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Government expenditures and unemployment: a DSGE perspective

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Abstract:

In a New Keynesian DSGE model with labor market frictions and liquidity-constrained consumers aggregate unemployment is likely to increase due to a non-persistent government spending shock. Furthermore, the group of asset-holding households reacts very differently from the group of liquidity-constrained consumers implying that the unemployment rate is likely to decrease for asset-holding households, while it increases among liquidity-constrained consumers. The main driver of our results is the marginal utility of consumption which moves in opposite directions for the two types. Regarding the model's parameters, we find that the size of the fiscal (unemployment) multiplier increases with i) highly sticky prices, ii) high degrees of risk aversion, iii) low convexity in labor disutility iv) high replacement rates, and v) debt-financed expenditures.

Keywords: search and matching, government spending shocks, unemployment.

JEL-Classification: E 32, J 64, E 62.

Non-technical summary

Arguably, it is an important objective of fiscal policy to cushion the labor market from adverse business cycle effects. This objective prevailed especially in the aftermath of the current crisis when the governments of most OECD-countries significantly increased their structural deficits in order to prevent economic activity – especially in face of unemployment rates – from imploding. While there are several works analyzing the link between a fiscal stimulus and economic output, the literature remains somewhat tacit on the effects of a fiscal stimulus and unemployment.

The current work addresses this latter issue in a conventional New Keynesian DSGE-model with search friction on the labor market. The results suggest that positive employment multipliers can only be achieved by rather 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. This is due to the fact that, in the latter case, firms tend to satisfy the increased aggregate demand rather by adapting hours worked (the intensive margin) than by changing employment levels (the extensive margin).

This work also analyzes the different effects a government spending shocks has on optimizing households and liquidity-constrained consumers that have become known as "rule-of-thumb" consumers inn the literature. The first household type is able to save and borrow, which allows him to determine his desired "optimal" consumption path, while the second type is excluded from capital markets by assumption. Hence, he is forced to consume all his labor income each period and, in case of unemployment, has to consume accordingly less. Optimizing households can, at least to a certain extent, insure themselves against this kind of consumption risk resulting from unemployment spells. This implies that, after a government spending shock, optimizing households reduce consumption because of the well-known wealth effect, while "rule-of-thumb" consumers increase consumption because the increase in aggregate demand allows them to enforce higher wage claims (of which they consume everything). This implies an increase (decrease) in marginal utility of consumption for optimizing ("rule-of-thumb") households and, thus, in their willingness to provide more (less) working hours for the same wage. For firms, it becomes relatively more attractive to employ optimizing households as they are more inclined to expand hours worked for a lower wage increase. This is the case for a wide range of parameter specifications.

Regarding the influence of deep model parameters, it is found that unemployment effects are more sizable if prices are highly sticky, when unemployment benefits are high as well as for high degrees of risk aversion, low degrees of convexity in labor disutility and debt financed expenditures.

Nicht-technische Zusammenfassung

Ein wichtiges Anliegen der Fiskalpolitik dürfte es sein, den Arbeitsmarkt von zyklischen Schwankungen abzuschirmen. Dies wurde auch in der letzten Krise deutlich, in der der überwiegende Teil der OECD-Länder ihre strukturellen Defizite mit der Begründung deutlich ausgeweitet haben, die ökonomische Aktivität – insbesondere im Hinblick auf die Arbeitslosenzahlen – stimulieren zu wollen. Während es eine Vielzahl von Untersuchungen zum Zusammenhang zwischen fiskalischem Stimulus und Output gibt, ist der Zusammenhang zwischen fiskalischem Stimulus und Arbeitslosigkeit wesentlich weniger gut untersucht.

In der vorliegenden Arbeit wird im Rahmen eines neukeynesianischen DSGE-Modells mit Suchfriktionen auf dem Arbeitsmarkt untersucht, wie sich ein Staatsausgabenschock auf die Arbeitslosigkeit auswirkt. Die Ergebnisse der Untersuchung legen den Schluss nahe, dass nur ein vergleichsweise langlebiger Staatsausgabenschock tatsächlich die Arbeitslosigkeit reduzieren kann, sofern Firmen ihr Einstellungsverhalten vorausschauend planen. Durch kurzlebige fiskalische Expansion ausgelöste Nachfragesteigerungen erscheinen, zumindest im Hinblick auf die Arbeitsmarktstimulierung, eher ineffizient zu sein und werden von den Unternehmen tendenziell weniger durch Beschäftigungsausweitung sondern vielmehr durch Variation der Arbeitszeit befriedigt.

