanism through which it has an effect on the credit frictions in the economy. It examines the impact of productive public capital injections in an economy challenged by the presence of financial frictions. Moreover, it shows how productive i.e., not wasteful government spending leads to a greater marginal productivity. It consequently has a negative effect on the default probability and, thus, the risk premium faced by credit-constrained firms. Furthermore, it provides empirical support for the main finding that government spending, and in particular government investment leads to a lower cost of external financing by affecting negatively the bank spread.

This paper is an important contribution because it fills the gap in the literature both the theoretical and the empirical one, by providing evidence of the important interaction between government spending and risk premia. In particular, theoretical work like those of Baxter and King (1993), and Linnemann and Schabert (2003), support the view of a strong negative wealth effect resulting from an increase in government demand. The strong presence of this effect leads to an increase in employment but a decrease in private consumption and wages. However, those papers treat government spending as wasted resources instead of proposing a model that emphasizes the important role of public capital injections in infrastructure, innovative technology, education, job creation and job education, as well as the key role of public services.

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$^1$The American Recovery and Reinvestment Act will hereafter be referred to as ARRA
On the other hand, an increase in private consumption after a positive shock in government was supported by papers that consider productive government spending, e.g., Linne-mann and Schabert (2006). This assumption is not new in the literature since Barro (1990), first introduced public capital stock in the production function in an endogenous growth model. Ever since, many papers have examined the effects of the presence of public capital stock in the production function, such as Turnovsky (2000), Ghosh and Mourmouras (2004). More recently Leeper, Walker and Yang (2010), and Trabandt (2006) have shown that the introduction of public capital in the production leads to higher welfare gains. As one introduces government spending in the production function generates results that are more closely related to the ones of this part of the literature.

However, these papers examine fiscal policy in the context of frictionless financial markets. It is important, therefore, to take into consideration the presence of frictions in the market since both theory and empirics support their significant role in affecting the dynamics in the economy. Theory has already proven the amplification effects of financial frictions. Bernanke, Gertler and Gilchrist (1996) analyze the role of a financial accelerator which amplifies business cycles when information asymmetries (which introduce agency costs) are present. Moreover, Bernanke and Gertler (1989) and Carlstrom and Fuerst (1997), in a more quantitative analysis of the model introduced by BG, examine a general equilibrium model with agency costs arising endogenously where fluctuations in agency costs - as a result of changes in the collateral - contribute even more to the propagation of productivity shocks. This paper takes a step further and combines those theoretical findings in a meaningful way by emphasizing the role of government spending in the presence of financial frictions.

Additionally, the main focus of the empirical literature on fiscal policy has been the magnitude of the fiscal multiplier without emphasizing the exact channel through which government spending affects output. Towards this direction, different methodologies have been employed to produce better measurements of the multiplier.

For example, using military spending as a proxy for government spending Barro and Redlick (2011) estimate that the range of the multiplier is between 0.6 and 1. Blanchard and Perotti (2002) use a SVAR and Choleski decomposition to estimate a multiplier of 0.9 or 1.29, when different detrended methods are applied. Mountford and Uhlig (2009), by imposing sign restrictions on the impulse response functions and an orthogonality assumption of fiscal variables to a general business cycle shock to identify fiscal shocks, estimate a multiplier of 0.65. Following the methodology of Blanchard and Perotti (2002), Ilzetzki, Mendoza and Vegh (2013) use a SVAR analysis on a quarterly dataset for 44 countries to estimate the impact and cumulative multiplier by including a larger range of dependent variables. Moreover, Kraay (2012) identifies fiscal shocks by using evidence from World Bank lending history. A part of government spending is considered to be uncorrelated with the state of the economy because it refers to projects that are affected by “changes in World Bank project approval decisions made in previous years” as it is mentioned in the paper. Moreover, Auerbach and Gorodnichenko rely on a SVAR that incorporates Ramey news to estimate multiplier ranges from -0.3 to 0.8 in expansions and from 1.0 to 3.6 in recessions. It is evident from the existing literature, however, that despite the vast estimates of the multiplier, i.e. the magnitude of the effects of fiscal policy on output, little attention has been given to the channels through which fiscal policy can affect output and what exactly the mechanism is

\(^2\)Bernanke and Gertler (1989) will hereafter be referred to as BG
behind all these estimates.

On the other hand, existing literature has provided important evidence for the presence of the financial accelerator mechanism in the US economy. In particular, Aliaga-Díaz and Olivero (2010a, 2010b) use different specifications for banks’ price cost margins, i.e., the difference between the interest rate on loans and the interest rate of deposits, as a proxy for the external finance premium discussed in BGG to examine cyclical behavior. The results of the regression of price-cost margins on different business cycles indicators show that bank margins are countercyclical. Furthermore, the authors explore the channel through which the cyclical indicators affect the determination of the margins. Finally, Aliaga-Díaz and Olivero (2010b) prove the existence of a significant negative relationship between the two series which is independent of their cyclical behavior, providing further support for the presence of the financial accelerator. To this extent the present paper constitutes and important contribution as it shows how the presence of the credit channel can alter the existing estimates of the effect of government spending on output, and in particular how fiscal multiplier estimates differ when accounting for the credit channel, while showing that government investment has a negative effect on the spread.

