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Fiscal Calculus and the Labor Market*

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Abstract

The endorsement of expansionary fiscal packages has often been based on the idea that large multipliers can counteract rising and persistent unemployment. We explore the effectiveness of fiscal stimuli in a model with matching frictions and endogenous participation. Results show that hiring subsidies, contrary to increase in government spending, deliver large multipliers, even with distortionary taxation. Those policies increase the incentives to post vacancies, hence employment. Furthermore, by reducing marginal costs they also reduce inflation and increase private consumption.

KEYWORDS: fiscal calculus, taxation, matching frictions, endogenous participation

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1 Introduction

The endorsement of expansionary fiscal packages has often been based on the idea that large multipliers can counteract rising and persistent unemployment. Following the 2007-2008 crisis, various national governments around the globe have passed expansionary fiscal packages arguing that, with nominal interest rates at the zero lower bound, only strong fiscal stimuli could help to counteract the recession and rising unemployment. In the United States the fiscal stimulus involved, in addition to a pure increase in government spending, also incentives to hiring. With the Hiring Incentives to Restore Employment (HIRE) Act, enacted on March 18, 2010, new tax benefits have been made available to employers who hire previously unemployed workers and who maintain them for a certain period of time. In Europe the response to the raising unemployment in the aftermath of the crisis took mainly the form of measures reducing layoffs.[1] While some time will elapse before economists can judge the relative success of measures reducing hiring costs versus measures reducing layoffs, this paper focuses on examining the effectiveness of the first by means of fiscal multipliers.

Recent and past literature (reviewed below) shows that generally fiscal multipliers for demand stimuli are small in business cycle models with various nominal and real frictions. However, none of the previous studies considered fiscal stimuli in the form of hiring subsidies. We do so using a New Keynesian model with matching frictions and endogenous workers' participation. The presence of unemployment and cost of hiring renders the model particularly suitable to analyze the relative effectiveness of traditional increases in government spending versus increases in hiring subsidies. Furthermore, in our model participation decisions depend procyclically upon the expected returns from search: adverse market conditions, as those fueled by a crisis, can discourage potential workers from entering the labor market, therefore increasing unemployment.[2]

We compute short-run and long-run multipliers for both traditional increases in government spending and increases in hiring subsidies. Under a variety of specification for parameters and policies, we find two general results. Traditional government spending policies deliver low multipliers, confirming results in the previous literature, while hiring policies deliver large multipliers. The rationale for the results is as follows. Due to the crowding out of private demand, increases in government spending reduce rather than increase vacancy posting and increase labor

[1]Examples include the Cassa Integrazione in Italy, the Kurzarbeit scheme in Germany, the chômage partiel in France. Those are essentially short time work schemes that have an impact on the firing margin rather than on the hiring margin.

[2]The discouraged workers' effect is considered as one of the potential explanations of the jobless recovery.

market tightness. Unemployment is higher and its fluctuations are more amplified. This is even more so under distortionary taxation, as households expect that the increase in government spending will be financed with future tax increases. Interestingly, in our model households increase participation in the labor market, due to the mild increase of aggregate demand on impact, making it easier for firms to fill their vacancies. This has a positive effect on vacancy posting decisions and overall vacancies increase, even though only in the short run. As a result, multipliers are higher than in a model with exogenous participation but remain still well below 1.[3]

On the other side, hiring subsidies deliver positive and large multipliers, even with distortionary taxation. A reduction in the cost of hiring indeed boosts vacancy creation, hence employment.[4] Importantly, hiring subsidies reduce the marginal costs of workers. The ensuing reduction in inflation produces a crowding in of private consumption, which in fact rises. Participation overall declines due to the positive income effect.

Our work is closely related to a number of papers considering fiscal stimuli with a particular focus on policies designed to improve the safety net: those contributions include Davig and Leeper (2011), Davig, Leeper, and Walker (2010) and Leeper, Walker, and Yang (2010). Our paper is generally related to the recent literature on fiscal multipliers which includes, among others, Romer and Bernstein (2009), Cogan, Cwik, Taylor, and Wieland (2010), Christiano, Eichenbaum, and Rebelo (2009). Within this literature Uhlig (2010) and Leeper, Plante, and Traum (2010) show that distortionary taxation dampens the multipliers.[5] In our model the dampening effect also works through depressing vacancy creation and job finding rates. Recently, other authors have analyzed multipliers from aggregate demand stimuli in models with labor market frictions. Yuan and Li (2000) show, within an RBC model, that matching frictions amplify the crowding out effects, hence they reduce multipliers. Monacelli, Perotti, and Trigari (2010) examine government spending multipliers in a model with matching frictions and find that they are small, even when adding endogenous job destruction and capital. Finally, Faia, Lechthaler, and Merkl (2010), using a labor selection model, confirm the results of small multipliers for demand stimuli. None of the above papers considers hiring

[3]In response to government expenditure shocks, employment increases due to the increase in vacancy creation. However, the increase in vacancy posting is not enough to compensate the increase in the participation rate, hence unemployment rises as well. This is consistent with empirical evidence recently provided in Brückner and Pappa (2010).

[4]Notice that in this model we do not consider an endogenous firing margin, since we assume an exogenous destruction rate. Under endogenous job destruction the equilibrium increase in employment might come along with an increase in the mass of firings: such an effect might partly, although not entirely, dampen the beneficial effect of hiring policies.

[5]See Baxter and King (1993) for early results on this.

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subsidies and endogenous participation. Both elements add realism to the model: hiring subsidies indeed represent an important measure of the fiscal stimulus packages and endogenous participation allows for the discouraged worker effect, which is typical of depressions following crises.

The structure of the paper is as follows. Section 2 presents the model economy and describes the fiscal sector. Section 3 shows the results on multipliers. Finally, Section 4 concludes.

2 A DNK Model with Matching Frictions and Endogenous Participation

There is a continuum of agents whose total measure is normalized to one. The economy is populated by households who consume different varieties of goods, save, work and home produce. Each family member can either actively participate in the labor market or stay at home. The labor market is characterized by matching frictions so that active members can be either employed or unemployed. In the first case, they allocate all their time endowment to work and receive a wage that is determined according to Nash bargaining. In the second case, they allocate a fraction of time to the search activity, while the remaining is used for home production. They also receive an unemployment benefit. The production sector is monopolistically competitive and faces quadratic adjustment costs in pricing.

2.1 Households

Household's size is normalized to 1. Households make consumption and labor participation decisions. The latter is modeled along the lines of Campolmi and Gnocchi (2011). Only a fraction n_t of family members actively participate into the labor market, while $1-n_t$ voluntarily choose non-employment. Active members can be either employed or unemployed. Household's expected life time utility is given by:

$$E_0\left\{\sum_{t=0}^{\infty}\beta^t\left[\Psi_t\frac{c_t^{1-\sigma}}{1-\sigma}+\Phi\frac{h_t^{1+\nu}}{1+\nu}\right]\right\} \tag{1}$$

where c_t denotes consumption, Ψ_t is a preference shock, Φ is a scaling parameter that pins down the steady state participation rate, $\nu<0$ is the inverse of the home production elasticity, $\sigma>0$ is the inverse of the intertemporal elasticity of substitution in consumption, and h_t denotes home production.

We assume instantaneous hiring so that matched workers start to work in the same period the match occurred. Hence, in each period workers searching for a job (beginning of the period unemployed) are given by:

$$s_t = n_t - (1-\rho)e_{t-1} \tag{2}$$

while employment evolves according to:

$$e_t = (1-\rho)(1-f_t)e_{t-1} + f_t n_t \tag{3}$$

where ρ is an exogenous destruction rate and f_t is the job finding rate. The latter will be specified when modeling matching frictions.