Im Rahmen der Modelluntersuchung wurde auch zwischen optimierenden Haushalten unterschieden und solchen, die Liquiditätsbeschränkungen unterliegen. Der erste Haushaltstyp kann durch Sparen einen für ihn "optimalen" Konsumpfad wählen, wohingegen der zuletzt genannte Haushaltstyp – in der Literatur als "Rule-of-thumb"-Haushalt bezeichnet – per Annahme vom Kapitalmarkt ausgeschlossen ist und nicht sparen kann. Somit ist er gezwungen, in jeder Periode genau das zu konsumieren, was er durch Arbeit verdient. Im Falle der Arbeitslosigkeit konsumiert er somit entsprechend weniger. Ein optimierender Haushalt kann sich hingegen bis zu einem gewissen Grad gegen dieses durch Arbeitslosigkeit ausgelöste Konsumrisiko durch optimal gestaltetes Sparverhalten "versichern". Nach einem Staatsausgabenschock reduzieren optimierende Haushalte wegen des negativen Vermögenseffekts ihren Konsum, wohingegen "Rule-of-thumb"-Haushalte ihren Konsum erhöhen, da aufgrund der gestiegenen gesamtwirtschaftlichen Nachfrage zumindest kurzfristig höhere Lohnforderungen durchgesetzt werden können. Damit steigt (sinkt) der Grenznutzen für Konsum für optimierende ('Rule-of-thumb"-) Haushalte und somit ihr Anreiz, zusätzliche Arbeitsstunden bei gleichem Lohn anzubieten. Für Firmen wird es deshalb attraktiver werden, vermehrt optimierende Haushalte einzustellen, da eine Arbeitszeitausweitung in diesem Fall günstiger ist und deswegen die Gewinnaussichten (stärker) steigen. Innerhalb des Modellrahmens ist dies für einen großen Parameterbereich der Fall.

Insgesamt sind die Effekte auf Arbeitslosigkeit in dem vorliegenden Modellrahmen umso größer, je rigider die Preise sind, je großzügiger die Arbeitslosenunterstützung ausfällt, je höher die Risikoaversion der Konsumenten ist, je niedriger der Grad der Konvexität vom Arbeitsleid ist und je mehr die zusätzlichen Staatsausgaben kreditfinanziert werden.

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Government Expenditures and Unemployment: A DSGE Perspective[1]

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 especially in the aftermath of the current financial and economic depression when the governments of OECD countries expanded structural deficits on average from -2.3 percent in 2007 to a projected value of -6.7 percent in 2010 in order to prevent economic activity and labor markets from imploding (Bernstein and Romer, 2009; OECD, 2009). We address this issue on the basis of 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 a government expenditure shock may even increase unemployment.[2] Whether augmenting fiscal expenditures is a suitable policy to positively influence employment 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. We additionally find that fiscal policy will be even less successful in stimulating the labor market the higher is the share 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.

Including liquidity-constrained consumers into DSGE models, which is

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[2]Among the large body of the DSGE literature mixing sticky prices and matching frictions, see Moyen and Sahuc (2005), Walsh (2005), Bodart et al. (2006), Trigari (2006, 2009), Krause and Lubik (2007), Christoffel and Kuester (2008) and De Walque et al. (2009).

nowadays a common feature when talking about fiscal policy (see, for example, Galí et al., 2007; and Forni et al., 2009), is mainly motivated by replicating empirically plausible responses of output and private consumption to a government expenditure shock following the seminal papers of Barro (1981, 1987), Aiyagari et al. (1992), Baxter and King (1993) and Gali et al. (2007). Most of these analyses, however, 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, exceptions being Yuan and Li (2000) and Monacelli et al.(2010). Yuan and Li (2000) address the issue in a conventional RBC model and find that the driving force why increasing government spending may increase unemployment is its effect on the stochastic discount factor when firms are forward-looking. Monacelli et al. (2010) address the issue in a sticky price model with non-separable utility in consumption and leisure neglecting adjustments over the intensive margin, however. They basically confirm the qualitative findings of Yuan and Li (2000) but additionally show that, with the complementarity between consumption an leisure being sufficiently high to generate an increase in private consumption and, thus, boost in output, this can generate realistic output multipliers quantitatively.

We contribute to this theoretical discussion by showing 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, the marginal utility of consumption 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 disposable income, however, fosters the boom in consumption. Hence, the different movements in hours worked resulting from contrary changes in marginal utility of consumption directly affects firms' profits in each labor market segment and, as optimizers have more incentives to work more, employing an optimizers is more desirable for firms.

The labor market implications of a government expenditure shock alter substantially with respect to the degree of persistence and the share of rule-of-thumb consumers. 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 the aim is 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 (see also Yuan and Li, 2000). However, in a sticky price framework with limited movement in the real interest rate and, thus, the marginal utility of consumption, this result cannot be confirmed, at least not for asset-holding households. The unemployment rate for this group moves procyclical for a wide range of parameters. But the inclusion of rule-of-thumbers non-trivially affects the cyclical behavior of unemployment and vacancy posting. On the one hand, rule-of-thumbers increase consumption along a government expenditure shock additionally contributing to the increase in output and, thus, increases the economic rent of the worker to the firm increases as the boom gains momentum with an increasing share of rule-of-thumbers. On the other hand, as they increase the business cycle volatility, the real interest rate path implied by the Taylor-principle increases such that the stochastic discount factor increases. Both channels are opposing, but our findings robustly suggest that rule-of-thumbers increase the vacancy posting activity for asset-holding families.