In an effort to address the above issues, and fill the gap in the existing literature, this paper proposes a model where government spending enters the production function of credit constrained manufacturers. It employs a DSGE model where productive government spending holds the key role. In this market, the probability of default by the firms as well as imperfect information between the borrower and the lender introduces financial market imperfections as a result of increased agency costs. In this framework, the presence of productive government spending can alleviate the cost of external finance as it affects negatively the default probability of the credit constrained firms. Furthermore, by employing a SVAR of aggregate US data, it investigates the empirical validity of those results. In particular, it is shown that spreads corresponding to either short-term or long-term rates drop after an increase in government spending. Moreover, it is shown that the main channel through which government spending affects negatively the spread is due to alleviating the part of the spread that is attributed to the presence of a risk due to a default probability. On top of that, it is proven that this negative relationship between government spending and spread is driven by the productive part of government spending i.e., government investment. Finally, it is shown how the magnitude of the existing estimates of the multiplier can change when taking into account the importance of the credit channel.

The contribution of this paper is twofold. From a policy maker’s perspective, this paper is important because it sheds more light on the current debate of the effectiveness of the fiscal stimulus packages and their optimal design, a debate that makes apparent the need for further research towards this direction. It proposes an additional effect that fiscal policy may have due to its negative impact on the spread, and the premium that results from the probability of borrower’s default.

Additionally, the proposed mechanism is very important for academic reasons as well. It propose a channel through which public spending, and in particular public investment, can reduce the degree of financial frictions in the economy and propagate the effects of the financial accelerator mechanism. Moreover, it shows that accounting for the presence of the credit channel may diversify the magnitude of the existing estimates of the fiscal multiplier.

The rest of the paper is organized in the following way: the second section describes the theoretical model. The third section discusses the theoretical results and predictions
that are going to be tested in the empirical part of the paper. The fourth section presents
the empirical methodology, the specification and identification procedure. The fifth section
presents the data. The sixth section presents the empirical results and compares them to
the theoretical predictions. The seventh section presents further empirical support on one
key prediction of the theoretical paper. Finally the last section, section eight, concludes.

2 The Theoretical Model

This paper employs a basic New Keynesian model with Calvo’s (1983) staggered price setting.
Furthermore, it builds on the model proposed by Demirel (2009) and the financial accelerator
framework of Bernanke, Gertler and Gilchrist (BGG) (1996). It differentiates itself by
introducing government spending in the production function, as in Linnemann and Schabert
(2006) as well as by emphasizing the role of government spending in the risk premium.

The model consists of households, credit-constrained manufacturers, retailers, financial
intermediaries, and government. Throughout the paper, lower-case letters denote real vari-
ables, upper-case letters denote nominal variables, letters with hat denote percentage de-
viations from the steady state, and variables without a time subscript denote steady-state
values.

2.1 Households

The representative household seeks to maximize the expected discounted value of lifetime
utility derived from consumption and leisure:

$$\mathbb{E}_t \sum_{t=0}^{\infty} \beta^t [c_t^{1-\sigma} - \gamma l_t^{1+\theta}] , \sigma > 0 , \theta \geq 0 \quad (1)$$

where $c_t$ is private consumption, $l_t$ is labor, $\beta$ is the discount factor, $\theta$ is the inverse of the
elasticity of labor supply, and $\sigma$ the intertemporal elasticity of substitution. Households have
access to nominal, one-period bonds, $B_t$ at the price $\frac{1}{R_f}$ where $R_f$ is the gross risk-free interest
rate. We can consider of these bonds, held by households, as the sum of government bonds
and private bonds. Also, they receive labor income $w_t l_t$, where $w_t$ is the real wage and $l_t$ is
the supplied labor, and pay distortionary taxes with a marginal rate $\tau_d$. Moreover, profits
from manufacturers, retailers and financial intermediaries are rebated in a lump-sum back
to the households, who are the owners. Their dynamic budget constraint is the following:

$$\frac{B_t}{R_f} + P_t c_t + (1 - \tau^d_t) P_t w_t l_t + B_{t-1} + \int_0^1 \pi^m_t(j) dj + \int_0^1 \pi^r_t(i) di + \pi^f_t \quad (2)$$

Maximization of (1) subject to (2) yields the following first order conditions:

$$(1 - \tau^d_t) w_t = c_t^\sigma \gamma l_t^\theta \quad (3)$$

$$c_t^{-\sigma} = \beta \mathbb{E}_t \frac{R_f}{\pi_{t+1}} c_{t+1}^{-\sigma} \quad (4)$$

Condition (3) is the labor supply. Equation (4) is the Euler equation that defines the
growth path of consumption and $\pi_{t+1}$ is the gross inflation rate.

The final consumption good that enters the utility function is a composite of differentiated goods produced by the monopolistically competitive retailers. The CES aggregate of the differentiated goods is:

$$C_t \geq \left[ \int_0^1 c_t(i)^{\frac{n+1}{n}} di \right]^{\frac{n}{n+1}}$$  \hspace{1cm} (5)

Minimization of total expenditure:

$$\min \int_0^1 P_t(i)c_t(i)di$$  \hspace{1cm} (6)

subject to (6) yields the demand for final good $i$:

$$c_t(i) = \left( \frac{P_t(i)}{P_t} \right)^{-u} C_t$$  \hspace{1cm} (7)

2.2 Manufacturers

There is a continuum of ex-ante identical manufacturers of mass one that produce intermediate goods. Manufacturers are indexed by $j$, and operate competitively using a constant returns to scale production function, while being subject to an idiosyncratic risk that introduces a probability of default. They hire labor from households and use aggregate government expenditures $g_t$ for the intermediate goods which are going to be used as inputs in the production of final goods by the retailers. Firm $j$ produces intermediate good $Y_{m,t}(j)$ using the following technology:

$$Y_{m,t}(j) = A_t(j) h_t(j)$$  \hspace{1cm} (8)

where $A_t(j)$ is the idiosyncratic TFP which is assumed to be distributed uniformly in the interval $[0, \bar{A}]$. $h_t(j)$ is the composite of labor and aggregate government spending defined by the following CES function:

$$h_t(j) \equiv \left[ \xi l_t^{\nu} + (1 - \xi) g_t^{\nu} \right]^{\frac{1}{\nu}}, 0 < \xi < 1$$  \hspace{1cm} (9)

where $\xi (1 - \xi)$ is the share of labor(gov. spending) in the production of intermediate goods.