Inactive family members allocate all their time to home production, contrary to employed family members that have no time left for this activity. Family members that were not in a match at the beginning of the period, and whose search activity was not successful, obtain the unemployment status and allocate the remaining time to home production. They are given by $u_t = n_t - e_t$. We use Γ to denote the cost of search. We thus define home production as given by:

$$h_t = \Upsilon_t(1 - e_t - \Gamma u_t) \tag{4}$$

where Υ_t is a shock to home production technology.[6]

Unemployed family members receive a real unemployment benefit b. Total real labor income is given by $w_t e_t$. The contract signed between the worker and the firm specifies the wage and is obtained through a Nash bargaining process. Agents also invest in non-state contingent nominal government bonds B_t which pay a gross nominal interest rate $(1 + r_t^n)$ one period later. Finally, agents receive profits from the monopolistic sector which they own, Θ_t. Agents are subject to the following tax system: τ_t^n is a tax on wages, τ^c is a tax on consumption, and τ_t represents lump sum taxation. Family members pool their incomes and home production that are then redistributed equally among all members so that they all enjoy the same level of consumption and home production.[7] The sequence of real budget constraints reads as follows:

$$(1+\tau^c)c_t + \frac{B_t}{p_t} \leq (1-\tau_t^n)w_t e_t + bu_t + \frac{\Theta_t}{p_t} - \tau_t + (1+r_{t-1}^n)\frac{B_{t-1}}{p_t} \tag{5}$$

Households choose $\{c_t, B_t, n_t, h_t, e_t\}_{t=0}^{\infty}$ taking as given $\{p_t, w_t, r_t^n, f_t, \tau_t^n, \tau_t, \Theta_t\}_{t=0}^{\infty}$ and the initial wealth B_0, so as to maximize (1) subject to (3), (4) and (5). Let's

[6] We are assuming a linear production technology in the home sector, similarly to what we assume in the market sector.

[7] See Andolfatto (1996) and Merz (1995).

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define λ_t as the Lagrange multiplier on constraint (5). Optimality in consumption/saving delivers the following conditions:

$$\lambda_t = \Psi_t \frac{c_t^{-\sigma}}{1+\tau^c} \tag{6}$$

$$1 = \beta(1+r_t^n)E_t\left\{\frac{\lambda_{t+1}}{\lambda_t}\frac{p_t}{p_{t+1}}\right\} \tag{7}$$

Equation (6) is the marginal utility of consumption and equation (7) is the Euler condition with respect to bonds. Optimality requires that the no-Ponzi condition on wealth be also satisfied. Merging the first order conditions with respect to the set $\{n_t, h_t, e_t\}_{t=0}^{\infty}$ delivers the following participation condition:

$$\Omega_t = w_t(1-\tau_t^n) - (1+\tau^c)\frac{\Phi h_t^{\nu} c_t^{\sigma}}{\Psi_t}\Upsilon_t + \beta(1-\rho)E_t\left\{\frac{\lambda_{t+1}}{\lambda_t}\Omega_{t+1}\right\} \tag{8}$$

where $\Omega_t \equiv \frac{1-f_t}{f_t}\left[(1+\tau^c)\frac{\Phi\Gamma h_t^{\nu} c_t^{\sigma}}{\Psi_t}\Upsilon_t - b\right]$ represents the utility loss required to marginally increase employment. Indeed, $(1+\tau^c)\frac{\Phi\Gamma h_t^{\nu} c_t^{\sigma}}{\Psi_t}\Upsilon_t - b$ represents the utility lost when moving one family member from non-participant to unemployed while $\frac{1-f_t}{f_t}$ represents the wedge introduced by matching frictions and captures the extra loss (relative to a frictionless labor market) needed to exactly increase employment by one unit. Thus, equation (8) equates the marginal benefit of having one extra family member employed (right hand side) to its marginal cost.

Absent the wedge created by matching frictions, the above condition would collapse to the standard labor/leisure optimality condition, $w_t\frac{(1-\tau_t^n)}{(1+\tau^c)} = \frac{\Phi h_t^{\nu} c_t^{\sigma}}{\Psi_t}\Upsilon_t$. Here instead, and as noted in Mortensen and Pissarides (2000) (chapter 7), the participation rate co-moves, other things being equal, with the job finding rate. When the job finding rate is low, the return from search is low too and workers prefer to stay at home. In the next section we show that the job finding rate is endogenously determined by the presence of matching frictions. Whenever the job finding rate is low, more of the jobless workers will leave the labor force. For our positive analysis, the most immediate consequence of this link is that policies which affect the job finding rate will also move participation and this will feed back into the finding rate and, ultimately, in the fiscal multipliers.

At last notice the role of the Frisch elasticity, $-\frac{1}{\nu}$. The higher its value, the more workers tend to substitute home with market production in response to changes in the returns to search. Hence, the marginal effect of policies increasing the job finding rate is larger under a larger elasticity.

2.2 Search and Matching in the Labor Market

The search activity is costly. The probability of finding a worker depends on a constant return to scale matching technology converting searching workers s_t and vacancies v_t into matches:

$$m(s_t, v_t) = m s_t^{\xi} v_t^{1-\xi} \tag{9}$$

where $v_t = \int_0^1 v_t(i)di$ and m represents the matching efficiency. Defining labor market tightness as $\theta_t \equiv \frac{v_t}{s_t}$, firms meet searching workers at rate $q(\theta_t) = \frac{m(s_t,v_t)}{v_t} = m\theta_t^{-\xi}$, while searching workers meet vacancies at rate $f_t \equiv \theta_t q(\theta_t) = m\theta_t^{1-\xi}$, which we refer to as the job finding rate. If the search process is successful, the firm in the monopolistic good sector operates the technology $z_t e_t(i)$, where z_t is the aggregate productivity shock which follows a first order autoregressive process, $\log z_t = \rho_z \log z_{t-1} + \varepsilon_{z,t}$, and $e_t(i)$ is the number of workers hired by firm i. At the beginning of period t firms observe the realization of the stochastic variables and post vacancies accordingly.

2.3 Monopolistic Firms

There is continuum of firms which hire a continuum of workers. Firms in the monopolistic sector use labor to produce different varieties of the consumption good: $c_t = \left[\int_0^1 c_t(i)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}$. They face a quadratic cost of adjusting prices and have to pay costs of posting vacancies which are linear in the number of vacancies. Due to the constant return to scale of vacancy posting technology, firms can take wages as given when choosing prices and employment. The representative firm chooses prices, $p_t(i)$, number of vacancies, $v_t(i)$, and number of employees, $e_t(i)$ to solve the following maximization problem (in real terms):[8]

$$Max\, E_0 \sum_{t=0}^{\infty} \beta^t \frac{\lambda_t}{\lambda_0} \left\{ \frac{p_t(i)}{p_t} z_t e_t(i) - w_t(i)e_t(i) - (1-\tau_t^k)\kappa v_t(i) - \frac{\psi}{2}\left(\frac{p_t(i)}{p_{t-1}(i)} - 1\right)^2 d_t \right\} \tag{10}$$

subject to

$$z_t e_t(i) = \left(\frac{p_t(i)}{p_t}\right)^{-\varepsilon} d_t \tag{11}$$

$$e_t(i) = (1-\rho)e_{t-1}(i) + v_t(i)q(\theta_t) \tag{12}$$

where d_t is aggregate demand inclusive of resources wasted for search activity and price adjustment, $\frac{\psi}{2}\left(\frac{p_t(i)}{p_{t-1}(i)} - 1\right)^2 d_t$ represents the cost of adjusting prices, ψ can

[8]Note that equation (12) is the equivalent of (3) just written at the firm level.