Regarding the influence of deep model parameters, we find that unemployment effects are more sizable if prices are highly sticky and when unemployment benefits are high, which is in line with findings of a related study by Monacelli et al. (2010). Additionally, we can report that the size of the fiscal multiplier tends to increase for high degrees of risk aversion, low degrees of convexity in labor disutility and debt financed expenditures. Playing with the tax rule as such, we can, furthermore, point to the fact that a realistic quantitative judgement resulting from a DSGE model on fiscal multipliers seems to be possible only when realistically assessing the tax regime as it is quite influential, too. Nevertheless, the degree of price stickiness and the level of the replacement rate are the two most important individual factors in shaping the size of the multiplier quantitatively. As a numerical benchmark on the available studies on fiscal multipliers, we rely on Cogan et al. (2009) and Christiano et al. (2009), and find that our model is capable of producing 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. In this section, 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 New Keynesian DSGE model incorporating liquidity-constrained consumers and search and matching frictions. The model also includes distortionary taxation and debt-financed government expenditures.

2.1 Households

There is a fraction μ of optimizing households which 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 consumer $i \in [o, r]$ – where the superscripts stand for optimizers o and rule-of-thumbers r – is characterized by the following per period utility function:

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

where σ_c is the inverse of the intertemporal elasticity of substitution for asset-holding households, σ_h governs the degree of convexity of the disutility of labor and κ_h^i is a scaling parameter relating the disutility of labor to the utility of consumption. Asset-holding households collect and distribute all income of its members maximizing the sum of their expected utilities. They, hence, face the following flow-budget constraint:

$$c_t^o + \frac{B_{t+1}}{P_t(1+i_t)} = N_t^o(1-\tau_t)w_t^o h_t^o + U_t^o \kappa_B^o + \Psi_t + \frac{B_t}{P_t}, \tag{2}$$

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. Let λ_t^o denote the Lagrangian multiplier on the optimizing household's budget constraint, consumption smoothing is guided by the following first-order conditions:

$$1 = (1+i_t)E_t\left\{\Omega_{t,t+1}\frac{1}{\pi_{t+1}}\right\}, \tag{3}$$

and

$$\lambda_t^o = (c_t^o)^{-\sigma_c}, \tag{4}$$

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 is liquidity-constrained and consumes all their disposable income. Hence, their consumption plan reads:

$$c_t^r = \begin{cases} c_t^r = (1-\tau_t)w_t^r h_t^r & \text{if employed} \\ c_t^r = \kappa_B^r & \text{if unemployed,} \end{cases} \tag{5}$$

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

The production sector is divided into three stages. Final good producers, intermediate goods producers and labor firms. Final good producers are perfectly competitive firms producing an aggregate final good Y_t that may be used for private and public consumption. This production is obtained using a continuum of differentiated intermediate goods $Q_t(j) \in [0,1]$ with a standard

Dixit-Stiglitz technology. The representative final good producer maximizes profits $P_tY_t - \int_0^1 P_t(j)Q_t(j)dj$ subject to its production function, taking as given the final good price P_t and the prices of all intermediate goods.

In the intermediate goods sector, firms are monopolistic competitors producing differentiated products using a labor good, while facing a staggered price-setting technology as in Calvo (1983). The labor good is produced by firms which take hours worked by each individual hired as their sole input of production. The labor good is sold to the intermediate goods producers in a perfectly competitive manner. Firms in the monopolistic sector produce the intermediate good varieties $Q_t(j)$, by buying the labor good $L_t(j)$ at nominal cost P_tx_t and, further, decide for how much the variety is sold in the market. The production technology available to intermediate firms is linear: $Q_t(j) = L_t(j)$. In 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:

$$\text{Max } \Pi_t(j) = E_t \sum_{k=0}^{\infty} \phi_P^k \Omega_{t,t+k} \left(\frac{P_t(j)}{P_{t+k}} - x_{t+k} \right) L_{t+k}(j), \tag{6}$$

subject to the demand equation $Q_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\epsilon} Y_t$ emanating from the final good producers profit maximization and its production function. 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, 1995; 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 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, there are two separate labor markets in our model, 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,

$$J_t^i = x_t h_t^i - w_t^i h_t^i + \beta E_t \left\{ \frac{\lambda_{t+1}^o}{\lambda_t^o} (1-s) J_{t+1}^i \right\}, \tag{7}$$

where for both types of workers $\frac{\lambda_{t+1}^o}{\lambda_t^o}$ is the relevant discount factor as optimizers are the owner of the firm sector. Analogously, let W_t^i be the present real value of an employed worker of type i. Then, optimizing workers' present value function – which is the asset-holding households' gain of having one additional member employed – is given by[3]

$$W_t^o = (1-\tau_t) w_t^o h_t^o - \kappa_B^o - \frac{\kappa_h^o}{\lambda_t^o} \frac{(h_t^o)^{(1+\sigma_h)}}{(1+\sigma_h)} + \beta E_t \left\{ \frac{\lambda_{t+1}^o}{\lambda_t^o} (1 - s - p_t^o) W_{t+1}^o \right\}. \tag{8}$$

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 (8) 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 of being dismissed, s, and the probability of being re-employed in the case of unemployment, p_t^i (which remains to be determined later).