In order to incorporate frictions in the financial market we follow Demirel (2009), and Bernanke Gertler and Gilchrist (1998) and introduce a costly state verification problem (CSV), first introduced by Townsend (1979). In the beginning of each period $t$, manufacturers must acquire working capital from financial intermediaries, prior to the realization of output, $D_t(j) = \delta W_t l_t(j)$ so that they can cover the cost of production i.e., the cost of labor. $\delta$ is the fraction of the wages they need to pay in the beginning of each period. A contract needs to be defined between manufacturers and lenders before the realization of the idiosyncratic shock and production. Manufacturers choose the threshold level $A^*_t(j)$ below which they have to default and above that level to repay back the loan plus the interest rate. After the idiosyncratic shock is revealed, ex post differentiated manufacturers default or not. If a default state occurs, risk-neutral intermediaries pay a cost for verification of the return of the manufacturers’ project. This is a constant share $\mu$ of output and is independent of the realization of the idiosyncratic risk.

Financial intermediaries demand a return from the contract that is at least equal to their
opportunity cost, the risk-free interest rate \( R^f_t \). Thus, the presence of a default probability and of costly state verification creates a spread above the risk-free rate, which manufacturers have to pay to acquire external finance.

The problem of the \( j \)th manufacturer is to choose the threshold level \( A^*_t(j) \) and labor input that maximizes expected profits:

\[
\max_{A^*_t(j), l_t(j)} \int_{A^*_t(j)}^{\bar{A}} [Q_tA_t(j)h_t(j) - R_tD_t]dF(A_t) \tag{10}
\]

subject to the participation constraint:

\[
\int_0^{A^*_t(j)} [Q_tA_t(j)h_t(j) - \mu Q_tA_t(j)h_t(j)]dF(A_t) + \int_{A^*_t(j)}^{\bar{A}} R_tD_t dF(A_t) \geq R^f_tD_t \tag{11}
\]

and the financing constraint:

\[ D_t(j) = \delta W_t l_t(j) \tag{12} \]

where for simplicity it is assumed that \( \delta = 1 \). Equation (11) states that manufacturers seek to maximize their expected profits (eq.10) subject to the expected return of the contract for the financial intermediaries being at least equal to the opportunity cost of their loans. One can rewrite the model in a more convenient way:

\[
\max_{A^*_t(j), l_t(j)} Q_t h_t(j) \phi(A^*_t) \tag{13}
\]

subject to:

\[
Q_t h_t(j) \gamma(A^*_t) \geq R^f_t W_t l_t \tag{14}
\]

where:

\[
\phi(A^*_t) \equiv \int_{A^*_t}^{\bar{A}} (A_t - A^*_t)dF(A_t), \quad \gamma(A^*_t) \equiv \int_{A^*_t}^{\bar{A}} A_t(1 - \mu)dF(A_t) + \int_{A^*_t}^{\bar{A}} A^*_t dF(A_t) \tag{15}
\]

and the break-even condition:

\[
A^*_t(j) = \frac{R_tD_t(j)}{Q_t h_t(j)} \tag{16}
\]

\( A^*_t(j) \) is the level of the realized idiosyncratic risk at which manufacturers are indifferent between repaying back their loan and defaulting.

From the first order conditions is derived the labor demand equation:

\[
Q_t h_{t,t} = \frac{R^f_t W_t}{\Phi(A^*_t)} \tag{17}
\]

where,

\[
\Phi(A^*_t) \equiv \frac{\phi'(A^*_t)\gamma(A^*_t) - \gamma'(A^*_t)\phi(A^*_t)}{\phi'(A^*_t)} \tag{18}
\]

According to equation (15), the marginal product of labor (on the left) is equal to the marginal cost. Two important features need to be considered here. First, the presence of government spending in the production function increases the marginal productivity. This
becomes clear if one considers that the marginal product of labor is:

$$h_{t,t} = \xi l_t^{\nu-1} h_t^{1-\nu}$$  \hspace{1cm} (19)

Second, the marginal cost now includes the risk-free interest rate $R^{f}_t$, a feature known in the literature as the cost-channel, and the spread through $\Phi(A^{*}_t)$. In the absence of imperfections in the credit market in which case the spread would not affect the labor demand schedule the presence of only the risk-free interest rate, $R^{f}_t$, would lead to similar results, as seen in Ravenna and Walsh (2006). However, when financial frictions are present the risk-premium enters the marginal cost. This occurs when firms borrow to hire more labor, thus leading to a higher marginal cost due to the increase in the spread. The marginal cost is affected positively by the higher risk premium. Moreover, in this model the presence of government spending in the marginal product of labor introduces an extra channel. As is shown in Linnemann and Schabert (2006), government spending acts as a cost-alleviating instrument.

In the analysis of the impulse response functions that this paper will discuss in section 3, it will become clear that the increase in government spending has a negative impact on the spread.