be thought of as the sluggishness in the price adjustment process, κ as the cost of posting vacancies, τ_t^k is a subsidy to the cost of posting vacancies, and $w_t(i)$ is the real wage paid by firm i. Let us define mc_t, the Lagrange multiplier on constraint (11), as the marginal cost of firms and μ_t, the Lagrange multiplier on constraint (12), as the marginal value of one worker. Since all firms will choose in equilibrium the same price and allocation we can now assume symmetry and drop the index i. Let us define the inflation rate as $\pi_t \equiv \frac{p_t}{p_{t-1}}$. First order conditions read as follows:

$$\mu_t = mc_t z_t - w_t + \beta E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t}(1-\rho)\mu_{t+1} \right\} \tag{13}$$

$$\frac{\kappa(1-\tau_t^k)}{q(\theta_t)} = \mu_t \tag{14}$$

$$\psi(\pi_t - 1)\pi_t - \beta E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t}\psi(\pi_{t+1}-1)\pi_{t+1}\frac{z_{t+1}e_{t+1}}{z_t e_t} \right\} = 1 - \varepsilon(1-mc_t) \tag{15}$$

By merging (13) and (14) we obtain the job creation condition:

$$\frac{\kappa(1-\tau_t^k)}{q(\theta_t)} = mc_t z_t - w_t + \beta E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t}(1-\rho)\frac{\kappa(1-\tau_{t+1}^k)}{q(\theta_{t+1})} \right\} \tag{16}$$

2.4 Nash Bargaining

The wage schedule is obtained through the solution to an individual Nash bargaining process. Let us denote by V_t^J the marginal discounted value of a vacancy for a firm. From equation (13) and noticing that $V_t^J = \mu_t$ we obtain:

$$V_t^J = mc_t z_t - w_t + \beta E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t}(1-\rho)V_{t+1}^J \right\} \tag{17}$$

The marginal value of a vacancy depends on real revenues minus the real wage plus the discounted continuation value. With probability $(1-\rho)$ the job remains filled and earns the expected value, while with probability ρ the job is destroyed and has zero value. In equilibrium, the marginal discounted value of a vacancy equalizes the expected cost of posting vacancies. For each worker, the surplus from being employed, keeping participation constant, is given by V_t^W:[9]

$$\begin{aligned} V_t^W = {} & (1-\tau_t^n)w_t - b - \frac{\Phi(1-\Gamma)h_t^\nu c_t^\sigma(1+\tau^c)}{\Psi_t}\Upsilon_t \\ & + \beta E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t}(1-\rho)(1-f_{t+1})V_{t+1}^W \right\} \end{aligned} \tag{18}$$

[9] See Campolmi and Gnocchi (2011) for the complete derivation.

Let ς being the workers' bargaining power. The optimal sharing rule of the standard Nash bargaining is given by:

$$V_t^W = \frac{\varsigma}{1-\varsigma}(1-\tau_t^n)V_t^J \tag{19}$$

After substituting the previously defined value functions into (19) it is possible to derive the following wage schedule:

$$\begin{aligned} w_t = \varsigma mc_t z_t + \frac{1-\varsigma}{1-\tau_t^n}\left[b + \frac{\Phi(1-\Gamma)h_t^{\nu}c_t^{\sigma}(1+\tau^c)}{\Psi_t}\Upsilon_t\right] \\ + \varsigma(1-\rho)\beta E_t\left\{\frac{\lambda_{t+1}}{\lambda_t}\left[1-(1-f_{t+1})\frac{1-\tau_{t+1}^n}{1-\tau_t^n}\right]\frac{\kappa(1-\tau_{t+1}^k)}{q(\theta_{t+1})}\right\} \end{aligned} \tag{20}$$

2.5 Equilibrium Conditions, Monetary Policy and Fiscal Regimes

The goods market clearing condition requires aggregate production to be equal to aggregate demand, $y_t \equiv c_t + g_t$, plus the resources wasted into the search activity and the cost of adjusting prices:

$$z_t e_t = y_t + \kappa v_t + \frac{\psi}{2}\left(\frac{p_t}{p_{t-1}} - 1\right)^2 z_t e_t \tag{21}$$

Monetary policy is conducted by means of an interest rate reaction function of the following form:

$$\ln\left(\frac{1+r_t^n}{1+r^n}\right) = (1-\phi_r)\left(\phi_\pi \ln\left(\frac{\pi_t}{\pi}\right) + \phi_y \ln\left(\frac{y_t}{y}\right)\right) + \phi_r \ln\left(\frac{1+r_{t-1}^n}{1+r^n}\right) \tag{22}$$

The government faces the following budget constraint:

$$g_t + bu_t + (1+r_{t-1}^n)\frac{B_{t-1}}{p_t} + \tau_t^k \kappa v_t = \tau^c c_t + \tau_t^n w_t e_t + \frac{B_t}{p_t} + \tau_t \tag{23}$$

Since government expenditure is financed partly with taxes and partly with government bonds, we need some rule to pin down the evolution of government bonds. First, we assume that $\tau_t = \tau$. Furthermore, following Uhlig (2010) we assume that a fraction ϕ of expenditure is financed through labor taxes while the rest is financed through government bonds:

$$\tau_t^n w_t e_t = \phi\left(g_t + bu_t + \tau_t^k \kappa v_t - \tau + (1+r_{t-1}^n)\frac{B_{t-1}}{p_t} - \tau^c c_t\right) \tag{24}$$

We consider two possible targets for government expenditure: aggregate demand and subsidy to cost of posting vacancies. They are both modeled through temporary

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shocks. Government expenditure in the form of demand stimuli takes the following form:

$$\ln g_t = (1-\rho_g)\ln g + \rho_g \ln g_{t-1} + \varepsilon_t^g \tag{25}$$

where ε_t^g is a surprise increase. Similarly, a hiring subsidy takes the following form:

$$\ln \tau_t^k = (1-\rho_{\tau^k})\ln \tau_k + \rho_{\tau^k} \ln \tau_{t-1}^k + \varepsilon_t^{\tau^k} \tag{26}$$

where $\varepsilon_t^{\tau^k}$ is a surprise increase.

2.6 The Policies Transmission Mechanism

Before moving to the quantitative results of our model in terms of fiscal multipliers, it is instructive to examine the analytics and the intuition of the policy transmission mechanisms in our model, with particular reference to the different mechanics produced by an increase in government spending as opposed to an increase in hiring subsidies. As anticipated in the introduction, wasteful government spending crowds out private consumption, therefore reducing the positive effect on aggregate demand and employment in the periods following the intervention. On the contrary, hiring subsidies increase both vacancy posting and aggregate demand via an increase in private consumption. The difference between those two policies effectively hinges upon their different impact on marginal costs and inflation, hence on the different response of monetary policy to the two fiscal packages. To understand the rationale behind this result, we start by analyzing the effects of policies on the marginal cost equation:

$$mc_t = \frac{\frac{\kappa(1-\tau_t^k)}{q(\theta_t)} + w_t - \beta E_t\left\{\frac{\lambda_{t+1}}{\lambda_t}(1-\rho)\frac{\kappa(1-\tau_{t+1}^k)}{q(\theta_{t+1})}\right\}}{z_t} \tag{27}$$

The equation above states that firms' marginal costs equate the cost of a marginal hire in t, plus the wage paid to that worker in period t minus the saved marginal cost of hiring tomorrow. An increase in government spending, by increasing aggregate demand on impact, produces an increase in wages. The latter induces, in turn, an increase in the marginal cost, as from equation (27), and an increase in inflation, via the Phillips curve, equation (15). It is such an increase in inflation which, by triggering an increase in the interest rate via the Taylor rule, produces a crowding out of private consumption. As aggregate demand falls in the periods following the intervention, vacancy posting falls as well. This is at the heart of why this type of fiscal intervention delivers low multipliers in terms of both employment and aggregate demand.

On the contrary, hiring subsidies reduces the cost of hiring. This, all else equal, reduces marginal costs and inflation, via the Phillips curve. Notice that while wages increase, since workers now face a better outside option, the direct effect of hiring subsidies dominates. Overall, in our quantitative simulations we observe a fall in marginal costs and inflation for a wide range of parameters' values. The fall in inflation generates an interest rate cut that produces a crowding in of private consumption and an overall increase in aggregate demand. Vacancy posting increases, and so do employment and output.