[3]The derivation follows standard procedures, i.e. the asset-holders maximize aggregate household utility $U_t^o = \frac{[c_t^o]^{1-\sigma_c}}{1-\sigma_c} - N_t^o \cdot \kappa_h^o \frac{[h_t^o]^{1+\sigma_h}}{1+\sigma_h}$ with respect to N_t^o subject to equation (2) and employment law-of-motion $N_t^o = (1-s)N_{t-1}^o + p_{t-1}^o(1-N_{t-1}^o)$, the latter specified in more detail below. With λ_t^o and ω_t^o being the Lagrangians on (2) and the employment law-of-motion, respectively, this yields $-\kappa_h^o \frac{[h_t^o]^{1+\sigma_h}}{1+\sigma_h} + \lambda_t \left[w_t^o h_t^o (1-\tau_t) - \kappa_B^o \right] - \omega_t^o + \beta E_t \left\{ (1-s-p_t^o)\omega_{t+1}^o \right\}$. Defining $W_t^o = \omega_t^o / \lambda_t^o$, we get equation (8); see also Moyen and Sahuc (2005).

Liquidity-constrained workers consume all their disposable income. An employed rule-of-thumb consumer, hence, bargains over the difference between the value functions of being employed or being unemployed, which is given by $\omega_t^r = \frac{[(1-\tau_t)w_t^r h_t^r]^{1-\sigma_c}}{1-\sigma_c} - \kappa_h^r \frac{[h_t^r]^{1+\sigma_h}}{1+\sigma_h} - \frac{[\kappa_B^r]^{1-\sigma_c}}{1-\sigma_c} + \beta E_t \left\{(1-s-p_t^r)\omega_{t+1}^r\right\}$. As J_t^i is expressed in real terms (see equation (7)), however, we convert the workers' present value function from utils to real values, which we achieve 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, given that $W_t^r = \omega_t^r/\lambda_t^r$, the present value function of liquidity-constrained workers is – very much in analogy to equation (8) – given by

$$\begin{aligned} W_t^r \;=\; & \frac{[(1-\tau_t)w_t^r h_t^r]^{(1-\sigma_c)}}{(1-\sigma_c)\lambda_t^r} - \frac{[\kappa_B^r]^{(1-\sigma_c)}}{(1-\sigma_c)\lambda_t^r} - \frac{\kappa_h^r}{\lambda_t^r}\frac{(h_t^r)^{(1+\sigma_h)}}{(1+\sigma_h)} \\ & + \beta E_t \left\{ \frac{\lambda_{t+1}^r}{\lambda_t^r}(1-s-p_t^r)W_{t+1}^r \right\}. \end{aligned} \tag{9}$$

Bargaining: In 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

$$\max_{w_t^i, h_t^i} S(w_t^i, h_t^i) = \left[W_t^i\right]^{\chi} \left[J_t^i\right]^{(1-\chi)}, \tag{10}$$

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

$$W_t^i = \frac{\chi}{1-\chi}(1-\tau_t)J_t^i \tag{11}$$

and

$$x_t = \frac{\kappa_h^i \left(h_t^i\right)^{\sigma_h}}{\lambda_t^i(1-\tau_t)}, \tag{12}$$

which determines the corresponding group's hours worked.[4] 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.

[4]As usual in matching models with Nash-bargaining, the wage results to be a weighted average of the labor goods firm's marginal gain from employing an additional worker and the worker's option value resulting from unemployment benefits as well as the disutility of work. For optimizing households, this term can explicitly be calculated, while it is given by an implicit function for rule-of-thumbers due to the non-linear utility function.

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 the 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 in each period, while vacant jobs are filled with probability q_t^i in each period, where

$$p_t^i = \frac{M_t^i}{U_t^i} = \kappa_e \left(\frac{V_t^i}{U_t^i}\right)^{1-\alpha} \quad \text{and} \quad q_t^i = \frac{M_t^i}{V_t^i} = \kappa_e \left(\frac{V_t^i}{U_t^i}\right)^{-\alpha}. \tag{13}$$

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

$$\frac{\kappa_v^i}{q_t^i} = E_t \left\{\Omega_{t,t+1} J_{t+1}^i\right\}. \tag{14}$$

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

$$L_t = \mu N_t^o h_t^o + (1 - \mu)N_t^r h_t^r. \tag{15}$$

2.4 Monetary authorities

Monetary policy follows a Taylor rule

$$\left(\frac{1+i_t}{1+\bar{i}}\right) = \left(\frac{1+i_{t-1}}{1+\bar{i}}\right)^{\rho_i} \left(\frac{\pi_{t-1}}{\bar{\pi}}\right)^{(1-\rho_i)\phi_\pi} \left(\frac{y_t}{\bar{y}}\right)^{(1-\rho_i)\phi_y}, \tag{16}$$

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 response 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

$$G_t + \mu\kappa_B^o U_t^o + (1-\mu)\kappa_B^r U_t^r + (1+i_{t-1})\pi_t^{-1} b_{t-1} = \tau_t\left[\mu N_t^o w_t^o h_t^o + (1-\mu) N_t^r w_t^r h_t^r\right] + b_t, \tag{17}$$