By the combination of the break-point equation (18), the labor demand (15), and the participation constraint (16), one derives the direct relationship between the spread and government spending which endogenously defines the spread between the risk-free rate and the risky rate on loans as a function of output and government spending:

$$\frac{R_t}{R^{f}_t} = \frac{A^{*}_t}{\gamma(A^{*}_t)}$$  \hspace{1cm} (20)

Once this spread is defined, it becomes more obvious that the spread affects the marginal product of labor. From the labor demand, equation (15), and the budget constraint, equation (31), one can derive the following relationship between the marginal product of labor and the risk premium:

$$h_{t,t} \frac{l_t}{h_t} = \frac{\gamma(A^{*}_t)}{\Phi(A^{*}_t)}$$  \hspace{1cm} (21)

where the spread is inside the term on the right-hand side.

2.3 Retailers

Retailers use the homogeneous product produced by manufacturers as an input to produce differentiated final goods. Firms (and final products) are indexed by $i$ they are monopolistically competitive, and adopt a sticky price setting of a standard New Keynesian model, similar to Yun (1996). Retailers employ the following technology:

$$Y_t(i) = \bar{X} Y_{t,m}(i)$$  \hspace{1cm} (22)
where $Y_t(i)$ is the produced final goods by $i$ retailer and $Y_{t,m}(i)$ is the demand for intermediate goods. $X$ is a scale. Retailers’ real marginal cost is:

$$mc_t = \frac{Q_t}{P_t X}$$ (23)

From (20) it is obvious that both the risk premium and the risk-free interest rate are going to enter the Phillips-curve.

The problem of the $i$ retailer is to maximize expected profits given by:

$$\max_{P_t(i)} E_t \sum_{k=0}^{\infty} \varphi^k \Gamma_{t,t+k} [P_t(i)Y_t(i) - Q_{t+k}Y_{m,t+k}(i)]$$ (24)

subject to:

$$Y_t(i) = \frac{P_t(i)^{-\eta}}{P_t} Y_t$$ (25)

and the production function. Combining the first order conditions with the price index:

$$P_t^{1-\eta} = (1 - \varphi)(P_t)^{1-\eta} + \theta(P_{t-1})^{1-\eta}$$ (26)

we get the Phillips-curve, linearized around the steady state:

$$\hat{\pi}_t = \kappa \hat{mc}_t + \beta E_t \hat{\pi}_{t+1}$$ (27)

where $\hat{mc}_t = \hat{q}_t$ and $k = \frac{(1-\beta\varphi)(1-\varphi)}{\varphi}$

### 2.4 Government

The government finances expenditures with taxes on labor income and by issuing debt. The budget constraint is given by:

$$\frac{B_t^G}{R_t^f} + P_t \tau^d w_t l_t = B_{t-1}^G + P_t g_t$$ (28)

Following Villaverde (2010), Linnemann and Schabert (2006), and Linnemann and Schabert (2004), one assumes an exogenous path for government spending given by the following autoregressive process:

$$g_t = g_{t-1}^{\rho_g} \exp(\epsilon_t)$$ (29)

with $\rho_g < 1, \epsilon_g \sim \text{i.i.d. } N(0, \sigma^2)$. Moreover, the government sets the risk-free interest rate according to a single active Taylor rule:

$$R_t^f = \pi_t^{\rho_\pi} > 1$$ (30)

According to Leeper (1991), an active monetary policy should accompany a passive fiscal policy, where the tax rate is positively connected to debt. Thus, one assumes the following rule for the marginal tax rate on labor income:
\[ \tau_t^d = b_{t-1}^z, \quad z > 0 \quad (31) \]

where a higher \( z \) leads to a faster convergence to the steady state level.

### 2.5 Equilibrium

The equilibrium is the set of allocations \((c_t, b_t, l_t)\), and prices \((Q_t, P_t, R_t, W_t)\), given the exogenous process for \((g_t)\), that satisfies

- households’ first order conditions
- manufacturers’ first order conditions
- retailers’ first order conditions
- and the following market clearing conditions:

In the market of goods:

\[ Y = C + G \quad (32) \]

In the market of intermediate goods:

\[
\int_i y(i)_{t,m} di = \int_{j \in \Xi_t} A_t(j)h_t(j)(1 - \mu) dj + \int_{j \notin \Xi_t} A_t(j)h_t(j) dj 
\]

(33)

where \( \Xi_t = \{ j \in [0,1] : A_t(j) < A_t(j)^* \} \) is the default set. One can write this more conveniently as:

\[ h_t \psi(A_t^*) = \frac{1}{X} Y_t \quad (34) \]

In the labor market:

\[ \int_i l_t^*(i) di = \int_j l_t^d(j) dj \quad (35) \]

### 3 Calibration and Theoretical Results

This paper presents in this section the impulse response functions for three different models after log-linearizing the equilibrium conditions around the steady state. All three models build on the basic sticky price model à la Calvo in a New Keynesian framework as in Clarida et al (1999), and Yun (1996). In particular, apart from the benchmark model discussed earlier, this paper considers a simple representation of a standard New Keynesian framework where output is divided into both private and public consumption. In this case government spending affects only the market clearing condition. The paper also considers a model without financial frictions that features productive government spending in the manufacturers’ production function. It examines the impulse response functions of the above models for each of the two different financing schemes: first, the balanced budget case of only distortionary taxation; second, the case of debt.

