Fiscal Calculus in a New Keynesian Model with Matching Frictions

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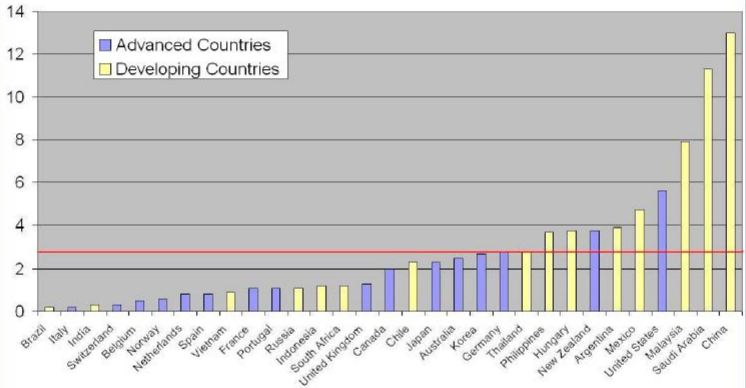
Expansionary fiscal packages around the globe



The thick line denotes the sample average of 2.8%. The values represent the volume to GDP (2008) ratio.

Figure 1: Scope of the National Stimulus Packages. *Source*: Data from ILO (2009).

Source: Ahrens (2009)

Research question

Are expansionary fiscal packages able to fight rising unemployment in a recession?

- Seek to answer this question in a New Keynesian model with unemployment due to matching frictions
- Calculate fiscal multipliers for alternative fiscal packages:
  - Target for the fiscal stimulus: aggregate demand vs. labor market policy
  - Source of financing: lump-sum vs. distortionary taxation

Recent literature on fiscal multipliers

Optimistic view

- Romer and Bernstein (2009) find fiscal multipliers significantly larger than one
- Christiano, Eichenbaum and Rebelo (2009): multipliers are large when interest rate is at the zero lower bound

Pessimistic view

- Cogan, Cwik, Taylor and Wieland (JEDC forthcoming) employ Smets-Wouters (AER 2007) model for the US economy and find multipliers only 1/6 as large as the ones of Romer and Bernstein (2009).
- Cwik and Wieland (2009): same approach for the Euro area, find multipliers smaller than one
- Uhlig (2009) emphasizes the role of distortionary taxation $\Rightarrow$ long-run multipliers may be even negative

Contribution

Non-Walrasian labor markets are a crucial dimension in evaluating fiscal multipliers!

- ⇒ Stimulus of a demand shock might be lower than expected, hence we join the pessimists
- ⇒ Support for the optimists: If spending is used to finance labor market policies (hiring subsidies), fiscal multipliers may be well above one

Similar results are found by Faia, Lechthaler and Merkl (2010) in an open economy model with labor turnover costs

Outline

1. Literature and contribution
2. Model and calibration
3. A special case: flexible prices
4. Simulation results
    1. Demand stimulus
    2. Alternative forms of fiscal stimuli
    3. Robustness checks: interest rate peg, starting from recession scenario, ...
5. Summary and future work

The model structure at a glance

- New Keynesian model for a closed and cashless economy with unemployment due to matching frictions [Krause and Lubik (JME 2007)]
- Monopolistic competition on product markets
- Nominal price rigidity modeled by Rotemberg adjustment costs
- Labor market characterized by matching frictions, exogenous job separations, inelastic supply of labor hours (no intensive margin), individual Nash wage bargaining
- Government collects lump-sum taxes, levies taxes on consumption purchases and labor income and issues bonds to finance government expenditure (government consumption, hiring subsidies)
- Monetary policy is described by a Taylor rule

Model equations

$$\lambda_t = c_t^{-\sigma} / (1 - \tau_t^c)$$

$$\lambda_t = \beta \, \mathrm{E}_t \left\{ \lambda_{t+1} (1 + r_t^n) / \pi_{t+1} \right\}$$

$$y_t = c_t + g_t$$

$$z_t n_t = y_t + \kappa v_t + \frac{\psi}{2} (\pi_t - 1)^2 y_t$$

$$n_t = (1 - \rho) n_{t-1} + m u_t^{\xi} v_t^{1-\xi}$$

$$\theta_t = v_t / u_t$$

$$q(\theta_t) = m \theta_t^{-\xi}$$

$$u_t = 1 - (1 - \rho) n_{t-1}$$

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

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

$$\psi(\pi_t - 1)\pi_t - \beta E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \psi(\pi_{t+1} - 1)\pi_{t+1} \frac{y_{t+1}}{y_t} \right\} = 1 - \varepsilon(1 - mc_t)$$

$$\ln \left(\frac{1+r_t^n}{1+r^n} \right) = \left(\phi_\pi \ln \left(\frac{\pi_t}{\pi} \right) + \phi_y \ln \left(\frac{y_t}{y} \right) \right)$$