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

$$\frac{\tau_t}{\bar{\tau}} = \left(\frac{b_{t-1}}{\bar{b}}\right)^{\chi_b}, \tag{18}$$

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

$$\frac{G_t}{\bar{G}} = \left(\frac{G_{t-1}}{\bar{G}}\right)^{\rho_G} \epsilon_t, \tag{19}$$

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 that

$$Y_t = C_t^{tot} + G_t + \mu\kappa_v^o V_t^o + (1-\mu)\kappa_v^r V_t^r = \frac{1}{D_t}\left[\mu N_t^o h_t^o + (1-\mu) N_t^r h_t^r\right], \quad (20)$$

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

$$C_t^{tot} = \mu c_t^o + (1-\mu)c_t^r. \quad (21)$$

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 labor market rather than 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 1. 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 believe it is plausible that at least 25% of the population are liquidity-constrained consumers. Since Shimer (2005) it has been well understood that the unemployment benefit or, more generally, the value of non-work activity is important in terms of replicating the response of vacancy posting over the business cycle. Unfortunately, no clear-cut consensus has emerged on 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 $\kappa_B^i = rrs^i \cdot (1-\bar{\tau})\bar{w}^i\bar{h}^i$ seems plausible, as it encompasses the range between the US to the European replacement rates. In our baseline calibration, we set $rrs^i = 0.5$ in the midst of this range, which also reflects the average value for industrialized countries (Nickell and Nunziata, 2001).

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	0.01	Matching efficiency, targets $U^i = 0.045$
s	0.04	Separation rate
rrs^i	0.50	Replacement ratio; Nickell and Nunziata (2001)
Wholesale sector		
ϵ	11.00	Price mark-up of 10%
ϕ_P	0.66	Calvo stickiness of prices; duration of 3.3 qrts
ω_P	0.50	Degree of price indexation
Monetary policy		
ρ_i	0.85	Interest rate smoothing parameter
ϕ_π	2.00	Response of interest rate to inflation
ϕ_y	0.00	Response of interest rate to output gap
Fiscal policy		
χ_b	0.10	Tax feedback to deviations of debt from steady-state
Shocks		
ρ_g	0.00; 0.50; 0.90	Autocorrelation of government spending

Table 1: Baseline calibration

3 Government expenditure shock and unemployment

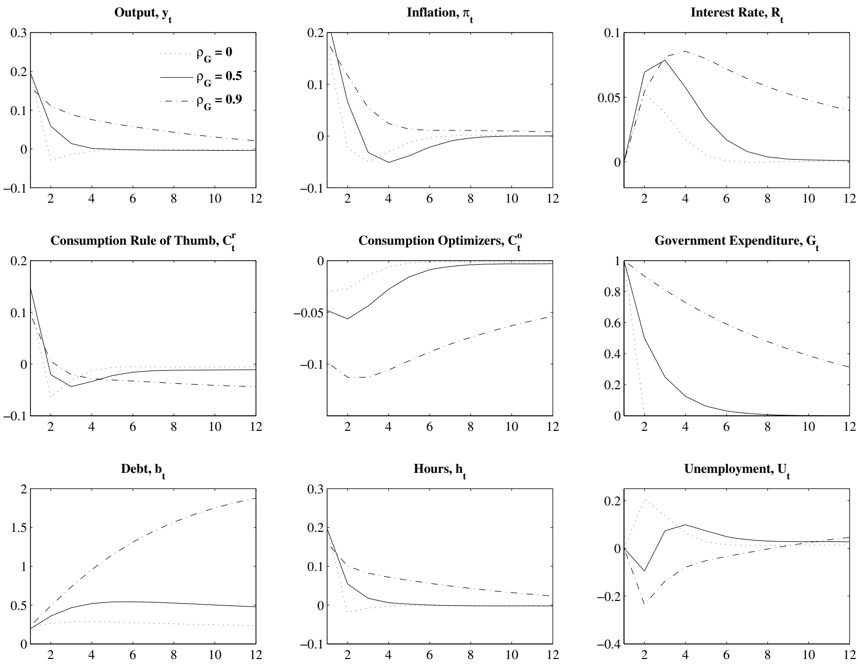
To kick off the analysis, we present in the next subsection the equilibrium dynamics of the business cycle to a government expenditure shock. In a first step, we check whether the impulse responses of output, inflation, consumption and wages are in line with conventional wisdom in a New Keynesian framework (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, the 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 households decreases, whereas the consumption of rule-of-thumbers increases. As asset-holding households account for three quarters 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: the wealth effect and the interest rate channel. As is well known, a tax-financed fiscal expansion withdraws resources from consumers such that they are willing to expand hours worked as consumption