The same parameter values for which the impulse response functions are computed apply to all three models. Following Linnemann and Schabert (2006), and Demirel (2009) the values below are set:
Apart from the above calibration as a robustness check the paper also uses the following values for the three key parameters that can affect the outcome of the impulse response functions:

<table>
<thead>
<tr>
<th>parameter</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>monitoring cost $\mu$</td>
<td>$0.25$</td>
</tr>
<tr>
<td>steady-state employment $l$</td>
<td>$1/3$</td>
</tr>
<tr>
<td>discount factor $\beta$</td>
<td>$0.99$</td>
</tr>
<tr>
<td>labor inverse elasticity $\theta$</td>
<td>$1.0$</td>
</tr>
<tr>
<td>labor share $\xi$</td>
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<tr>
<td>upper bound $\bar{A}$</td>
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<td>elasticity of substitution $\eta$</td>
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<tr>
<td>factor elasticity of substitution $\nu$</td>
<td>$0.01$</td>
</tr>
<tr>
<td>degree of price stickiness $\phi$</td>
<td>$0.75$</td>
</tr>
<tr>
<td>autoregressive parameter $\rho_g$</td>
<td>$0.9$</td>
</tr>
<tr>
<td>government spending share $\frac{g}{y}$</td>
<td>$0.2$</td>
</tr>
</tbody>
</table>

### 3.1 Distortionary taxes

The government’s budget constraint in the case of a balanced budget with distortionary taxation becomes:

\[ g_t = \tau^d_t w_t l_t \]  (36)

Under this balanced budget regime the tax rate is following the increase in government spending and it is determined in the following way, in log-deviations from the steady-state:

\[ \hat{\tau}^d_t = \hat{g}_t - \hat{w}_t - \hat{l}_t \]  (37)

In figure 2 one can see the impulse response functions of the most important aggregates in the three models when government spending increases by 1%. The third model, which is a standard NK model with government spending affecting only the market clearing condition, exhibits the standard results. There is a very small increase in output, since the increase in $g$ causes a crowding out effect in consumption. With consideration to the second model, where government spending affects the production function, one sees that the output increases more in comparison to the third model, and inflation drops as government spending now acts as a supply side shock. The increase in output is a result of the increase in the marginal productivity of labor. The resulting shift in the labor demand schedule increases
the equilibrium wage. However, due to the distortionary taxation, labor supply shifts inwards, leading to a drop in the equilibrium employment and an even higher increase in the equilibrium real wage.

Furthermore, the presence of $g$ in the production function and the increase in the MPL has a cost-alleviating effect as first mentioned by Linnemann and Schabert (2006) so the marginal cost drops in comparison to the third model. As a result inflation increases by less than in the previous case.

In the benchmark model, the results are quite different. Apart from the cost-alleviating effect, the marginal cost drops by even more, since there is negative relationship between government spending and the spread. There is a positive one with the MPL, leading to an even higher increase in employment and a drop in the marginal cost. The countercyclical behavior of the spread can be attributed to either a positive shock to government spending or due to the increase in output which brings the spread down further. This proves the effectiveness of the financial accelerator effect first discussed by BGG.

As mentioned above, apart from the standard calibration values this paper computes the impulse response functions for alternative values of $\nu$, $\xi$, and $\mu$. Every time one parameter is changed, the rest are maintained with their initial values displayed in table 1.

In considering a case where labor and government spending are perfect substitutes, as shown in figures 4 and 5, one sees that the results for the third model do not change. In the second model, the cost-alleviating effect has an even stronger effect, in comparison to the case where $\nu = 0.01$, which leads to a lower increase in inflation. The reason is that labor demand now increases by less, due to the substitutability between labor and government spending, leading to a lower increase in wages. For the benchmark model, the spread falls by even more. The important result of the negative relationship between the government spending and the spread, as well as the positive relationship between government spending and the marginal product of labor, still holds.

Finally, this paper considers a case where $\nu = -1$, in figures 6 and 7. Note that the results do not change qualitatively for more negative values of $\nu$. Regarding the second model, we can see that government spending still has a cost-alleviating effect. Also, labor demand now increases more than in the case where $\nu = 0.01$, which leads to an increase in employment. In the benchmark model, the negative effect of an increase in $g$ on the spread is still present.

Despite employment decreasing and wages increasing, the key feature of these results is that in the benchmark case-unlike the model without frictions-the marginal cost still decreases. This is due in small part to the increase in marginal productivity. It is due in large part, however, to the negative effect of government spending on the spread, allowing firms to borrow at a lower cost and thus, to have access to more working capital.

The reduction of the spread due to the increase in $g_t$ allows firms to have more access to external funding and to demand more labor. Even though wages increase, the marginal cost is affected by the reduced risk premium and subsequently decreases. Firms able to adjust their prices respond by lowering inflation, while the rest respond by increasing output.

### 3.2 Debt

This paper now considers a more realistic case where government is not keeping a balanced budget in each period but government can issue debt. In this case the budget constraint in
real terms becomes:

$$\frac{B_t^G}{R_t^f} + P_t \tau^d_t w_t \ell_t = B_{t-1}^G + P_t g_t$$  \hspace{1cm} (38)$$

Following Leeper (1999) we specify a "passive" policy rule for the marginal tax rate on labor income, which, in deviations from the steady-state is:

$$\hat{\tau}^d_t = z \hat{b}_{t-1}, z > 0$$  \hspace{1cm} (39)$$

In this case, the government can increase its deficit in the short term but in the longer term the debt should return to its steady state. This means that the government is not required to keep a balanced budget in the short term as long as the budget is balanced in the long term. To bring debt back to a long term stability, there must be some interaction between the tax rate and the outstanding debt. This rule is a simple case of a tax-rate rule that allows government to keep its debt under a long term stability. According to Leeper (1999), determinacy requires that an "active" interest rate rule should be followed by a passive fiscal policy, or in other words, a tax rate that responds "passively" to the government debt shocks. The simplicity of this rule allows one to consider an empirically more reasonable case for fiscal policy while avoiding any unnecessary complexity of our model. A higher value of $z$ means that a higher share of government spending is financed with distortionary taxation.