2.7 Calibration and Quantitative Properties of the Model

When computing fiscal multipliers, and to check how robust our results are, we perform the following analysis. First, we calibrate the model to the U.S. economy and compute the multipliers for what we call our *baseline model*. Second, we perform a series of robustness checks changing (one by one) a set of crucial parameters, and considering alternative policy scenarios.

The calibration of the labor market parameters has been done so as to generate steady state values for the job flows, the cost of vacancies and the surpluses which are either in line with the data or with the literature. Tables 1 and 2 contain a selected set of steady state values for job flows, vacancy costs and surpluses generated by the model.

Table 1: Steady State Job Flows

Unemployment rate	Participation rate	Tightness	Job finding rate	Job filling rate
0.06	0.66	0.75	0.52	0.70

Table 2: Steady State Costs and Surpluses

Vacancy posting costs (% of y)	Vacancy posting costs (% of $w \cdot e$)
0.017	0.021
Value of a vacancy (% of y)	Surplus of being employed (% of y)
0.39	0.28

Preferences. Time is measured in quarters. The discount factor β is set equal to 0.99, so that the annual real interest rate is equal to 4 percent. The inverse of the intertemporal elasticity of substitution σ is set equal to 2.

Production. Following Basu and Fernald (1997), the value added mark-up of prices over marginal cost is set to 0.2. This generates a value for the price elasticity of demand ε of 6. We parametrize the cost of adjusting prices by comparing the Phillips curve under Rotemberg (1982) adjustment costs with the one under Calvo-Yun set-up. Consistent with a Calvo probability of adjusting prices of 2/3, this delivers a value of $\psi \approx 30$.

Labor market frictions parameters. The matching technology is a homogenous of degree one function and is characterized by the parameter ξ. Consistently with estimates by Blanchard and Diamond (1991) this parameter is set to 0.4. The exogenous separation probability ρ is set to 0.07, consistently with estimates from Hall (1995).[10] By setting the employment rate equal to 94%, and given the exogenous separation probability of 0.07, we obtain an implied job finding rate of 0.52 (see Table 1). This value is lower than the one estimated in Shimer (2005), the reason being that our model features instantaneous hiring, upon which workers can be matched in the same period in which they start searching. The scaling parameter in the matching technology m is set so as to induce a job filling rate q of 0.7 (see Table 1), which is the value used by den Haan, Ramey, and Watson (2000). This also implies a value for the labor market tightness of 0.74, which is slightly lower, but in line, with the value obtained in Shimer (2005). For the parameters concerning the endogenous participation side of the model, we follow Campolmi and Gnocchi (2011) and set Φ using (8) so as to target a steady state participation rate $n = 0.66$ (see Table 1), consistent with the evidence for the U.S. We set $\nu = -5$ implying a Frisch elasticity for labor supply of 0.2. Finally, we set $\Gamma = 0.44$. We interpret the cost of search as the time devoted to home production that a household member loses when moving from non-participant to unemployed, compared to the time lost when moving from non-participant to employed. This value has been computed using data on time allocated to home production by employed, unemployed and out of the labor force individuals as provided by the American Time Use Survey (ATUS). We define the replacement ratio as the value of the outside option for an unemployed worker (unemployment benefit plus home production obtained when not involved in the search activity) relative to the wage and we set it equal to 0.6. This value implies a b/w ratio of 0.2, a value within the admissible range of $(0.2, 0.4)$ as reported in Petrongolo and Pissarides (2001) and Mortensen and Nagypal (2007). With those values, and using the fact that the steady state number of matches is given by $\frac{\rho}{1-\rho}(1-u)$, it is possible to determine the number of vacancies and the vacancy/unemployment ratio. The bargaining power of workers ς is set to 0.5 as in most papers in the literature, while the value for the cost of posting vacancies κ is set to achieve a steady state cost of posting vacancies (both, as percentage of wages and as percentage of output; see Table 2) which is in line with the literature (see Hagedorn and Manovskii (2008), Silva and Toledo (2007)).

[10] This value is also compatible with those used in the literature which range from 0.07 (Merz (1995)) to 0.15 (Andolfatto (1996)).

Notice that the value for a filled vacancy for a firm is relatively small (see Table 2): this is consistent with arguments done in Costain and Reiter (2008) stating that in order to match the response of unemployment and wages to both, productivity and policy shocks, one needs to choose a calibration which delivers a relatively small surplus for the match.

Monetary and fiscal policy parameters and shocks. The coefficient on inflation ϕ_p is set to 1.5 while the coefficient on output ϕ_y is set $0.5/4$. Finally, the parameter ϕ_r is set equal to zero in the baseline calibration. The constant fraction of public spending g financed by current taxes is calibrated so as to match $g/y = 0.15$. Steady state taxes are set to $\tau^c = 0.05$ and $\tau^n = 0.28$ which are values calculated for the U.S. by Trabandt and Uhlig (2011). The steady state level of the hiring subsidy is set to $\tau^k = 0.01$. Under the assumption of distortionary taxation, ϕ is set to 0.275 so as to generate $\frac{B}{y} = 0.6$. The autocorrelations of government spending ρ_g and of the hiring subsidy ρ_{τ^k} are calibrated to 0.9.

It is important to notice that the baseline parametrization outlined above is also consistent with the value which the literature generally assigns to the elasticity of wages to productivity shocks. In our model such elasticity is 0.51. Shimer (2005) argues that, in the standard search and matching model, the sensitivity of wages to productivity shocks is excessively large compared to the data (around 0.9 in the model and 0.49 in the data). In this respect our model is successful in reproducing a low elasticity of wages to productivity shock. This elasticity is also important in guiding the interpretation of the policy transmission in our model: as we will argue later on, the low sensitivity of wages, coupled with the low steady state costs of posting vacancies[11], explains why hiring subsidies are particularly effective in generating a high increase in firms' vacancy posting. The large increase in vacancy posting, coupled with the minor increase in wages, produces an increase in both, labor and consumption demand, hence large fiscal multipliers. Finally, under the benchmark calibration we find that the elasticity of the unemployment rate to government expenditure shocks is 0.19[12], while the elasticity with respect to the hiring subsidy is -0.01. The latter elasticity captures the positive effect of the hiring subsidy on labor demand.

Before computing the fiscal multipliers, it is instructive to verify that our model is broadly in line with the main stylized facts characterizing the labor market. To obtain the main business cycle statistics reported in Table 3, the model is subject to AR(1) productivity, preference, government spending and home production technology shocks with the following parametrization: $\sigma_z = 0.0071$, $\rho_z = 0.9$,

[11]Notice that both facts are consistent with empirical evidence. See Hagedorn and Manovskii (2008).

[12]A fact consistent with evidence in Brückner and Pappa (2010).

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$\sigma_\Psi = 0.025$, $\rho_\Psi = 0.9$, $\sigma_g = 0.008$, $\rho_g = 0.9$, $\sigma_\Upsilon = 0.0125$, $\rho_\Upsilon = 0.9$. We also assume a positive correlation between TFP and home production technology shocks of 0.3571. Calibration for the rest of the parameters is set at the benchmark values. We also assume the presence of real wage rigidity[13]: an extensive literature has indeed advocated such an assumption as particularly important in matching some labor market stylized facts[14], with particular reference to the Beveridge curve.[15] In the computation of the fiscal multipliers we consider both cases, with and without wage rigidity, in order to asses the role of this assumption for the impact of fiscal policy.

