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Fiscal Expenditures and Unemployment: A DSGE Perspective*

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Abstract

We investigate the behavior of the unemployment rate after a government expenditure shock and present evidence that the group of asset-holding households reacts very different from the group of liquidity-constrained consumers. Our findings suggest that the unemployment rate is likely to decrease for asset-holding households while it increases among liquidity-constrained consumers. The main driver for our results is the marginal utility of wealth which moves in opposite directions for the different types of households after a government expenditure shock. We find that the size of the fiscal (unemployment) multiplier increases with i) highly sticky prices ii) high degrees of risk aversion iii) low real wage elasticities iv) high replacement rates and v) debt financed expenditures.

Keywords: search and matching, government shocks, unemployment.
JEL code: E 32, G 61, E 62.

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1 Introduction

In this paper, we investigate the behavior of the unemployment rate after a government expenditure shock. Arguably, it is an important objective of fiscal policy to cushion the labor market and, in particular, the unemployment rate from adverse business cycles effects. This objective prevailed in particular in the aftermath of the current financial and economic depression when the governments of OECD countries expanded on average the structural deficits from -2.3 percent in 2007 to a projected value of -6.4 percent in 2010 to prevent economic activity and labor markets from imploding (Bernstein and Romer, 2009). We address this issue based on a search and matching model (e.g. Pissarides, 2000) embedded into an otherwise standard DSGE framework (Christiano et al., 2005; Woodford, 2003) and come to the conclusion that whether the fiscal expenditures to cushion the labor market are a suitable policy depends on the degree of persistence of government expenditure shocks and the type of household under consideration. Our findings suggest that positive employment multipliers can only be achieved by highly persistent government expenditure shocks, while short lived fiscal expansions are likely to be ineffective in an environment where the recruitment behavior of firms is forward looking. Additionally fiscal policy will be less successful to stimulate the labor market segment of liquidity-constrained consumers. Even for persistent government expenditure shocks, we find an increase in the unemployment rate in this segment of the labor market.

In the literature the effects of government expenditure on employment are under researched. The core of analysis so far, following the seminal papers of Barro (1981, 1987), Aiyagari et al. (1992), Baxter and King (1993) and Gali et al. (2007), focused on the effects of government expenditure shocks on aggregate output, consumption, investment and hours worked while they neglect the intensive (increasing hours worked per worker) versus extensive (change in the number of employed workers) margin. Accordingly, this class of models remains tacit on unemployment. We

show in a sticky price model with distortionary labor taxation and rule-of-thumb consumers that a government expenditure shock is likely to increase unemployment for rule-of-thumbers while it is likely to decrease unemployment rates for members of asset-holding households. The rationale for this finding is straightforward as private consumption moves in opposite directions for these two groups of households after a government expenditure shock. Therefore, the marginal utility of wealth increases for asset-holding households while it decreases for rule-of-thumbers. Accordingly, rule-of-thumbers have fewer incentives to increase hours worked as the marginal disutility of providing hours relative to marginal utility of consumption increases. For asset-holding households the result is driven by the well known negative wealth effect of tax-financed expenditures such that hours worked tend to expand as long as consumption and leisure are normal goods. Compared to a Real Business Cycle (RBC) setting, the increase in hours worked is amplified in the New Keynesian framework as price adjustment is sluggish. Accordingly, prices are lower and demand is higher in this setting on average. For the group of rule-of-thumbers a rise in the disposable income fosters the boom in consumption.

The labor market implications of a government expenditure shock alter substantially with respect to the degree of persistence. Our findings suggest that in a search and matching framework firms become more forward looking with respect to employment decisions such that fiscal policy packages need to be multi–period in nature if it is the aim to stimulate the labor market. A temporary shock in government expenditures implies incentives for firms to create jobs as the period profit increment of a worker increases but the increase is too short lived for newly built matches to be sustained. Additionally an increase in the stochastic discount factor decreases the net present value of the worker to the firm. Put differently the capital value of a hired worker is lowered. Yuan and Li (2000) identify the evolution of the stochastic discount factor as the driving force in a RBC setting and argue that the unemployment rate will even increase after a government expenditure shock due

to an increase in the stochastic discount factor. In a sticky price framework with limited movement in the real interest rate and thus the marginal utility of consumption (which drives the stochastic discount factor), however, this result cannot be confirmed, at least not for asset-holding households. The unemployment rate for this group moves for a wide range of parameters procyclically.

Regarding the influence of deep model parameters, we find that unemployment effects are more sizable if prices are highly sticky and unemployment benefits are high. This is in line with the findings of a related study by Monacelli et al. (2009) who use a slightly different model framework.[1] Additionally, we can report that the size of the fiscal multiplier tends to increase for high degrees of risk aversion, low real wage elasticities and debt financed expenditures. Quantitatively, the degree of price stickiness and the level of the replacement rate are the single most important factors in shaping the size of the multiplier. As a numerical benchmark on the available studies on fiscal multipliers, we rely on Cogan et al. (2009) and find that our model is capable to produce empirically plausible fiscal multipliers for unemployment rates and output over a horizon of one year.

The remainder of the paper is structured as follows: Section 2 outlines the model. Section 3 illustrates the effect of a government expenditure shock on the labor market. Therein, we focus on the job creation condition of firms and conduct some sensitivity analysis to investigate which deep parameters are most important in terms of shaping the size of the multiplier. Section 4 concludes.

2 The model

In this section, we describe a standard DSGE model incorporating search frictions. The model simultaneously includes rule-of-thumb consumers, distortionary taxation and debt financed expenditures related to works by Bodart et al. (2006), Christoffel

[1] They emphasize the role of non-separable utility while largely imposing a balanced-budget rule and lump-sum taxation.

et al. (2009) and Gali et al. (2007).