In the case where $\nu = 0.01$, shown in figures 8 and 9 one sees that the responses of the third and second model are similar to the case where only distortionary taxes were used. Moreover, the same conclusion holds for the benchmark model, where the responses differ only in the magnitude.

When one considers the case with $\nu = 1$, it is important to note that in the benchmark case, the reduction in the spread following a positive shock in government spending offsets the increase in wages. This is due to an increase in both labor demand and supply, leading to a lower inflation. The countercyclicality of spreads is one more the main mechanism that is responsible for this outcome. Figures 10 and 11 present the results for the case where $\nu = -1$.

Finally, the remaining figures present the impulse response functions for both financing schemes for different values of $\xi$, the share of labor, and $\mu$, the magnitude of monitoring cost. It is noteworthy that the spread drops in all specifications when following a positive shock in government spending.

4 Empirical Specification and Identification

This section describes the methodology followed to estimate the effect of government spending on the spread. Details on the data and definitions of the variables are provided in the next section.

The three main methodological approaches followed in the literature in order to identify government spending shocks are the structural vector autoregressive (SVAR) method used by Blanchard and Perotti (2002), the methodology proposed by Barro (1981) using military expenditures as a proxy for government spending, and the dummy variable approach proposed by Ramey and Shapiro (1998). This paper follows the SVAR approach, since the

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\[^{3}\text{Blanchard and Perotti hereafter will be referred to as BP.}\]
The purpose is to examine the effect of government spending on the spread when there are no other exogenous forces affecting the state of the economy.

The following VAR specification is estimated:

\[ X_t = a + bt + ct^2 + \Gamma(L)X_t + \sum_{i=1}^{3} \beta_i D_{i,t} + u_t \]

(40)

where \( X_t \equiv [G_t T_t S_t Y_t \Pi_t]' \) is the vector of the logarithm of real government spending, the logarithm of real net taxes (net of transfer payments), the spread, the logarithm of real GDP and inflation respectively. Moreover, \( t \) is the trend variable, \( \Gamma(L) \) is a lag polynomial of order \( p \), and \( D_{i,t} \) is a set of quarter dummies that control for seasonality. \( u_t \equiv [u_g^t u_t^t u_s^t u_y^t u_\pi^t]' \) is the vector of the reduced residuals that are allowed to be contemporaneously correlated, and \( p \) is the number of lags. According to the AIC and SBIC the optimal number of lags is four.

In order to identify truly exogenous shocks to government spending I can express the reduced form - estimated residuals from the above VAR, as a linear combination of three components as shown in the following system:

\[ u_g^t = a_{gs} u_s^t + a_{gy} u_y^t + a_{gs} u_t^t + \beta_1 e_t^g + e_t^g \]

(41)

\[ u_t^t = a_{ts} u_s^t + a_{ty} u_y^t + a_{ts} u_t^t + \beta_2 e_t^t + e_t^t \]

(42)

\[ u_s^t = a_{sg} u_g^t + a_{st} u_t^t + a_{sy} u_y^t + \epsilon_s^t \]

(43)

\[ u_y^t = a_{yg} u_g^t + a_{yt} u_t^t + a_{ys} u_s^t + \epsilon_y^t \]

(44)

\[ u_\pi^t = a_{\pi g} u_g^t + a_{\pi t} u_t^t + a_{\pi y} u_y^t + \epsilon_\pi^t \]

(45)

where \( e_t \equiv [e_t^g e_t^t e_s^t e_y^t e_\pi^t]' \) are the structural shocks with mean zero and \( E e_t e_t' = \Sigma_e \), \( t = s \).

Following BP and Perotti (2007), the first component is the structural policy shocks which are the truly exogenous shocks one is interested in when estimating the impulse response functions. The second component is the automatic response of government spending and net taxes to changes in output, spreads and inflation. The last component is the systematic discretionary response to output, spread and inflation shocks.

The important underlying assumption is that due to quarterly data one can follow BP and assume that a shock to GDP cannot affect government spending within a quarter. As BP mention, this assumption is essential for identifying fiscal shocks. Furthermore, it is assumed that due to quarterly data and the absence of the systematic response government spending and net taxes are not affected by unexpected movements of the spread within a quarter. Thus, the coefficients of the two policy-residuals, \( a_{gy} \) and \( a_{ty} \), correspond only to an automatic response. Moreover, the coefficient \( a_{ty} \) captures the automatic response of net taxes to changes in output while the coefficient \( a_{gy} \) equals zero since there is no automatic response of government spending to output innovations within a quarter. Regarding the values of the rest coefficients, since they can be translated as elasticities, I borrow the elasticity estimates of taxes and spending to GDP and inflation provided by Perotti (2007)

The elasticity estimates provided by Perotti (2007), corresponding to the same time period are summarized in the following table:
parameter elasticity
\[ a_{gs} = a_{ts} \]
\[ a_{gπ} = -0.5 \]
\[ a_{tπ} = 1.4 \]
\[ a_{ty} = 1.97 \]
\[ a_{gy} = 0 \]

Imposing those restrictions generates the following system of equations:

\[ u_t^g = -0.5u_t^π + \beta_1e_t^t + e_t^0 \] (46)
\[ u_t^t = 1.97u_t^t + 1.4u_t^π + \beta_2e_t^g + e_t^t \] (47)
\[ u_t^s = a_{sg}u_t^g + a_{st}u_t^t + a_{sy}u_t^y + e_t^s \] (48)
\[ u_t^y = a_{yg}u_t^g + a_{yt}u_t^t + a_{ys}u_t^s + e_t^y \] (49)
\[ u_t^π = a_{πg}u_t^g + a_{πt}u_t^t + a_{πy}u_t^y + e_t^π \] (50)

The estimation of the two first equations is exactly the same as the one followed by BP (2002). I use an instrumental variable approach to estimate the last three equations and obtain the estimated coefficients.