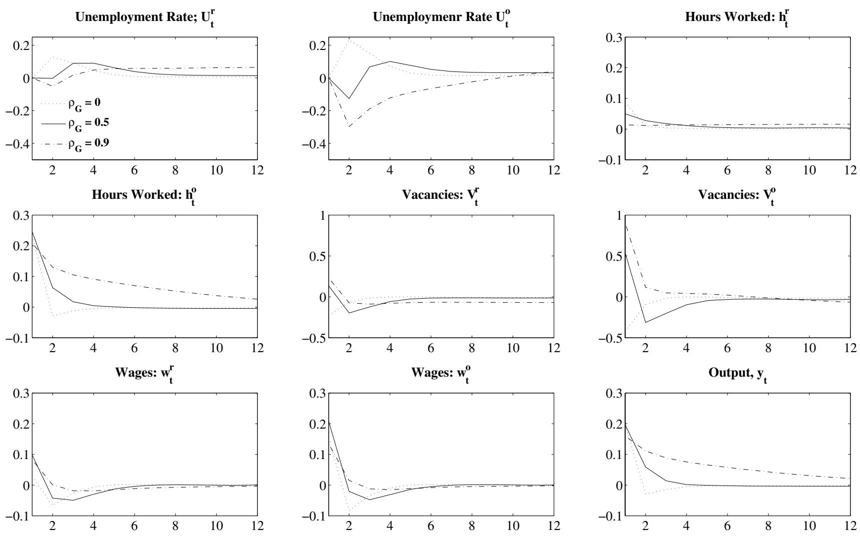
Figure 1: Fiscal expenditure shock



Notes: The impulse response portrays the response of selected variables to a fiscal policy shock of a 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 $\rho_G = 0.90$.

and leisure are normal goods.[5] As a 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 a 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.

The procyclical evolution of real wages can be explained as follows. As is well known from the matching labor market literature, wages are a weighted average of the marginal productivity of a worker and of the worker's fall back position. The latter is determined by unemployment benefits (the "foregone income" when working) and the disutility of work. In order to satisfy the increased (government) consumption demand, private production has to be increased. This is, at least partly, done by augmenting hours worked. More hours worked increase both the firms' marginal gain resulting from a worker

[5] As shown by Monacelli and Perotti (2008) for non-seperable preferences, 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.

and the disutility of working and, thus, raises wage claims. Because hours worked and wages increase more for optimizers, the first effect, namely, the firms' gain in profitability, seems to be the dominating effect in wage determination. The fact that optimizers increase their hours worked more than rule-of-thumbers do can be explained by opposing movements in their consumption behavior. We will explain this issue in more detail below, however.

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.

In the next subsection, we investigate the underlying causes 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

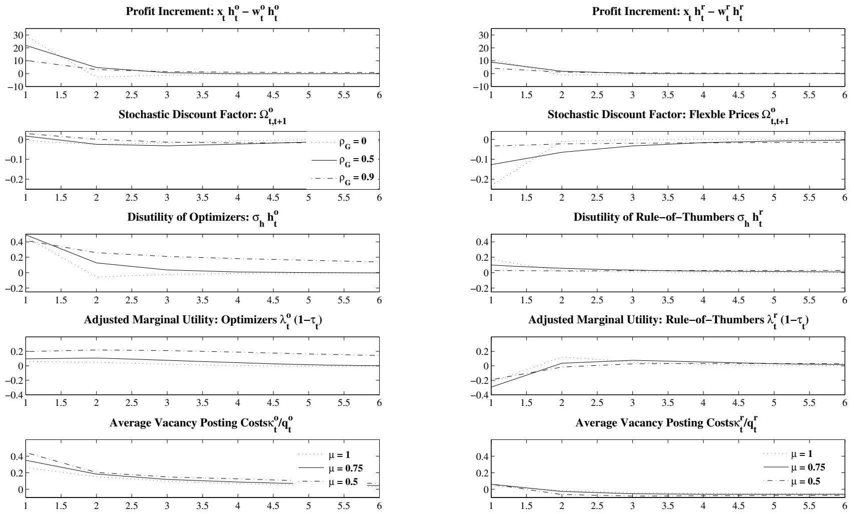
While the last section gave the broad picture, we now put the spotlight on labor market dynamics.

Figure 2 reveals the striking result that, once we look at the average labor market response in the first year after the shock, a fiscal expansion increases the unemployment rate among rule-of-thumbers for all degrees of persistence. For uncorrelated and mildly correlated shocks it is, in fact, 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 simply reflects the fact that the vacancy creation movements' amplitude differs on the two labor market segments.

Obviously, as the unfavorable increase in the stochastic discount factor is common to all labor good producers, this behavior is driven by changes in expected profits. As we can see from figure 3, the contribution of the expected profit increment $x_t h_t^i - w_t^i h_t^i$ in period $(t+1)$ for optimizers exceeds by a large factor the profit increment of rule-of-thumbers, thus, explaining the vacancy creation differential.

The deep explanation to this finding lies in the evolution of the marginal rate of substitution. Rule-of-thumbers have little interest in working harder to consume more when the marginal utility of consumption deteriorates relative

Figure 3: Job creation condition



Notes: The impulse response portrays the response of selected variables to a fiscal policy shock of a 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. In the lower panel (average vacancy posting costs), we keep the degree of persistence in government expenditures fixed at $\phi_g = 0.9$ while we alter the share of optimizing households from $\mu = 0.5$ to $\mu = 1.0$.

to the marginal disutility of hours worked. In contrast, as their marginal utility of consumption increases, optimizing households need to be less compensated for the same increase in hours worked. The outside option, and thereby the wage, of the optimizers is less responsive to changes in hours worked. Firms operating in the labor market segment of asset-holding households thus have strong incentives to expand along the extensive margin and to post additional vacancies.