2.1 Households

There is a fraction μ of optimizing households who save, while the remaining fraction $(1-\mu)$ is liquidity-constrained and consumes all current labor income. Each agent can be either employed or unemployed. We assume that household $i \in [o, r]$ – where the superscripts stand for optimizers o and rule-of-thumbers r – is characterized by the following per period utility function:

$$u(c_t^i(j), h_t^i(j)) = \frac{(c_t^i(j))^{1-\sigma_c}}{(1-\sigma_c)} - \kappa_h^i \frac{(h_t^i(j))^{1+\sigma_h}}{(1+\sigma_h)},$$

where σ_c is the inverse of the intertemporal elasticity of substitution, σ_h is the inverse of the Frisch elasticity of labor supply and κ_h^i is a level parameter relating the disutility of labor to the utility of consumption. The asset-holding households face the following flow-budget constraint:

$$c_t^o + \frac{B_{t+1}}{P_t(1+i_t)} = N_t^o(1-\tau_t)w_t^o h_t^o + U_t^o \kappa_B^o + \Psi_t + \frac{B_t}{P_t},$$

where h_t^o is per capita of hours employed among the group of asset-holding households, while w_t^o is the corresponding hourly real wage, τ_t is the labor tax rate, κ_B^o denotes unemployment benefits per period, N_t^o the asset-holding households' employment rate, while Ψ_t pictures the firm profits. P_t is the price level, B_{t+1} denotes the nominal end-of-period value of government bonds and i_t is the nominal interest paid on these bonds. Consumption smoothing is guided by the Euler-equation:

$$c_t^o = (1+i_t)E_t\left\{c_{t+1}^o \Omega_{t,t+1} \frac{1}{\pi_{t+1}}\right\}, \tag{1}$$

where $\Omega_{t,t+k} = \beta^k \frac{\lambda_{t+k}^o}{\lambda_t^o}$ is the stochastic discount factor and $\pi_t = \frac{P_t}{P_{t-1}}$ is the gross inflation rate.

The remaining measure of $(1-\mu)$ consumers are liquidity-constrained and consumes all their disposable income. Hence, their consumption plan reads:

$$c_t^r = \begin{cases} c_t^r = (1-\tau_t) w_t^r h_t^r & \text{if employed} \\ c_t^r = \kappa_B^r & \text{if unemployed,} \end{cases} \tag{2}$$

where κ_B^r describes real unemployment benefits received by unemployed workers of the liquidity-constrained pool. Note further that, as before, a fraction N_t^r of the liquidity constraint consumers is employed, while a fraction $U_t^r = 1 - N_t^r$ is unemployed, which implies that the amount of employed liquidity-constraint consumers is equal to $(1-\mu)N_t^r$.

2.2 Production

Firms in the final goods sector sell their output in a monopolistic competitive market using an intermediate labor good, while facing a staggered price setting technology as in Calvo (1983). The labor good is produced by intermediate firms which take hours worked by each individual hired as their sole input to production. The labor good is sold to the final goods producers in a perfectly competitive manner. Firms in the monopolistic sector produce the final good varieties $Q_t(j)$, with j being an index for each firm, by buying the labor good $L_t(j)$ from the intermediate production sector at nominal cost $P_t x_t$ and, further, decide for how much the variety is sold in the market. The production technology available to intermediate firms is linear: $Q_t(j) = L_t(j)$. Each period only a fraction $(1-\phi_P)$ of firms is able to adapt prices, where ϕ_P is the Calvo parameter (see Calvo, 1983). The representative firm chooses $\{L_t(j), P_t(j)\}$ to solve the following maximization problem:

$$\text{Max } \Pi_t(j) = E_t \sum_{k=0}^{\infty} \phi_P^k \Omega_{t,t+k} \left[\frac{P_t(j)}{P_{t+k}} - x_{t+k} \right] L_{t+k}(j), \tag{3}$$

subject to the demand constraint $Q_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\epsilon} Y_t$. This implies that the aggregate price level evolves according to $P_t^{(1-\epsilon)} = (1-\phi_p)\tilde{P}_t^{(1-\epsilon)} + \phi_p P_{t-1}^{(1-\epsilon)}$, where $\tilde{P}_t$ is the optimal price symmetrically chosen by those who are allowed to set prices in period t.

2.3 Labor goods producers

The labor market structure follows the standard search and matching framework (e.g., Andolfatto, 1996; Merz, 1996; Moyen and Sahuc, 2005; Pissarides, 2000). Matching firms and workers is a costly and time-consuming process and firms need to find exactly one worker to produce. The timing is as follows. Workers who are already matched with firms Nash bargain about wages and hours. Production takes place. Thereafter and firms post vacancies. New matches are determined and separations occur. Thus, employment is the outcome of firms' and workers' search behavior, while wages and hours worked are the outcome of the Nash bargaining.

We work backwards and first describe separation and the bargaining. We then describe the matching process and vacancy posting decisions. For the sake of simplicity, in our model, there are two separate labor markets, one for each type of worker.

Value functions of labor good firms, workers and exogenous separations: Period real profits from production of a labor firm employing a worker of type $i = o, r$ are given by $\Psi_t^i = x_t(h_t^i)^\theta - w_t^i h_t^i$. Toward the end of the period, after production has taken place, each firm draws an exogenous separation shock, such that, with probability s, the match is severed and the worker moves back into unemployment. If the match survives, it continues into the next period. Let J_t^i be the firm real value in period t. Then,

$$J_t^i = x_t(h_t^i)^\theta - w_t^i h_t^i + \beta E_t \left\{ \frac{\lambda_{t+1}^o}{\lambda_t^o} J_{t+1}^i \right\}. \tag{4}$$

Analogously, let W_t^i be the present real value of an employed worker of type i. Then, optimizing workers' present value function is given by

$$W_t^o = (1-\tau_t) w_t^o h_t^o - \kappa_B^o - \frac{\kappa_h^o}{\lambda_t^o} \frac{(h_t^o)^{(1+\sigma_h)}}{(1+\sigma_h)} + \beta E_t \left\{ \frac{\lambda_{t+1}^o}{\lambda_t^o} (1 - s - p_t^o) W_{t+1}^o \right\}. \tag{5}$$

In period t, the employed worker works h_t^i hours and receives the hourly wage w_t^i. From his income, he has to pay taxes at rate τ_t. If the worker is unemployed he

would have received κ_B^i. Hence, this is the foregone income due to employment. Further, the worker experiences disutility from work, represented by the third term on the (rhs) of equation (5) which we have to divide by the marginal utility of consumption λ_t^o in order to have a representation in real terms. The last term on the (rhs) captures the discounted future utility of future periods including the probabilities to be dismissed, s, and the probability to be re-employed in the case of unemployment, p_t^i (which remains to be determined later).