What the above relationship captures is that an unexpected shock to government spending has a contemporaneous effect to both real GDP and spread but is affected only by their lagged values. Moreover, it is assumed that both the real GDP and the spread are jointly determined. The results described in the following section are robust to different orderings of the two fiscal variables i.e., they hold either when \( \beta_1 = 0 \) and \( \beta_2 \neq 0 \) or \( \beta_1 \neq 0 \) and \( \beta_2 = 0 \).

Before estimating the above system of equations the series were tested for the presence of unit root processes. The methodology proposed by Dolado, Jenkinson, and Sovilla - Rivero (1990) was adopted in order to decide whether the series follow a unit root process or are trend stationary. Due to the mixed results of the tests, the model was estimated assuming both a deterministic trend for all variables and a stochastic trend.

5 Data

This section describes the data used in the estimations and presents some important features of the variables. Government spending is defined as the sum of government consumption and gross investment. Taxes are defined as current receipts minus the summation of current transfer payments, interest payments, and subsidies. Both government spending and net taxes exclude interest payments and receipts. Moreover, all variables, apart from spread and inflation, are made real after dividing by the GDP deflator, and per capita after dividing by the civilian non-institutional population. All data are from the NIPA tables of the Bureau of Economic Analysis. Moreover, all data are quarterly ranging from the first quarter of 1980 to the fourth quarter of 2007.

There are different definitions of the spread that are used in the empirical section of the paper. The baseline specification refers to the difference between the bank prime loan rate and the Treasury bill rate. Moreover, results are also presented in the case where the spread is defined as the net interest margin of banks, which is the real spread that bank receive...
after correcting for default. The last specification of the spread is the difference between the Baa-rated corporate bond yield and the long-term government bond yield. All the date from the interest rates are from the Federal Reserve Bank of St. Louis.

Figure (a) plots together the cyclical components of the log of real GDP and the spread - where the difference between the bank prime loan rate and the Treasury bill rate is used in the baseline definition of the spread. Both series are detrended using the hp-filter. The important feature of this graph is the countercyclical nature of the spread. The log of real GDP and the spread follow opposite directions for the entire time path. This feature of the data is well known in the existing literature.

Figure (b), on the other hand, plots the cyclical components of the log of real government spending and the spread.

6 Results

Figure 14 shows the impulse response functions of the main variable when there is a shock to government spending by 1%. The figure also displays the impulse response functions that BP derive in order to point out the changes in the responses of the main variables due to the presence of the spread in the estimations. The results verify the theoretical predictions that an increase in government spending leads to a decrease in the spread that will last for several quarters before returning to the long run equilibrium. Due to this negative relationship, there is a stronger response of output than in the case where the credit channel is absent, verifying the important role of the financial accelerator mechanism in the US economy. Those results suggest that there is an important effect of government spending on the spread that was previously ignored.

After a 1% shock to government spending, the spread decreases by seven basis points on impact. The spread drops by up to fourteen basis points in the second quarter before going back to its long-run trend almost two years after the initial shock and remains negative for several quarters after the initial shock before returning to the long run trend. This negative relationship is consistent with the theoretical predictions. The countercyclical nature of the spread is well established in the literature and it is something that emerges from the exercise performed in this paper as well. The negative response of the spread leads to an increase in output that is longer than in the case without the credit channel. This is due to the fact that apart from the increase in output due to the positive shock to government spending, the negative response of the spread leads to an even higher response of the real GDP. Those results show how the financial accelerator mechanism magnifies the response of output following a positive shock to government spending.

The higher response of output after a positive shock to government spending can be verified by the multiplier in figure 15. The estimates of the multiplier are different between the two models due to the amplification effect of the credit channel. The biggest part of the empirical literature on fiscal policy is focused on obtaining more accurate estimates of the multiplier. However, improvements in the estimates of the multiplier are mainly due to improvements in the empirical methodology. Little attention has been given to the channel through which larger government spending can lead to a larger increase in output. Even though it is not the purpose of this paper to provide accurate estimates of the multiplier it is highlighted, though, how important is accounting for the presence of credit frictions.
The cumulative responses presented in the first table show that when the spread is included in the estimations the response of the real GDP remains higher even twelve quarters after the initial change in government spending.

In order to verify the second theoretical prediction that the main channel through which an increase in government spending has a negative effect on spreads is through the negative impact on the default probability, the following exercise is performed: instead of the difference between the bank prime loan rate and the three-month treasury bill rate, I consider the spread between a bank’s interest earnings and expenses as a percent of interest-earning assets. This difference is known in the literature as the net interest margin. Those rates depend on the actual income that banks receive after considering defaulted loans. If the theoretical predictions are correct then there should be only a minimum effect of government spending left on the nim. Indeed, figure 16 shows that after a positive 1% increase in government spending the nim decreases only slightly. The response of the nim to an increase in government spending is smaller than the response of the baseline spread since the nim drops only after three quarters by one basis point and it drops at most up to two basis points. Those results imply that the main channel through which government spending has a negative effect on the spread is through its effect on the default probability. After a government spending shock, both the responses of the real GDP and government spending are more persistent in comparison to the simpler case considered by BP. Those results suggest that the credit channel matters in the transmission of fiscal policy shocks. In particular, fiscal policy becomes essential when financial market frictions are present.