Table 3: Model Business Cycle Statistics

σ_y	σ_e/σ_y	σ_u/σ_y	σ_v/σ_y	σ_w	σ_π	$Corr(u,v)$	$Corr(n,y)$	$Corr(u,y)$
1.35	0.51	7.25	9.18	0.17	0.63	-0.34	0.12	-0.71

The model generates a volatility of employment (relative to that of output) of 0.51 and a volatility of unemployment rate[16] (relative to that of output) of 7.25: both values are compatible with data for the U.S. The model also correctly generates a low volatility of wages and inflation, and a high volatility of vacancies. Finally, the model reproduces the negative correlation between unemployment and vacancies i.e., the Beveridge curve, the procyclicality of participation and the countercyclicality of unemployment.

Sensitivity parameters. As outlined earlier, and extensively explained later in sections 3.1 and 3.2, the transmission mechanism underlying the different effectiveness of government spending versus hiring subsidy shocks, hinges on the reaction of wages, marginal costs (hence inflation) and private consumption. For this reason, and in order to asses robustness of our results, we also perform sensitivity checks with respect to the parameters directly affecting the above-mentioned transmission mechanism. In particular, we consider alternative parametrizations for the workers bargaining power, which affects the response of wages to policy shocks, the Frisch elasticity, which affects the response of both wages and participation to policy shocks, the price and wage rigidity parameters, which affect the response of inflation to marginal costs, and the parameters in the Taylor rule, which affect the

[13]Wages are set according to the partial adjustment equation $w_t = \gamma w_{t-1} + (1-\gamma) w_t^*$, where w_t^* is described by the baseline wage equation (20) and the degree of real wage rigidity γ, is calibrated to 0.9.

[14]Notice that in our model the empirical business cycle statistics would be replicated also in absence of wage rigidity and under a high parametrization for the replacement rate.

[15]See Shimer (2005), Krause and Lubik (2007) and Kuester (2010).

[16]Notice that we report second moments for the unemployment rate, defined as u_t/n_t.

response of the policy rate to changes in inflation (therefore determining the crowding out or crowding in of consumption). At last, sensitivity is performed also with respect to the persistence of the fiscal shock.

3 Fiscal multipliers

For each fiscal intervention we compute multipliers both in terms of employment, and in terms of aggregate demand. We follow Uhlig (2010) in computing dynamic multipliers:

$$NPV multiplier_{t,t+j} = \frac{\sum_{i=1}^{j} \beta^{i-1}(x_{t+i} - x_{t+i-1})}{\sum_{i=1}^{j} \beta^{i-1}(cost_{t+i} - cost_{t+i-1})} \tag{28}$$

where $x_t = e_t$ for the employment multiplier, while $x_t = y_t$ for the demand multiplier. When considering a traditional demand stimulus, the cost associated to the fiscal shock is given by $cost_t = g_t$, while when considering an increase in the hiring subsidy the cost is given by $cost_t = \tau_t^k \kappa \bar{v}$.[17] This is the expression used to compute the multipliers reported in Figure 1 and Figure 3. Short-run multipliers as reported in Table 4 and Table 5 are given by $NPV multiplier_{0,1}$ with the system being in its steady state at time 0 and the fiscal shock being realized at time 1. The long-run multiplier is simply $NPV multiplier_{t,t+j}$ for $j \to \infty$.[18]

3.1 Demand stimulus

We start by considering a temporary one percent increase in government spending which is either financed by lump sum taxes or by distortionary labor taxes. This policy scenario allows to compare the results of our model with those in the literature, which indeed focuses on this type of stimulus.

Figure 1 shows the aggregate demand and employment dynamic multipliers for the baseline calibration. Furthermore, Table 4 and Table 5 report the size of the aggregate demand and employment multipliers for the benchmark calibration (first line in both tables). When the expansion in government expenditure is financed with lump sum taxation, multipliers are always positive but quite small (between 0.2 and 0.3).

[17] With this formulation we compute the cost of a change in the subsidy keeping the number of vacancies constant at their steady state level. In equilibrium, vacancies will change reacting to the higher subsidy. Thus, an alternative formulation for the cost could have been $cost_t = \tau_t^k \kappa v_t$. Multipliers computed using this different definition are quantitatively very similar to the ones reported in Table 4 and Table 5.

[18] Long-run multipliers as reported in Table 4 and Table 5 are computed by setting $j = 1000$.

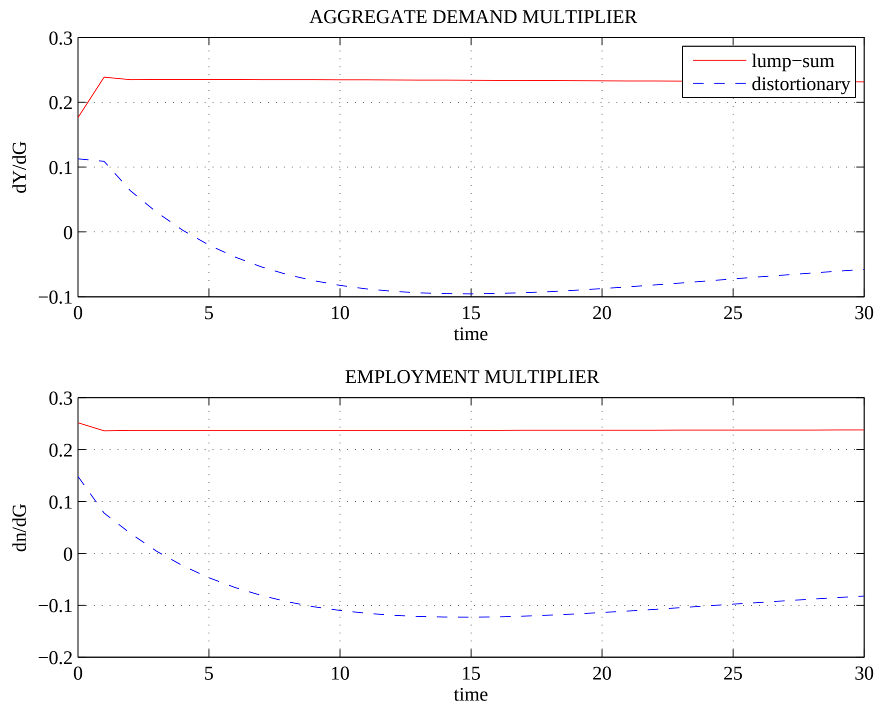

Figure 1: Fiscal multipliers for a one percent temporary increase in government spending

When a certain fraction is financed with distortionary taxation ($\phi = 0.275$), they become smaller in the short run, turn negative after a few quarters and remain negative in the long run. This is consistent with results found using New Keynesian models, in which wasteful government expenditure, by producing crowding out in private consumption, delivers small fiscal multipliers. Yuan and Li (2000) show within an RBC model that the presence of matching frictions dampens the size of the multipliers, the reason being that the private consumption crowding out also reduces vacancy posting incentives. Monacelli, Perotti, and Trigari (2010) using a New Keynesian model with matching frictions, also find small multipliers in response to aggregate demand stimuli, even under endogenous job destruction and in presence of physical capital. The negative long-run multipliers under distortionary taxation are consistent with the findings in Uhlig (2010).