Liquidity-constrained workers consume all their disposable income. Hence, an intertemporal representation of those workers' value function must be done in utility terms. As J_t^i is expressed in real terms (see equation (4)), however, we can achieve this by dividing all relevant terms by the marginal utility of consumption $\lambda_t^r = (c_t^r)^{-\sigma_c} = [(1-\tau_t)w_t^r h_t^r]^{-\sigma_c}$. Then the present value function of liquidity-constrained workers is – very much in analogy to equation (5) – given by

$$\begin{aligned} W_t^r &= \frac{[(1-\tau_t)w_t^r h_t^r]^{(1-\sigma_c)}}{(1-\sigma_c)\lambda_t^r} - \frac{[\kappa_B^r]^{(1-\sigma_c)}}{(1-\sigma_c)\lambda_t^r} - \frac{\kappa_h^r}{\lambda_t^r}\frac{(h_t^r)^{(1+\sigma_h)}}{(1+\sigma_h)} \\ &\quad +\beta E_t\left\{\frac{\lambda_{t+1}^r}{\lambda_t^r}(1-s-p_t^r)W_{t+1}^r\right\}. \end{aligned} \tag{6}$$

Bargaining: Each period, wages and hours worked are determined by means of bargaining over the match surplus, where $\chi \in [0,1]$ determines the bargaining power of workers. Each match solves

$$\max_{w_t^i, h_t^i} \; S(w_t^i, h_t^i) = \left[W_t^i\right]^{\chi}\left[J_t^i\right]^{(1-\chi)},$$

which lead to the first-order conditions for wages and hours:

$$W_t^i = \frac{\chi}{1-\chi}(1-\tau_t)J_t^i$$

and

$$x_t = \frac{\frac{\kappa_h^i\left(h_t^i\right)^{\sigma_h}}{\lambda_t^i(1-\tau_t)}}{\left(\theta\left(h_t^i\right)^{\theta-1}\right)},$$

which determines the corresponding group's hours worked. This equation nicely reflects that marginal production costs are predominantly driven by the evolution of the marginal rate of substitution $mrs_t = \frac{\kappa_h^i \left(h_t^i\right)^{\sigma_h}}{\lambda_t^i(1-\tau_t)}$ for a linear production technology. As noted by Christoffel et al. (2009) the subjective price of work drives marginal wages and thus marginal cost.

Matching process and labor market flows: New matches arise according to a linear homogenous matching function $M_t^i = \kappa_e(1 - N_t^i)^\alpha (V_t^i)^{(1-\alpha)}$, where M_t^i is the number of new matches of type i in period t (see Pissarides, 2000, for a detailed discussion). $U_t^i = (1 - N_t^i)$ is the unemployment rate of labor market i, while V_t^i is the number of vacancies in the economy corresponding to type i. $\kappa_e > 0$ denotes a scale parameter of the matching function, which may be interpreted as matching efficiency, and $0 < \alpha < 1$ is the matching elasticity. From this, it follows that, with probability p_t^i, a worker will find a match each period, while vacant jobs are filled with probability q_t^i each period, where

$$p_t^i = \frac{M_t^i}{U_t^i} = \kappa_e \left(\frac{V_t^i}{U_t^i}\right)^{1-\alpha} \quad \text{and} \quad q_t^i = \frac{M_t^i}{V_t^i} = \kappa_e \left(\frac{V_t^i}{U_t^i}\right)^{-\alpha}. \tag{7}$$

Given the number of new matches each period and, therewith the probabilities to fill a vacancy and to find a job, the employment law of motion can be stated as $N_t^i = (1-s)N_{t-1}^i + M_{t-1}^i = (1-s)N_{t-1}^i + p_t^i(1 - N_{t-1}^i)$, where the first term on the (rhs) describes the number of matches that survived the previous period, while the second term pictures the newly formed matches.

Vacancy posting: In order to stand a chance of finding a worker of a specific type, labor firms need to post a vacancy in that labor market. As a result of free entry into the vacancy posting market, in equilibrium, the cost of posting a vacancy for the respective type of worker is given by κ_v^i and must be equal to the expected

discounted profit

$$\frac{\kappa_v^i}{q_t^i} = E_t \left\{ \Omega_{t,t+1} J_{t+1}^i \right\}. \tag{8}$$

Labor market equilibrium: Given the matching function, hours worked, the sharing rule, the value functions of workers and firms, as well as the employment laws of motion by equation, it is a straightforward matter to derive the labor market equilibrium, i.e. the corresponding number of vacancies. Bundling the output of each labor firm total labor reads

$$L_t = A_t \left[\mu N_t^o \left(h_t^o \right)^\theta + (1-\mu) N_t^r \left(h_t^r \right)^\theta \right]. \tag{9}$$

2.4 Monetary authorities

Monetary policy follows a Taylor rule

$$\frac{(1+i_t)}{(1+\bar{i})} = \left(\frac{(1+i_{t-1})}{(1+\bar{i})} \right)^{\rho_i} \left(\frac{\pi_{t-1}}{\bar{\pi}} \right)^{(1-\rho_i)\phi_\pi} \left(\frac{y_t}{\bar{y}} \right)^{(1-\rho_i)\phi_y}, \tag{10}$$

where any bared variable $\bar{z}$ denotes the corresponding steady-state value of the variable. ρ_i is an interest rate smoothing parameter and ϕ_π indicates how strongly monetary authorities respond to deviations of inflation from target, while ϕ_y is the reaction to the output gap.

2.5 Fiscal authorities

Fiscal authorities have to finance real government spending G_t and unemployment benefits, $\mu \kappa_B^o U_t^o + (1-\mu)\kappa_B^r U_t^r$. They rely on income taxes per employed worker, $\tau_t \left[\mu N_t^o w_t^o h_t^o + (1-\mu) N_t^r w_t^r h_t^r \right]$, and can further issue nominal bonds B_t on which they have to pay a nominal interest i_t in the following period. Hence, the governments flow-budget constraint in real terms reads

$$G_t + \mu \kappa_B^o U_t^o + (1-\mu)\kappa_B^r U_t^r + (1+i_{t-1})\pi_t^{-1} b_{t-1} = \tau_t \left[\mu N_t^o w_t^o h_t^o + (1-\mu) N_t^r w_t^r h_t^r \right] + b_t, \tag{11}$$

where we have defined $b_t = \frac{B_{t+1}}{P_t}$.