The government

Government budget constraint:

$$g_t + b(1 - n_t) + (1 + r_{t-1}^n)\frac{B_{t-1}}{p_t} + \tau_t^k \kappa v_t = \tau_t^c c_t + \tau_t^n w_t n_t + \frac{B_t}{p_t} + \tau_t$$

Following Uhlig (2009), assume the following tax rule:

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

$\Rightarrow \phi = 0$: lump-sum taxation

$\Rightarrow \phi = 0.275$ implying $\overline{B}/\overline{y} = 0.6$

$\Rightarrow \phi = 1$: pure distortionary taxation

Fiscal stimuli

Traditional increase in aggregate demand

$$\frac{g_t}{g} = \left(\frac{g_{t-1}}{g}\right)^{\rho_g} + \varepsilon_t^g$$

Alternative forms of fiscal stimuli

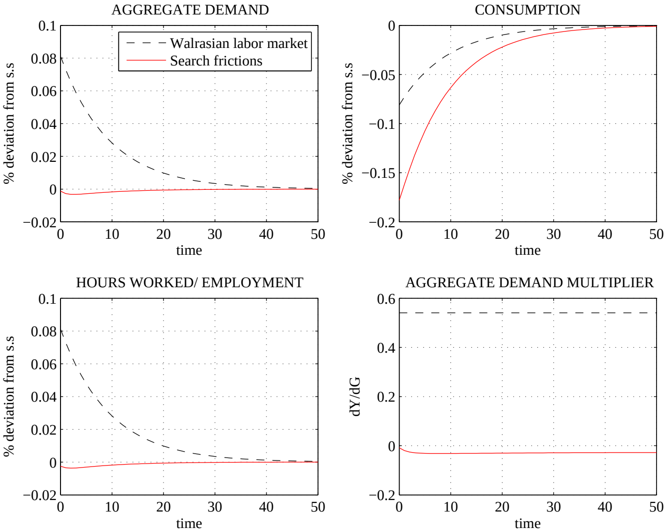
Increase in unemployment benefits
Subsidies to the cost of posting vacancies

Calibration

Parameter	Value	Description	Source
β	0.99	discount rate	standard value
σ	2	CRRA	standard value
$\frac{\varepsilon}{\varepsilon-1}$	0.2	mark up	Basu and Fernald (1997)
ψ	30	consistent with Calvo 2/3	standard value
ζ	0.4	matching technology	Blanchard and Diamond (1991)
ρ	0.07	separation rate	Hall (1995)
$\overline{u}$	0.12	stst. unemployment	Krause and Lubik (2007)
$q(\overline{\theta})$	0.7	firm matching rate	den Haan et. al (2000)
b	0.5 $\overline{w}$	unemployment benefit	Nickell and Nunziata (2001)
ς	0.5	bargaining power	standard value
ϕ_p	1.5	Taylor coefficient	Taylor (1993)
ϕ_y	0.5/4	Taylor coefficient	Taylor (1993)
$\overline{g}$	0.15 $\overline{y}$	stst. government spending	standard value
$\overline{\tau}^c$	0.05	consumption tax	Trabandt and Uhlig (2009)
$\overline{\tau}^n$	0.28	stst. labor tax	Trabandt and Uhlig (2009)
ρ_g, ρ_{τ^k}	0.9	autocorrelation of shocks	standard value

A special case: Dynamics under flexible prices

Demand stimulus under lump-sum taxation



RBC model with Walrasian labor market

Since $mc_t = (\varepsilon - 1)/\varepsilon$ and $mc_t = w_t$, the labor supply equation is given by

$$\frac{\varepsilon - 1}{\varepsilon}(1 - \tau_t^n) = N_t^{\varphi} C_t^{\sigma}$$