Relatively to the literature, our model contains a further dimension, the endogenous participation margin. Figure 2, which shows the impulse response functions to government spending for a number of selected variables under both lump sum and distortionary taxation, helps to gain intuition regarding the additional effects present in our model. As in all abovementioned models, the increase in

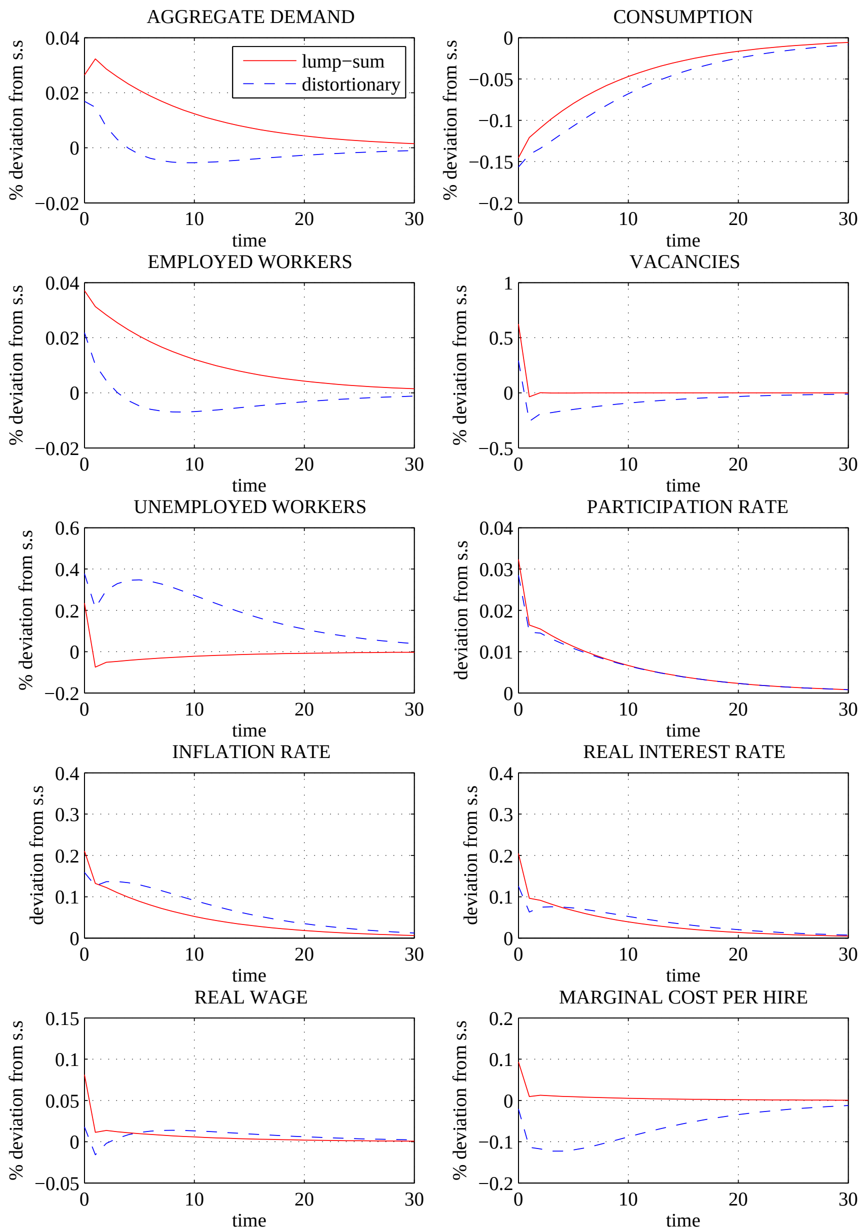

Figure 2: Impulse responses to a one percent temporary increase in government spending

government spending has a crowding out effect on private consumption. The increase in government spending increases, on impact, labor demand and wages. The consequent increase in marginal costs and inflation induces the monetary authority to

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raise the nominal interest rate. The ensuing rise in the real interest rate decreases firm's incentives to post vacancies. In our model the initial increase in aggregate demand produces an increase in participation, which in turn increases the incentives toward vacancy posting, as it is now easier to fill a vacancy. Overall, vacancy posting increases (even though only in the short run) and so does employment, relatively to a model in which participation is kept constant. However, the increase in vacancy posting is not enough to compensate the rise in participation, hence unemployment increases as well. Under distortionary taxation the tax wedge rises, thus dampening the beneficial effects and lowering the multipliers.

Tables 4 and 5 also report a number of sensitivity checks for both short and long-run multipliers under both financing schemes. The robustness checks have been conducted by selecting the parameters that govern the dynamic of wages, inflation and the interest rate: indeed, as explained before those are the main macro variables involved in the transmission of the policy shock. The main highlights relate to the effects of changes in the bargaining power and in the elasticity of labor supply. Changes in the bargaining affect the size of the surpluses accruing to firms and workers in the steady state. Under low bargaining power[19], firms' steady state share of surplus is low, while workers' steady state share of surplus is high. In this case wages increase by less in response to an increase in government spending, as they are large to start with, hence the increase in the marginal cost, inflation and interest rate are lower. The crowding out in private consumption is smaller and multipliers are larger. The tables show that long-run multipliers (both employment and demand) are indeed higher the higher the bargaining power.[20] Next, we examine the effects of different values for the Frisch elasticity, $-\frac{1}{\nu}$. Other things being equal, increases in the job finding rate move participation up, the more so the higher is the sensitivity in the adjustment of the participation margin (high elasticity of labor supply). Furthermore, the more elastic is the labor supply, the less wages rise if aggregate demand picks up, so the less inflation and the real rate rise. It follows that under high values for the Frisch elasticity, multipliers are larger.

We then compare fiscal multipliers for different degrees of price and real wage rigidity. We set the cost of adjusting prices ψ so as to generate a slope of the log-linear Phillips curve consistent with an average price duration of two quarters ($calvo = 0.5$), four quarters ($calvo = 0.75$), and twenty months ($calvo = 0.85$).

[19] This is the parametrization that Hagedorn and Manovskii (2008) consider relevant for matching the unemployment volatilities.

[20] For demand multipliers this is true also in the short run, while employment multipliers become smaller as we increase the bargaining power. The short run reaction of the employment multipliers is entirely driven by the short run movements in participation. Indeed, the higher the workers' bargaining power the more congestioned is the market and the smaller is the increase in participation. Thus, the smaller is the increase in employment on impact.

Table 4: Employment Multipliers

	Lump sum		Distortionary	
	Short run	Long run	Short run	Long run
Demand stimulus				
Baseline model	0.2515	0.2381	0.1481	-0.0489
Bargaining power				
$\varsigma = 0.7$	0.2292	0.2384	0.1344	-0.0454
$\varsigma = 0.4$	0.2756	0.2378	0.1633	-0.0520
$\varsigma = 0.3$	0.3313	0.2374	0.1991	-0.0569
Frisch elasticity				
$-1/\nu = 0.5$	0.4916	0.4284	0.2951	-0.0015
$-1/\nu = 0.1$	0.1409	0.1411	0.0734	-0.0746
Price rigidity				
$calvo = 0.85$	0.4733	0.3546	0.3003	0.1507
$calvo = 0.75$	0.3170	0.2670	0.1710	-0.0074
$calvo = 0.5$	0.1902	0.2143	0.1227	-0.0766
Real wage rigidity ($\gamma = 0.9$)	0.3241	0.2317	0.1804	-0.0456
Persistence of stimulus				
$\rho_g = 0.975$	0.2256	0.2144	0.1133	-0.0581
$\rho_g = 0.5$	0.5626	0.5298	0.5496	0.2948
Taylor rule				
$\phi_\pi = 3$	0.1995	0.2142	0.1253	-0.0820
$\phi_y = 0.5$	0.2408	0.2232	0.1212	-0.0538
$\phi_r = 0.8$	0.5171	0.2590	0.4580	-0.0032
Increase in hiring subsidies				
Baseline model	2.3905	2.2690	2.6220	2.5033
Bargaining power				
$\varsigma = 0.7$	4.4649	4.6518	4.8900	5.3767
$\varsigma = 0.4$	1.9348	1.6759	2.1285	1.7841
$\varsigma = 0.3$	1.7416	1.2563	1.9334	1.2702
Frisch elasticity				
$-1/\nu = 0.5$	2.4775	2.1576	2.7942	2.5049
$-1/\nu = 0.1$	2.3037	2.3196	2.4918	2.4973
Price rigidity				
$calvo = 0.85$	2.4466	1.8515	2.4694	1.8755
$calvo = 0.75$	2.5783	2.1867	2.7750	2.3678
$calvo = 0.5$	2.0463	2.3000	2.2406	2.5619
Real wage rigidity ($\gamma = 0.9$)	3.0700	2.2107	3.2297	2.4174
Persistence of stimulus				
$\rho_{\tau^k} = 0.975$	2.1661	2.0547	2.3734	2.2185
$\rho_{\tau^k} = 0.5$	2.8630	2.7227	2.9553	2.9739
Taylor rule				
$\phi_\pi = 3$	2.1708	2.3219	2.4024	2.5971
$\phi_y = 0.5$	2.3270	2.1603	2.4773	2.3179
$\phi_r = 0.8$	1.8288	2.1832	1.8829	2.3687