Tax rule: We allow for debt financing, but assume that there exists a tax rule to keep the level of real debt constant in the long run

$$\frac{\tau_t}{\bar{\tau}} = \left(\frac{b_{t-1}}{\bar{b}}\right)^{\chi_b}, \tag{12}$$

where χ_b is the feedback parameter from debt to taxes which insures determinacy. With this modeling strategy we can mimic a near balanced-budget regime for high feedback parameters χ_b as well as highly debt-financed expenditures for low values of χ_b.

Spending rule: Government spending is assumed to be exogenous

$$\frac{G_t}{\bar{G}} = \left(\frac{G_{t-1}}{\bar{G}}\right)^{\rho_G} \epsilon_t, \tag{13}$$

where ρ_G is the autocorrelation coefficient and ϵ_t is a white noise spending shock.

2.6 Market clearing and equilibrium

Aggregate supply is obtained by combining the labor market equilibrium with final goods production equilibrium. Aggregated demand is given by total private consumption, government consumption and resources attached to the search activity, i.e. $C_t^{tot} + G_t + \mu\kappa_v^o V_t^o + (1-\mu)\kappa_v^r V_t^r$. Accordingly, it holds:

$$Y_t = C_t^{tot} + G_t + \mu\kappa_v^o V_t^o + (1-\mu)\kappa_v^r V_t^r = \frac{A_t}{D_t}\left[\mu N_t^o \left(h_t^o\right)^\theta + (1-\mu) N_t^r \left(h_t^r\right)^\theta\right], \tag{14}$$

where $\frac{1}{D_t} = \left(\frac{\tilde{P}_t}{P_t}\right)^\epsilon$ measures the degree of price dispersion, and aggregated consumption demand, C_t^{tot}, is given by

$$C_t^{tot} = \mu c_t^o + (1-\mu) c_t^r. \tag{15}$$

2.7 Calibration

Our calibration strategy does not aim at replicating the US-economy or the European data. For those values which are typically linked to a more anglo-saxon versus European labor markets such as the bargaining power of workers or the replacement rate we conduct sensitivity analysis to potentially encompass both types of labor markets such that our findings are robust with respect to country specific calibrations. For the details see Table 2. For most of the values we follow Christofel et. al. (2009). As we do not have a distinctive imagination for appropriate numerical values for the fraction of liquidity-constrained consumers, we follow Coenen et. al. (2008) who think that it is plausible that at least 25% of the population are liquidity-constrained consumers. Since Shimer (2005) it is well understood that the unemployment benefit or more generally the value of non-work activity is important in terms of replication the response of vacancy posting over the business cycle. Unfortunately no clear cut consensus has emerged where to calibrate this ratio of non-work to work activity. However, as we interpret this value as the unemployment benefit, setting a value between $rrs^i = 0.4$ to $rrs^i = 0.65$, where rrs^i is the replacement ratio and $\kappa_B^i = rrs^i \cdot (1 - \bar{\tau})\bar{w}^i\bar{h}^i$ seem plausible, as it encompasses the range between the American to the European replacement rates. In our baseline calibration we set $rrs^i = 0.5$ in the midst of this range.

3 Fiscal expenditure shock and unemployment

To kick off the analysis we present in the next subsection the equilibrium dynamics of the business cycle to a government expenditure shock. In a first step we check whether the impulse responses of output, inflation, consumption and wages are in line with conventional wisdom in a New Keynesian framework (e.g., Forni et al., 2009; Gali et al., 2007). In a second step we investigate the business cycle dynamics of the labor market and in particular the unemployment rate. To do so we

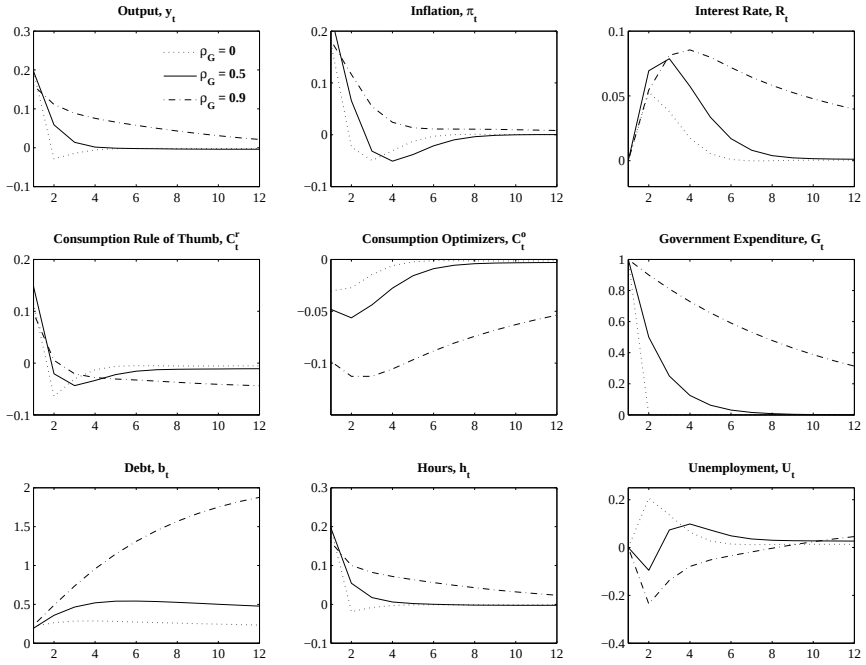
take a close look at the job creation condition which governs vacancy posting and thus recruitment behavior of firms. Recall that, compared to a standard neoclassical framework ,employment is the outcome of firms' and workers' search behavior, while wages and hours worked are the outcome of Nash-bargaining and are thus not allocative. Finally, we dig a little deeper and identify the underlying factors which drive our results by re-calibrating the model.

3.1 A government expenditure shock: Impulse responses

The impulse responses portray the response of selected variables to a one percentage point increase in fiscal expenditures from steady state for three different scenarios (see figures 1 and 2). In the first scenario, the economy is hit by an uncorrelated fiscal expenditure shock (dotted line), in the second scenario (solid line), we portray a mildly correlated shock and, in the last scenario, we illustrate a highly persistent fiscal expansion (dashed-dotted line).