Given a linear production technology, marginal costs are entirely driven by the evolution of the marginal rates of substitution mrs_t. In log-linearized terms it holds

$$\widehat{x}_t = \sigma_h \widehat{h}_t^i - (\widehat{\lambda}_t^i + o\widehat{\tau}_t), \tag{22}$$

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 directions 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 firms employing 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 which is, given the bargaining structure in the matching labor market, also in the interest of optimizing households.

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. First, an increase in the stochastic discount factor might lower the discounted economic rent generated by the worker for the firm. Second, 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. Note, however, that for flexible prices with $\phi_P = 0$, we find in a "close-to-RBC" framework that the stochastic discount factor drives the response of unemployment as it instantaneously dips up to 20 percent depending on the degree of correlation in the exogenous government expenditure shock. Therefore, this supports Yuan and Li (2000), who use an RBC framework, and our analysis does not mean to challenge their results.

Still, it remains the question what 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.

Finally our analysis suggests that the introduction of rule-of-thumbers has non-trivial implications besides increasing the impact multiplier of GDP and attenuating the initial drop in aggregate consumption. As a summary statistic, figure 3 reports the evolution of vacancy posting for different shares of rule-of-thumbers with $(1-\mu)=0$, $(1-\mu)=0.25$ and $(1-\mu)=0.50$. The analysis indicates that vacancy posting and, thus, the expected rent of a worker to the firm that owns assets sharply increases in the share of rule-of-thumbers. This reflects that with an increasing share of rule-of-thumbers the economic boom following a government expenditure shock gains momentum such that expected rents attached to the worker increase. This effect is supported by the Taylor-Principle which promotes a stronger dip in consumption in response to the stronger increase in inflation. As we have seen beforehand this in turn increases the marginal utility $\widehat{\lambda}_t^o$ of consumption among asset holders which in turn moderates the wage claims and thus enhances firm profitability. In principle, the stochastic-discount-factor channel and the economic-rent channel operate in opposite directions. Our findings robustly suggests that the economic-rent effect dominates the stochastic-discount-factor channel in a sticky price model.

3.3 Fiscal impact on unemployment: What determines its strength

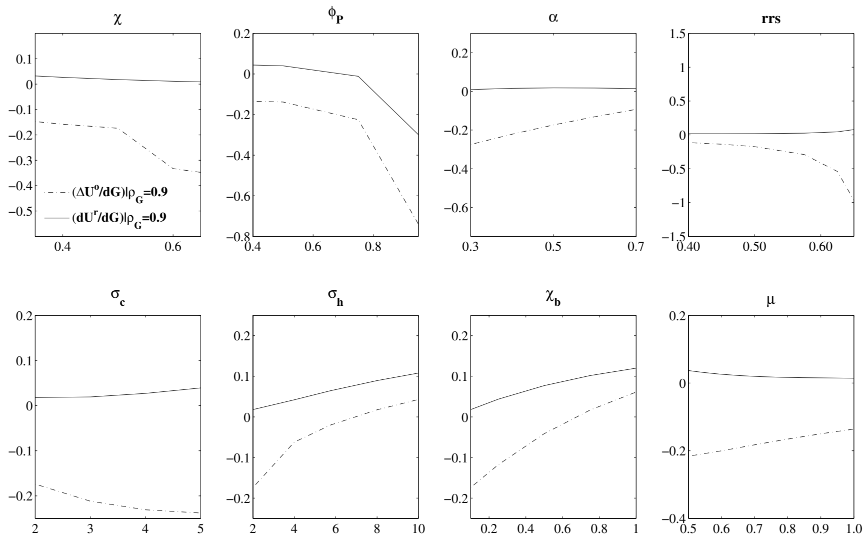
In this section, we dig a little deeper and investigate how the effects of a government expenditure shock on the unemployment rate change as a function of the deep parameters of the model for persistent government expenditure shocks with $\rho_G = 0.9$. To do so, we conduct the following experiment. For each parameter, 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. $\frac{d\widehat{U}}{d\widehat{G}} = (1/4)\sum_{k=2}^{5} \widehat{U}_{t+k}^{i}$. Note, $\widehat{U}_t$ denotes the log–linear deviation from the steady-state value $\bar{U}$, i.e. $\widehat{U}_t = ln(U_t) - ln(\bar{U})$ 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 unemployment 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. It is only for the case of a persistent shock $\rho_G = 0.9$ in conjunction with highly sticky prices that 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, i.e. σ_c, σ_h and χ_b which we have 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-averse for increasing values of σ_c, fiscal policy becomes more effective in terms of lowering the unemployment rate. With increasing values of σ_c, the elasticity of the outside option to consumption (i.e. the effect on λ_t^i) increases. For optimizing households, this means that the relatively moderate upward pressure on wages is even more moderated (vice versa for rule-of-thumbers), which then amplifies the effects described above. Additionally 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 a straightforward matter 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 three quarters 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, for example, Trigari, 2009), our analysis indicates that the sign of the fiscal impact on unemployment turns positive even for the group of optimizers.