Short and long-run multipliers are larger with higher price and real wage rigidity, both under lump sum taxation and under distortionary taxation. The degree of price stickiness governs the slope of the Phillips curve: the more prices are sticky, the less inflation reacts, so the smaller is the increase in the real interest rate and the

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Table 5: Aggregate Demand Multipliers

	Lump sum		Distortionary	
	Short run	Long run	Short run	Long run
Demand stimulus				
Baseline model	0.1764	0.2298	0.1128	-0.0268
Bargaining power				
$\varsigma = 0.7$	0.1988	0.2342	0.1204	-0.0366
$\varsigma = 0.4$	0.1528	0.2264	0.1037	-0.0181
$\varsigma = 0.3$	0.1007	0.2213	0.0810	-0.0037
Frisch elasticity				
$-1/\nu = 0.5$	0.3582	0.4180	0.2269	0.0210
$-1/\nu = 0.1$	0.0945	0.1341	0.0560	-0.0527
Price rigidity				
$calvo = 0.85$	0.3082	0.3289	0.2013	0.1439
$calvo = 0.75$	0.2152	0.2543	0.1256	0.0084
$calvo = 0.5$	0.1402	0.2097	0.0979	-0.0502
Real wage rigidity ($\gamma = 0.9$)	0.2111	0.2249	0.1287	-0.0240
Persistence of stimulus				
$\rho_g = 0.975$	0.1628	0.2102	0.0923	-0.0333
$\rho_g = 0.5$	0.3562	0.4759	0.3535	0.2679
Taylor rule				
$\phi_\pi = 3$	0.1467	0.2099	0.0997	-0.0546
$\phi_y = 0.5$	0.1715	0.2176	0.0963	-0.0313
$\phi_r = 0.8$	0.3350	0.2479	0.3015	0.0137
Increase in hiring subsidies				
Baseline model	1.2536	1.7516	1.4054	1.9610
Bargaining power				
$\varsigma = 0.7$	3.4874	4.1594	3.8468	4.8497
$\varsigma = 0.4$	0.6280	1.1361	0.7252	1.2279
$\varsigma = 0.3$	0.0531	0.6794	0.1036	0.6908
Frisch elasticity				
$-1/\nu = 0.5$	1.3478	1.6454	1.5679	1.9659
$-1/\nu = 0.1$	1.1728	1.7994	1.2880	1.9531
Price rigidity				
$calvo = 0.85$	1.2818	1.3855	1.3030	1.4073
$calvo = 0.75$	1.3679	1.6791	1.4990	1.8411
$calvo = 0.5$	1.0424	1.7795	1.1687	2.0134
Real wage rigidity ($\gamma = 0.9$)	1.5702	1.7055	1.6716	1.8904
Persistence of stimulus				
$\rho_{\tau^k} = 0.975$	1.1158	1.5668	1.2519	1.7131
$\rho_{\tau^k} = 0.5$	1.5373	2.1362	1.6003	2.3616
Taylor rule				
$\phi_\pi = 3$	1.1186	1.7988	1.2692	2.0448
$\phi_y = 0.5$	1.2114	1.6535	1.3105	1.7939
$\phi_r = 0.8$	0.9064	1.6778	0.9423	1.8434

crowding out of private consumption.[21] The same is true with a higher degree of real wage rigidity: the upward pressure on wages and the downward pressure on labor demand are dampened, giving rise to larger multipliers.[22]

Next, we investigate how the response of monetary policy affects government spending multipliers. We analyze a more aggressive reaction to inflation by setting the Taylor rule coefficient ϕ_p to 3 and a stronger reaction to output fluctuations by setting the Taylor coefficient ϕ_y to 0.5. Finally, we consider interest rate smoothing by setting $\phi_r = 0.8$. As explained above, an increase in government consumption brings about a rise in inflation and an increase in aggregate demand. The monetary authority raises the interest rate, the more so the higher ϕ_p or ϕ_y and the smaller the degree of interest rate smoothing. A high degree of interest rate smoothing, by lowering the rise in the interest rate, mitigates the crowding out of private consumption thus increasing fiscal multipliers.

At last, we re-compute the fiscal multipliers for different degrees of the persistence of the stimulus package. We set the persistence of the government spending process ρ_g, to 0.975 and 0.5. The higher the persistence of government expenditure shocks, the stronger is the negative wealth effect implied by increased taxation. For this reason, multipliers depend negatively on the degree of persistence.

3.2 Hiring Subsidies

In practice, fiscal stimuli have taken various forms, which go beyond the mere increase of aggregate demand. This was particularly true in the aftermath of the 2007-2008 crisis: the expansionary fiscal packages approved in various countries were largely devoted to support job creation in the labor market. The Hiring Incentives to Restore Employment (HIRE) Act, in the U.S., is an example of this. Matching models allow us to analyze policies targeted particularly at the labor market. One of such policies we focus on, is the introduction of subsidies to the cost of posting vacancies. The most immediate effect of such policy, is that of increasing hiring and job creation.

We thus consider a temporary one percentage point increase in the subsidy to the cost of posting a vacancy. Figure 3 presents the employment and demand dynamic multipliers under both lump sum and distortionary taxation. Furthermore, Tables 4 and 5 report the size of the aggregate demand and employment multipliers. A simple comparison between Figure 3 and Figure 1 makes it evident the higher effectiveness of this policy, particularly if the fiscal authority is concerned about employment. Now both multipliers are well above 1, both in the short run and

[21] Notice that multipliers remain below 0.5 even with an average price duration of 20 months.

[22] This extension is relevant as this is one of the assumptions used to solve the Shimer puzzle.

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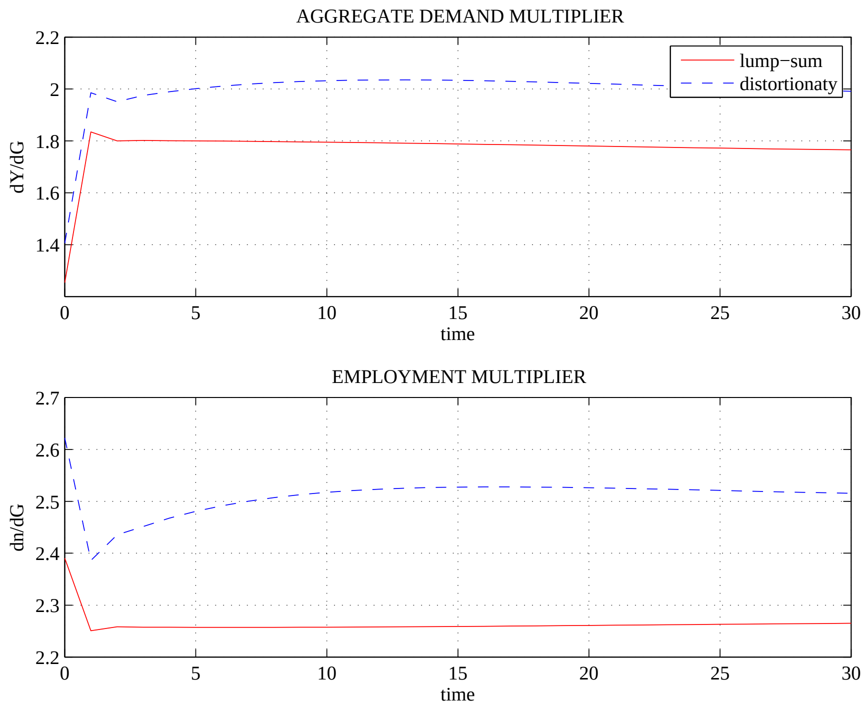

Figure 3: Fiscal multipliers for a one percentage point temporary increase in the subsidy to the cost of posting vacancies

in the long run. This is so independently of the financing strategy adopted, lump sum versus distortionary labor tax. Hiring subsidies have a twofold effect. First, they increase the incentive to post vacancies, hence labor demand. Second, as they reduce firms' marginal costs, they also reduce inflation. The monetary authority reacts to the fall in inflation by reducing the nominal interest rate. The ensuing fall in the real interest rate pushes private consumption upward. Hence, a hiring subsidy policy is characterized by a crowding in of private consumption. The result is an overall increase in aggregate demand, output and employment.