We observe in all three cases that production increases on impact fueled by government demand while consumption falls. The drop in aggregate consumption masks that the consumption of Ricardian decreases whereas the consumption of rule-of-thumbers increases. As asset-holding households account for (3/4) of the population they somewhat dominate the aggregate picture although Non-Ricardians attenuate the drop in consumption. The drop in aggregate consumption is driven by two channels which operate alongside each other. On the one hand the wealth effect and on the other hand the interest rate channel. As it is well known, a tax-financed fiscal expansion withdraws resources from consumers such that they are willing to expand hours worked as consumption and leisure are normal goods. As shown by Monacelli and Perotti (2008), the strength of the wealth effect is driven by the degree of complementarity between consumption and hours worked as implied by the utility function. In particular, the size of the initial shift of the labor supply curve is inversely related to the intertemporal elasticity of substitution σ_c. As a

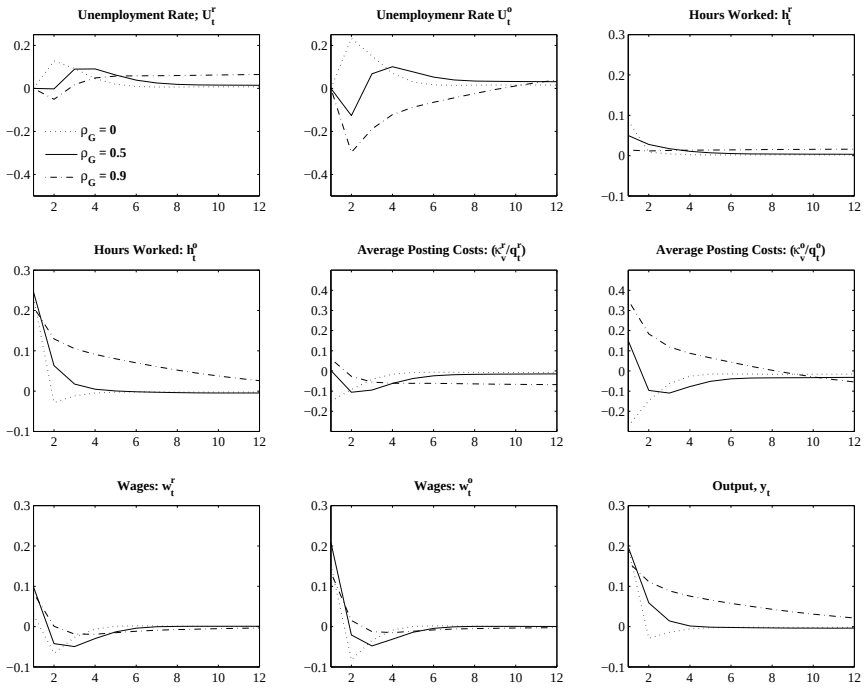
Figure 1: Fiscal expenditure shock



Notes: The impulse response portrays the response of selected variables to a fiscal policy shock of one percentage point deviation from steady state $\bar{G}$ for three different scenarios. The dotted line for $\rho_G = 0$ depicts the response of the economy to an uncorrelated shock. The solid line illustrates the business cycle dynamics for a mildly correlated shock with $\rho_G = 0.5$. Finally, we present the case of a highly correlated shock with $\rho_G = 0.90$.

second channel, the Taylor-Principle designs an increase in real interest rates which sets incentives for asset-holding households to postpone consumption into the future. This interest rate channel operates alongside the wealth effect although its strength decreases with an increasing σ_c.

Figure 2: Labor market dynamics



Notes: The impulse response portray the response of selected variables to a government expenditure shock of one percentage point deviation from steady state $\bar{G}$ for three different scenarios. The dotted line for $\rho_G = 0$ depicts the response of the economy to an uncorrelated shock. The solid line illustrates the business cycle dynamics for a mildly correlated shock with $\rho_G = 0.5$. Finally, we present the case of a highly persistent shock with $\rho_G = 0.90$ (dash-dotted). For reasons of comparability for each variable the same scale is chosen for Ricardians and Non-Ricardians.

Besides the shift in the labor supply curve the shift in the labor demand curve plays an important role as it determines whether real wages and thus the wage bill moves pro or countercyclical. Sticky prices imply that the bulk of firms do not

adjust prices on impact. This shifts the labor demand curve outward, in particular for those firms in the intermediate good industry that do not adjust prices upward. Inspecting the impulse responses, we can report evidence that this shift of the labor demand curve overcompensates the shift in the labor supply curve as real wages move procyclical. Thus, more hours worked in conjunction with higher real wages reflect that workers want to be compensated for the higher provision of hours during the bargaining process. The boom in consumption among the group of rule-of-thumbers illustrates that their disposable income moves procyclical following a government expenditure shock.

The impulse response analysis provides evidence that only highly persistent government expenditure shocks can generate a sustained decrease in the aggregate unemployment rate. For short lived blips in output, firms adjust entirely by relying on the intensive margin. For mildly correlated shocks we can report evidence that the unemployment rate initially decreases while it already starts to increase from quarter three onward.

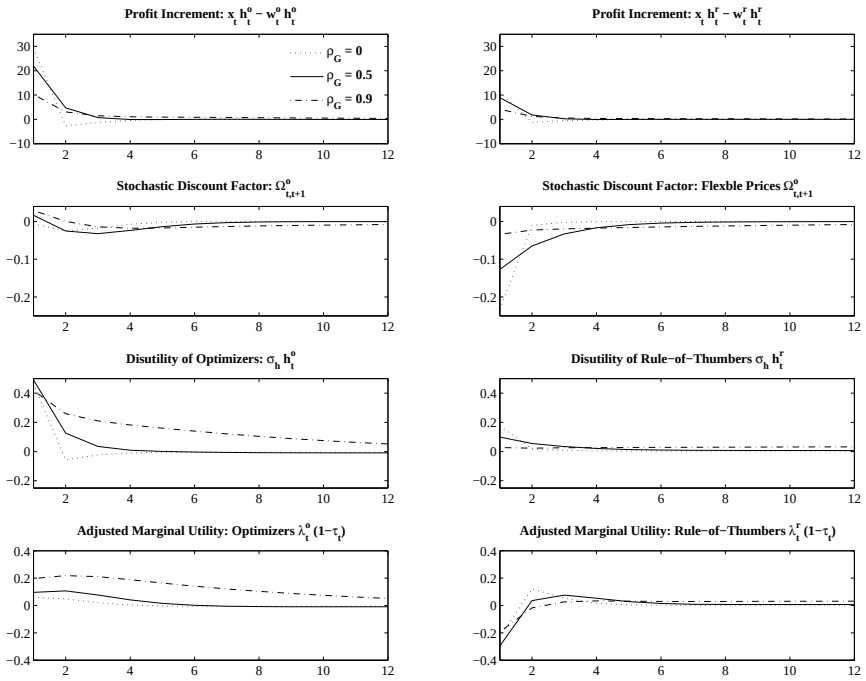
Within the next subsection we go to the bottom of these results and identify the driving mechanisms for the movement in unemployment rates in each segment of the labor market.