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 when 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 increases from 10 percent to 10.1 percent.

Finally, taxes have a direct impact on the marginal rate of substitution and the size of the impact as we include non-Ricardian households. For low values of χ_b, i.e. 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. First, the consumption behavior of rule-of-thumbers is driven by current disposable income which decreases with a more ambitious refinancing scheme (and, thus, negatively affects aggregate consumption demand). Second, 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 due to both issues. Our analysis indicates that moving from $\chi_b = 0.05$, which corresponds to highly debt-financed expenditures closer to a balanced-budget regime with $\chi_b = 1.00$, can even change the sign of the multiplier for the group of asset-holding households. To this extent, 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 fiscal expenditure shock as inflation remains moderate during the boom. This 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 the real interest rate. This finding approaches that of Ravn et al. (2007) who report that, for highly countercyclical 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 the fraction of optimizing households μ are also in line with expectations. With an increasing fraction of liquidity-constrained consumers (decrease in μ), 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 moves 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 the fact 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 cancel each other out.

Not surprisingly the figure reveals that lowering α and thereby increasing the probability of filling a vacancy decreases the fiscal unemployment multiplier.

The replacement rate, which reflects the generosity of unemployment benefits, is alongside the degree of price stickiness, one of the most important parameter for determining 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. This result reflects the mechanics of the search and matching model as highlighted by Hagedorn and Manovski (2008). To deliver a higher cyclical volatility of unemployment and vacancies the basic search and matching setup needs to exhibit smaller steady state profits. For a given, and pretty low, worker bargaining power, this can only be achieved by increasing the value of non-work activity. This obviously explains our finding.

3.4 Fiscal unemployment multipliers

Another dimension along which we can compare our results to the existing literature on fiscal multipliers is to normalize the cumulative response of the unemployment rate over a specific horizon – for example, one year – by the cumulative fiscal impulse. Formally, this is given by $\frac{\sum du^i}{\sum dG}$, which is the fiscal (unemployment) multiplier, and $\frac{\sum dY}{\sum dG}$ which denotes the output multiplier.

Reviewing the literature, VAR evidence seems to indicate for US data that the output multiplier is somewhat above one. Monacelli et al (2010) report a cumulative output multiplier of 1.35. Ramey (2008) estimates a value of 1.2. Simulations in sticky price DSGE models typically report estimates somewhat below one (Christiano et al (2009), Gali et al (2007), Monacelli and Perotti (2008)). For the fiscal unemployment multiplier Monacelli et al (2010) reports a value of -0.28 percentage points.

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 χ_b of fiscal expenditures as the driving sources, table 2 reports how the multiplier changes when we alter these parameters individually to somewhat extreme values, while all other parameters remain fixed at their baseline calibration.

Table 2: 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			
$rrs = 0.65$	0.67	-0.22	-0.00
Tax financed			
$\chi_b = 2.00$	0.41	0.02	0.06
High fraction of ROT			
$\mu = 0.20$	0.83	-0.05	0.03

Notes: Fiscal multipliers as implied by the baseline calibration in Table 1 except for the parameters altered.

Within our model framework, it is well possible to generate empirically plausible fiscal unemployment multipliers by either assuming highly sticky prices with $\phi_p = 0.95$, as in Smets and Wouters (2003), or, alternatively, somewhat high replacement rates comparable to European unemployment benefits $rrs = 0.65$. Additionally, we only succeed in producing empirically plausible values for the output and unemployment multipliers if expenditures are debt-financed. For $\chi_b = 2.00$, which mimics a balanced budget regime financed by labor taxes, the output multiplier shrinks to 0.41 and the fiscal multipliers switch their sign. Our analysis also highlights the fact that a large fraction of rule-of-thumbers (with $1 - \mu = 0.80$) boosts the output multiplier from 0.63 to 0.83 and somewhat improves the fiscal unemployment multiplier for asset-holding families.

4 Conclusions

In this paper, we explore the effects of government expenditure shocks on the unemployment rate in a model economy with asset-holding households and rule-of-thumb consumers. The current financial and economic crisis ignited a lively debate on fiscal multipliers. The debate on this issue has largely centered on the classical question how a government expenditure shock impacts on GDP. However, the current fiscal packages – for instance, in the US – have been explicitly designed to prevent labor markets from imploding (see, for example, Bernstein and Romer, 2009).

Surprisingly, the literature largely remains tacit concerning 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 the factors which determine the 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 goods 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 household move in opposite directions. This implies that rule-of-thumbers have few incentives to work harder in order to consume more when the marginal utility of consumption deteriorates relative to the marginal disutility of work. Conversely, optimizing households have stronger incentives to increase labor supply as 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 degrees of convexity in the disutility of labor, iv) high replacement rates, and v) debt-financed expenditures increase the fiscal unemployment multiplier.

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