Figure 3 also shows that, contrary to the demand stimulus, multipliers are higher if distortionary taxation is in place. The reason for this result is that such a policy might actually become self-financing. Figure 4 shows the rationale for this result. Under an increase in hiring subsidy both private consumption and vacancy posting increase. At the same time participation declines: since market consumption is higher, households decide to increase home production. The combined effect of a fall in participation and of an increase in vacancy posting produces an increase in employment and a fall in unemployment. From the point of view of the fiscal authority, the direct consequence of such combined movements is higher tax revenues.

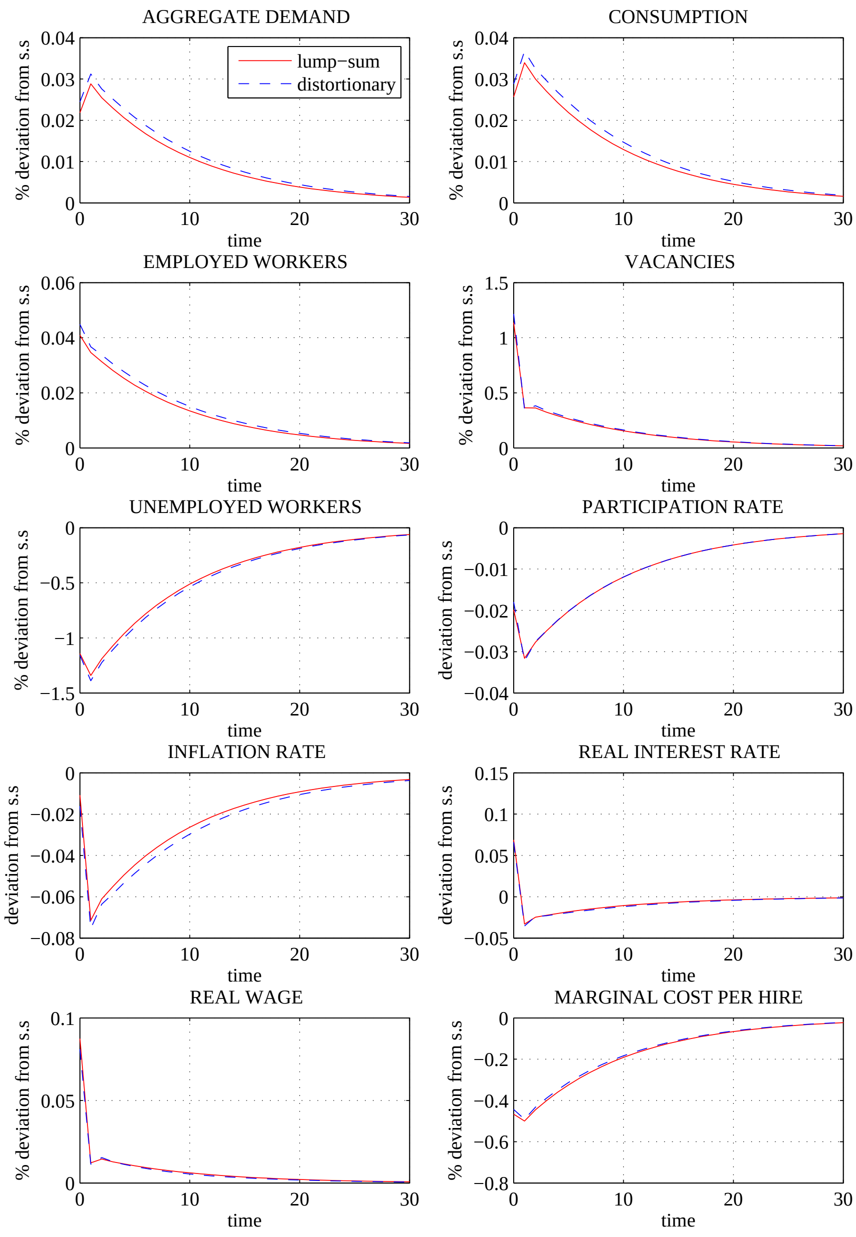

Figure 4: Impulse responses to a one percentage point temporary increase in the subsidy to the cost of posting vacancies

Such an increase is large enough to allow the fiscal authority to run a temporary minor decrease in the labor tax: this explains the higher multipliers relatively to the case with lump sum taxation.

Tables 4 and 5 report again a number of sensitivity checks for both short and long-run multipliers under both financing schemes. The robustness checks have been conducted considering the same parameters analyzed for the government spending shock.

First, we analyze the effect of changes in the bargaining power. Under high values of bargaining power, the surplus accruing to the firm, as well as the hiring costs, in the steady state are smaller. The size of the hiring costs in the steady state is relevant in judging the effects of the hiring policies, as the outlays of the government used to compute the multipliers refer to the level of the hiring costs. If hiring costs tend to be small to start with, vacancy multipliers are larger than if hiring costs are large. As expected indeed employment and aggregate demand multipliers are larger under higher values of the bargaining power. Also, recall that under high bargaining power, the increase in wages in response to an increase in labor demand is smaller, as wages are higher to start with. This results in larger decreases of the marginal costs, inflation and the real interest rate. The overall effect is also an amplification of the crowding in of private consumption.

Secondly, we consider the effect of changes in the Frisch elasticity. A high labor supply elasticity dampens the increase in wages, following the increase in labor demand. Under high Frisch elasticity, hiring subsidies produce larger falls in marginal costs, inflation and real interest rates and a larger crowding in of private consumption.

Thirdly, we investigate the effect of changing the Taylor rule coefficients. Under a strong reaction to inflation, hiring subsidies lead to a larger interest rate fall that increases the long-run fiscal multipliers. Everything else equal, a stronger reaction of the interest rate to output dampens fiscal multipliers through a drop in private consumption. Interest rate smoothing, by mitigating the monetary policy accommodation, dampens fiscal multipliers compared to our baseline scenario.

Finally, and similarly to what observed for the aggregate demand stimulus, decreasing the persistence of the fiscal stimulus has positive effects on the size of the multipliers.

4 Conclusions

A large literature has found that government spending multipliers tend to be smaller than unity except for special, but possibly unrealistic, circumstances.[23] The question therefore arises whether a government which aims at stimulating economic activity and employment, might find other, more effective, means of providing such

[23]One of such circumstances is the case of rule of thumb consumers, namely the assumption that a certain fraction of consumers is prohibited from saving.

a stimulus. The results in this paper suggest that well targeted labor market policies, in the form for instance of hiring subsidies, can be such instruments. Actual labor market stimulus policies, such as the HIRE Act, show that our results are indeed also in the radar of the policy perception. While our results are robust to a number of parameters and policy settings, in this paper we neglect the role of an endogenous firing margin: an increase in employment, achieved through the implementation of hiring subsidies, might indeed bring about also an increase, ex post, in the firing rate. The latter might partly reduce the beneficial effect of hiring subsidies on output. All this is left for future research.

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