3.2 Fiscal multipliers and the job creation condition

While the last section has portrayed the broad picture we now put the spotlight on labor market dynamics.

Figure 3 reveals the striking result that a fiscal expansion increases the unemployment rate among rule-of-thumbers for all degrees of persistence once looking at the average labor market response in the first year after the shock. For uncorrelated and mildly correlated shocks it is even positive from the second quarter onward. Average vacancy posting costs $\frac{\kappa_v^i}{q_t^i}$ in log-deviations are much higher in amplitude for members of asset-holding households than for rule- of-thumbers. This reflects,

Figure 3: Job creation condition



Notes: The impulse response portrays the response of selected variables to a fiscal policy shock of one percentage point deviation from steady state $\bar{G}$ for three different scenarios. The solid line for $\rho_G = 0$ depicts the response of the economy to an uncorrelated shock. The dash-dotted line illustrates the business cycle dynamics for a mildly correlated shock with $\rho_G = 0.5$. Finally, we present the case of a highly persistent shock with $\rho_G = 0.90$. For reasons of comparability the same scale is chosen for Ricardians and Non-Ricardians.

as we can see in the figure 3, that the contribution to the expected profit increment $x_t(h_t^i)^\theta - w_t^i h_t^i$ in period $(t+1)$ for optimizers exceeds by a large factor the profit increment of rule-of-thumbers.

The solution to this finding is the evolution of the marginal rate of substitution that is tied to marginal cost. Firms operating in the labor market segment of asset–holding households have strong incentives to expand along the extensive margin and to post additional vacancies. In contrast, rule-of-thumbers have little interest in working harder to consume more when the marginal utility of consumption deteriorates relative to the marginal disutility of hours worked. For optimizing households the same increase in the wage rate suffices to increase labor supply by much higher degrees as the marginal utility of consumption increases. Given a linear production technology, marginal cost are entirely driven by the evolution of the marginal rates of substitution mrs_t. In log-linearized terms it holds:

$$\widehat{x}_t = \sigma_h \widehat{h}_t^i - (\widehat{\lambda}_t^i + o\widehat{\tau}_t), \tag{16}$$

with $o = \bar{\tau}/(1-\bar{\tau})$. The only household specific variables in this equation are per capita employment in each segment $\widehat{h}_t^i$ and the consumption Lagrangians $\widehat{\lambda}_t^i$. As the marginal utility of consumption moves in opposite direction for both types of households with, $\widehat{\lambda}_t^o > 0$ for asset-holding households and $\widehat{\lambda}_t^r < 0$ for rule-of-thumb consumers, the marginal disutility of work needs to move such that the equilibrium condition holds. This necessarily implies that rule-of-thumbers largely freeze their labor supply, while optimizing households have strong incentives to expand along the intensive margin and to sustain a newly built match after a government expenditure shock has hit the economy.

A second point needs some clarification. We have seen that the unemployment rate increases for uncorrelated fiscal shocks. This can be explained by two competing hypothesis. On the one hand, an increase in the stochastic discount factor might lower the discounted economic rent generated by the worker for the firm. On the

other hand, the economic rent might simply become negative. The first hypothesis was propagated by Yuan and Li (2000) in a RBC framework. A look at figure 3 supports the second hypothesis as the profit increment and not the stochastic discount factor is the driving force in our model. Still, it remains the question what are the driving forces behind the deterioration in expected profits are. Obviously, for the uncorrelated shock with predetermined employment the expansion is too short lived for vacancies to increase. Accordingly, we conclude that employment and vacancy posting for optimizers largely moves procyclical. In contrast to an RBC setting, in which the real rate of interest and thus the marginal rate of substitution are more flexible, the evolution of the stochastic discount factor cannot break this comovement for asset holding households.

3.3 Fiscal impact on unemployment: What determines its strength

In this section, we dig a little deeper and investigate how the effects of a government expenditure shock on the unemployment rate change as a function of the deep parameters of the model for persistent government expenditure shocks with $\rho_G = 0.9$. To do so we conduct the following experiment. For each parameter, the figure 4 reports the impact of the expenditure shock on the unemployment rate for asset-holding households and rule-of-thumb consumers as a series of the parameter shown in the title of each subplot, while all other parameters remain constant at their baseline calibration. To compute the fiscal impact on unemployment, we take the average of the interim responses of the unemployment rate from period 2 to 5, i.e. $\frac{d\widehat{U}}{d\widehat{G}} = (1/4)\sum_{k=2}^{5}\widehat{U}^i_{t+k}$. Note, $\widehat{U}_t$ denotes the log–linear deviation from the steady-state value $\bar{U}$, $\widehat{U}_t = ln(U_t) - ln(\bar{U})$ value. We exclude the first quarter as unemployment is predetermined and thus invariant to changes in deep parameters. Each subplot contains information on the unemployment responses of fiscal policy for rule-of-thumbers (solid line) and asset-holding-households (dashed line).

Figure 4 highlights the finding that the sign of the fiscal impact on unemploy-

ment is mostly negative for asset-holding households while it is often positive for rule-of-thumb consumers. As a general finding we can report that re-calibrating the baseline model does not alter the conclusion that households with no asset-market participation are rather inactive over the business cycle. The fiscal unemployment impact on unemployment remains very robustly positive for a wide range of parameters. Only for the case of a persistent shock $\rho_G = 0.9$ in conjunction with highly sticky prices the average response for rule-of-thumbers becomes negative.