Moreover, as a robustness check I compute the impulse response functions using the difference between the yield of an index of seasoned long-term Baa-rated corporate bonds and the yield on the constant maturity 10-year treasury note. This is a long-term spread that reflects an “adequate” capacity on behalf of the obligor to meet its financial commitments. This is a standard long-run maturity spread that has been proved to have a strong predictive power of the economic performance at longer forecast horizons. In figure 17 we see that by performing the same exercise as before, a positive shock to government spending does not only affect short-term spreads but it has an effect on longer-term credit spreads.

The results presented in this section show that the effect of government spending on the spread as predicted by the theoretical paper, is robust across spreads of short or long maturity rates.

7 Decomposing Government spending

In this section I provide some evidence on the theoretical prediction that it is productive government spending that can have a negative impact on the degree of financial frictions in the economy. In order to verify this prediction I decompose the previous variable of government spending into government consumption and government investment. Traditionally, government spending has been treated as “wasteful” in the theoretical macroeconomic literature. This stark view has been modified somewhat in recent years, and especially after the recent financial crisis. However, the way by which such spending can affect the economy is still unclear. In order to estimate the effect of the productive part of government spending on the degree of financial frictions I perform a similar exercise as in the previous section by
including the two variables of government spending in the baseline system.

Figure 18 presents the impulse response functions of the main variables of interest following a 1% increase in government investment. The results show that after the shock the drop in the baseline spread i.e., the difference between the bank prime loan and the treasury bill rate, is larger than in the previous cases. On impact the spread falls by four basis points before returning to the long run trend several quarters later.

On the contrary, a shock to government consumption, as shown in figure 19, has opposite effects. When government spending is just “wasteful” then the spread increases following an increase in government consumption.

Those results suggest that only when there is a productive role of fiscal policy it can alleviate the degree of financial frictions in the economy. Notice that the results that an expansion of public consumption generates negative multipliers are consistent with the results provided by Auerbach and Gorodichenko (2010). Also, Mendoza et al (2013) present negative effects on output of public consumption increases. Moreover, those results shed some light to the direction that future research should follow. There are important implications for the private sector when the government decides to intervene in the market, implications that have not been fully explored.

Finally, the above results provide further support of the theoretical predictions of the existence of an interaction between productive government spending, the private sectors default probability and credit spreads. This is the channel which should be explored further by future research.

8 Conclusion

This paper, provides both theoretical and empirical evidence of the strong interaction between fiscal policy and financial frictions. In particular, using a New Keynesian, dynamic stochastic general equilibrium model with costly state verification, it is shown that positive shocks to government spending have a negative effect on the spread independently on the government’s financing scheme. Those results are empirically tested and supported by a structural vector autoregression on U.S. data. The estimated impulse response functions show that government spending, and in particular government investment, has a negative effect on risk premia. The results are robust for both short-term and long-term spreads. Thus, both the theoretical model and the empirical results exhibit a financial accelerator effect since fiscal policy shocks have an amplified effect on output due to the presence of financial frictions.

The main picture is that there is a way for the government to affect the degree of financial frictions in the economy, a mechanism that was used extensively and by many countries during the recent financial crisis, and needs to be explored to a greater extend. The main contribution of this paper is that it provides a basic background on the way through which policy intervention may play a role and evidence of how existing findings, regarding the magnitude of its impact in the economy, can be altered as soon as the credit channel is accounted for. Moreover, those results are important since they provide further evidence that fiscal stimulus packages can be effective when there are tight credit market conditions that exhibit increased borrowing costs. What fiscal policy can do is that it alleviates firms’ cost of external financing and allows them to have access to external funding. Further research
should focus on exploring the effect of unconventional policies that were used extensively during the recent financial crisis.

References


[31] Trabandt, Mathias. ”Optimal pre-announced tax reforms under valuable and productive government spending.” Available at SSRN 884977 (2006).

9 Figures and Tables

Note: Confidence intervals for the impulse response functions will be added to the final draft of the paper.
Figure a: Cyclical components of the log of real GDP and spread (BP-TB)
Figure b: Cyclical components of the log of real government spending and spread (BP-TB)
Figure 2: IRFs when $v=0.01$
Figure 3: IRFs when v=0.01
Figure 4: IRF when v=1
Figure 5: IRF when v=1
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Figure 8: IRFs when the government issues debt and \( v = 0.01 \)
Figure 9: IRFs when the government issues debt and $v=0.01$
Figure 10: IRFs when the government issues debt and $v=1$
Figure 11: IRFs when the government issues debt and $v=1$
Figure 12: IRFs when the government issues debt and $v=-1$
Figure 13: IRFs when the government issues debt and v=-1
Figure 14: IRFs when the spread = BP-TB
Figure 15: Multiplier

Table 2: Cumulative responses

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<th>Baa-spr.</th>
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Figure 16: IRFs when the spread=nim
Figure 17: IRFs when the spread=Baa-TB
Figure 18: IRFs when government investment is ordered first
Figure 19: IRFs when government consumption is ordered first