In a first step we take a look at the deep parameters that have a direct influence on the marginal rate of substitution, thus σ_c, σ_h and χ_b which we identified as the key relationship in terms of understanding the labor supply behavior of the different groups of households. With respect to these parameters the following findings stand out. When individuals become more risk-avers for increasing values of σ_c, fiscal policy becomes more effective in terms of lowering the unemployment rate. On the one hand, with increasing values of σ_c the initial shift in the labor supply curve is attenuated so that downward pressure on wages is moderated. Both effects of the shift – the additional increase in production and the more moderate wage evolution – increase profitability and thus the incentive of firms to sustain a newly built match. The moderate shift of the labor supply curve endorses the demand driven output expansion in a sticky price model as wages and thus disposable income of rule-of-thumbers increase (see Monacelli and Perotti, 2008). Alongside the wealth effect, the real interest rate channel implies that higher degrees of risk aversion with increasing σ_c lowers the incentive to postpone consumption. Accordingly, the collateral damage of a fiscal expansion on private consumption is attenuated.

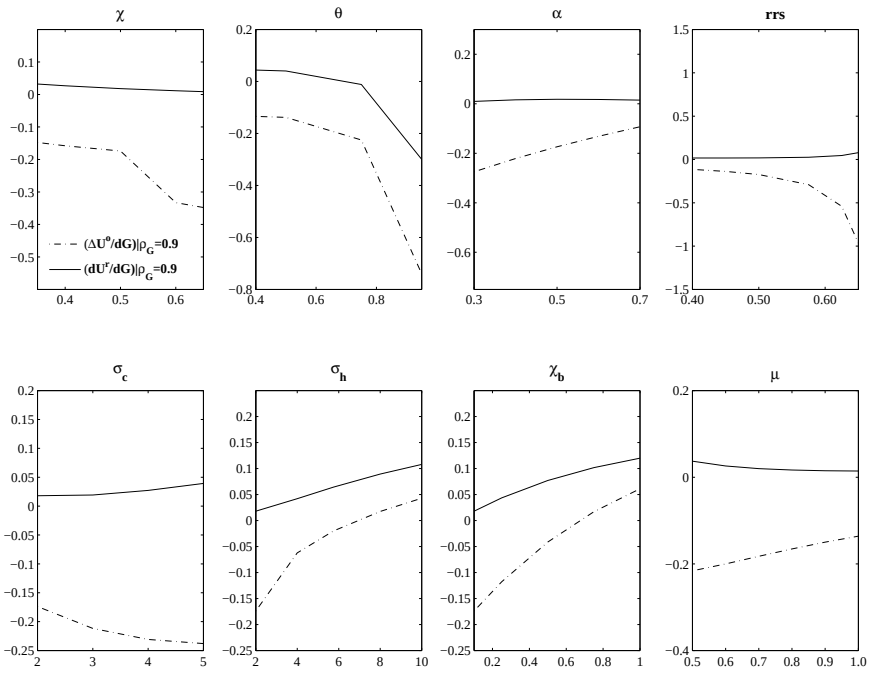
Figure 4 illustrates that the unemployment response shrinks with increasing values for σ_h. It is well understood that, for the case of efficient Nash-bargaining, the subjective price of work determines the marginal wage (see Christoffel et. al., 2009). As we consider a linear production technology, the marginal cost of production equals the worker's marginal rate of substitution between consumption and leisure.

Therefore it is straightforward that, with increasing convexity in the disutility of labor, the marginal costs of production increase and marginal profits are squeezed. As an amplifier the Taylor-Principle designs higher real interest rates which in turn depresses consumption as (3/4) of the population are asset-holding households. Both effects decrease the profitability of firms and thus the incentive to sustain a newly built match and vacancy posting decreases. For high values of $\sigma_h \geq 10$, which are still common in the literature (see e.g., Trigari, 2009), our analysis indicates that the sign of the fiscal impact on unemployment turns positive even for the group of optimizers.

Finally taxes have a direct impact on the marginal rate of substitution. For low values of χ_b when expenditures are largely debt financed and debt exhibits a near random walk behavior the fiscal impact on unemployment is largest. If fiscal authorities frontload tax revenues to keep the debt close to the steady–state ratio then a government expenditure shock is likely to have little effect on the unemployment rate. There are at least two reasons why this result is not surprising. On the one hand, the consumption behavior of rule-of-thumbers is driven by current disposable income which decreases with a more ambitious refinancing scheme. On the other hand, the marginal rate of substitution reveals that higher labor taxes put pressure on marginal cost and thus marginal profits. Incentives to increase output and to post vacancies are lower. Our analysis indicates that moving from $\xi_b = 0.05$, which corresponds to highly debt financed expenditures closer to a balanced-budget regime with $\xi_b = 1.00$ can even change the sign of the multiplier for the group of asset-holding households. To this extend, our results indicate that a realistic quantitative judgement out of a DSGE model on fiscal multipliers can only be done by realistically assessing the tax revenue regime which goes along with a fiscal expenditure shock.

For the Calvo parameter, ϕ_p, and thus the degree of price stickiness, our results are in line with Monacelli and Perotti (2008). We also find that, with increasing values of ϕ_p, the boom in terms of quantities produced gains momentum after a fis-

Figure 4: Fiscal unemployment multiplier



Notes: The figure computes the average impact of fiscal policy on the labor market from quarter 2 to 5. We start with the first quarter following the shock as unemployment is predetermined in the period the shock hits the economy. While all other parameters remain fixed at their baseline the parameter on top of the figure is altered by the indicated range. The vertical axis reports the size of the fiscal multiplier as percentage deviations from steady state. Thus a value of 1 percent denotes for instance that the unemployment rate increase from 10 percent to 10.1 percent.

cal expenditure shock as inflation remains moderate during the boom which fosters demand. As firms need to produce whatever is posted at the current price, sticky prices fuel the demand driven boom in terms of quantities produced. Therefore fiscal policy becomes more effective in reducing unemployment. Additionally, for extremely sticky prices with little movement in the inflation rate, the central bank designs a less aggressive path for real interest rate. This finding goes into the direction of Schmitt-Grohe and Uribe (2006) who report that for highly counter–cyclical mark-up movements private consumption increases after a government expenditure shock.

The interplay between government expenditure shocks and the cumulative response of the unemployment rate for μ are also in line with expectations. With an increasing fraction of liquidity-constrained consumers the amplitude of the cycle increases. Obviously, as myopic consumers spend their entire disposable income, fiscal multipliers increase as long as the output multiplier is significantly positive. As in the Keynesian IS/LM model, the additional consumption generates new income which, in turn, generates new disposable income and so forth. Therefore, the ability of fiscal policy to have significant effects on unemployment is enhanced. Accordingly, the fiscal impact on unemployment becomes larger for asset–holding households and shrinks for rule-of-thumbers. As the unemployment rate for asset–holding households move largely procyclical for most of the parameter ranges considered, it just reflects a rise in amplitude of the cycle. For rule-of-thumbers, it mirrors that the incentive to work more deteriorates as the marginal utility of consumption decreases further.

With respect to the deep labor market coefficients stemming from the search and matching framework the following findings stand out. The fiscal impact on unemployment remains largely invariant to changes in χ which reflects the degree of bargaining power of workers. This result shows the interplay between opposing channels. On the one hand, an increase of χ lowers the incentive of firms to post

vacancies as a larger share of the Nash-product goes to workers. On the other hand, as the consumption behavior of rule-of-thumbers is driven by the current disposable income, which increases in χ, the boom in output and thus the drop in the unemployment rate of asset-holding households is amplified. In sum, the opposing effects almost chancel out each other.

Not surprisingly the figure reveals that for low values of α which increase the probability to fill a vacancy the fiscal unemployment multiplier decreases.

The replacement rate, which reflects the generosity of unemployment benefits, is besides the degree of price stickiness the single most important parameter to determine the quantitative effects of an expenditure shock on unemployment. While moving from a replacement level of $rrs^i = 0.4$ to a level of $rrs^i = 0.65$, the cumulative response of the unemployment rate increases from -0.2 to -1.3.

3.4 Fiscal unemployment multipliers

In order to get a feeling of the magnitude of the fiscal multipliers, we can normalize the cumulative response of the unemployment rates and output over a specific horizon, for example, one year, by the cumulative fiscal impulse. Formally, this is given by $\frac{\sum d\widehat{u^i}}{\sum d\widehat{G}}$, which can be interpreted as the fiscal (unemployment) multiplier.

As we have identified the degree of price stickiness ϕ_p, the replacement rate rrs, which determines unemployment benefits, and the degree of debt financing ξ_b of fiscal expenditures as the driving sources, table 1 reports how the fiscal multiplier changes when we alter these parameters individually to somewhat extreme values, while all other parameters remain fixed at their baseline calibration.

Within our model framework it is well possible to generate empirically plausible fiscal unemployment multipliers by either assuming highly sticky prices or alternatively somewhat high replacement rates. As we take the approach to interpret the replacement rate as the unemployment benefit and abstract from home production we already succeed for relatively low values of the replacement rates with $rrs = 0.65$,

Table 1: Fiscal multipliers over a one year horizon

Model	$\frac{\sum dY}{\sum dG}$	$\frac{\sum du^o}{\sum dG}$	$\frac{\sum du^r}{\sum dG}$
Baseline	0.63	-0.04	0.00
Highly sticky prices $\phi_p = 0.95$	1.05	-0.17	-0.07
High Replacement Rates $rrs = 0.95$	0.67	-0.22	-0.00
High Fraction of liquidity–constraint consumers $\mu = 0.20$	0.83	-0.05	0.03

Notes: Fiscal multipliers as implied by the baseline calibration in Table 2.

which reflects European levels of unemployment benefits, to replicate realistic values.

With respect to the output multiplier, the single most important parameters are the degree of price stickiness ϕ_p and the fraction of rule-of-thumbers μ.

4 Conclusion

In this paper we explore the effects of government expenditure shock on the unemployment rate in a model economy with asset-holding households and rule-of-thumb consumers. In the vague of the current financial and economic crisis, a lively debate on fiscal multipliers was ignited. This debate largely centers around the classical question how a government expenditure shock impacts on GDP. Nevertheless, in the background, the fiscal packages – for instance in the US – were explicitly designed to prevent labor markets from imploding (see, e.g., Bernstein and Romer, 2009).

Surprisingly, the literature largely remains tacit how such a package should be designed and which factors are likely to increase the propensity to reduce employment rates. In this paper we aim to explore which factors determine over success or

failure of such packages within a stylized DSGE model. Our findings indicate that although myopic consumers are highly responsive to a fiscal stimulus on the good market, their labor supply is highly rigid compared to optimizing households. We argue that, following a fiscal expansion, the consumption Lagrangians for both types of households move in opposite directions. This implies that rule-of-thumbers have little incentives to work harder in order to consume more when the marginal utility of consumption deteriorates relative to the marginal disutility of work. Optimizing households, on the contrary, have stronger incentives to increase labor supply as the crowding out in private consumption increases the marginal utility and thus sets incentives to work more.

Our analysis highlights the forces that shape the interaction between labor supply and labor demand following a fiscal policy shock. We reveal in particular that: i) highly sticky prices, ii) high degrees of risk aversion, iii) low real wage elasticities, iv) high replacement rates and v) debt financed expenditures increase the fiscal unemployment multiplier.

Parameter	Value	Description
Preferences		
μ	0.75	Share of optimizing households
β	0.992	Time-discount factor
σ_h	2.00	Labor supply elasticity of 0.5
σ_c	2.00	Risk aversion;
κ_h^o	1.015	Scaling factor to disutility of work (optimizers); targets $h = 1$
κ_h^r	1.291	Scaling factor to disutility of work (constrained); targets $h = 1$
Bargaining and Labor Good		
α	0.50	Elasticity of matching function;
χ	0.50	Workers' bargaining power
κ_e	xxx	Matching efficiency, targets $U^i = 0.045$
Wholesale Sector		
ϵ	11.000	Price markup of 10%
ϕ_P	0.66	Calvo stickiness of prices; duration of 3.3 qrts.
Monetary Policy		
ρ_i	0.850	Interest rate smoothing parameter
ϕ_π	2.0	Response of interest rate to inflation
ϕ_y	0.0	Response of interest rate to output gap
Fiscal Policy		
ξ_b	0.10	Tax feedback to deviations of debt from steady-state
Shocks		
ρ_g	0.5; 0.9	Autocorrelation of government spending

Table 2: Baseline Calibration

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