- If τ_t^n is constant, an increase in N is accompanied with a decrease in consumption, the more the higher η

$\Rightarrow$ Fiscal multiplier is always below one

- If τ_t^n increase, drop in consumption is larger the higher the increase in taxes

$\Rightarrow$ Financing with distortionary taxation reduces the fiscal multiplier

RBC model with matching frictions

To prove that fiscal multipliers turn negative, assume that workers have zero bargaining power ($\varsigma = 0$). Combining the wage equation with the job creation condition yields

$$\frac{\varepsilon - 1}{\varepsilon} - \frac{b}{1 - \tau^n} = \frac{\kappa(1 - \tau_k)}{m}\theta_t^{\xi} - (1 - \rho)\beta\frac{\kappa(1 - \tau_k)}{m}E_t\left\{\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}\theta_{t+1}^{\xi}\right\}$$

- To accommodate an increase in G, firms will have to post more vacancies $\Rightarrow \theta_t \uparrow$
- As we consider a temporary shock, we expect firms to post less vacancies in future periods, hence $\theta_{t+1} < \theta_t$.
- Thus, for $\theta_t \uparrow$, we need an increase (decrease) in the stochastic discount factor (the real interest rate) $\Rightarrow$ this requires an increase in current consumption
- However, the negative wealth effect leads to a decrease in consumption inducing a fall in vacancy posting

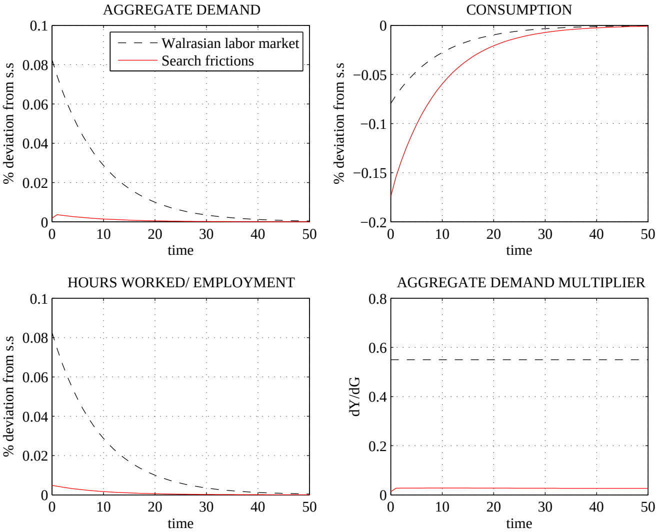
RBC model with matching frictions

Distortionary taxation:

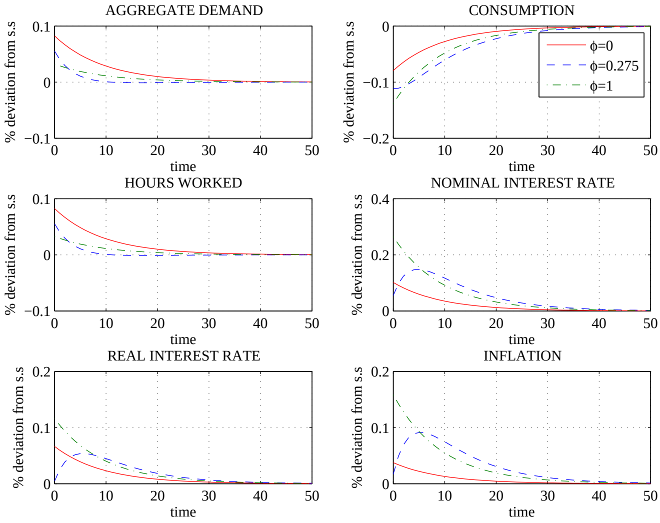
$$\frac{\varepsilon - 1}{\varepsilon} - \frac{b}{1 - \tau_t^n} = \frac{\kappa(1 - \tau_k)}{m}\theta_t^{\xi} - (1-\rho)\beta\frac{\kappa(1 - \tau_k)}{m}E_t\left\{\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}\theta_{t+1}^{\xi}\right\}$$

$\Rightarrow$ If labor taxes are used to finance the increase in government spending, the left hand side decreases, thus requiring an even bigger reduction in vacancy posting.

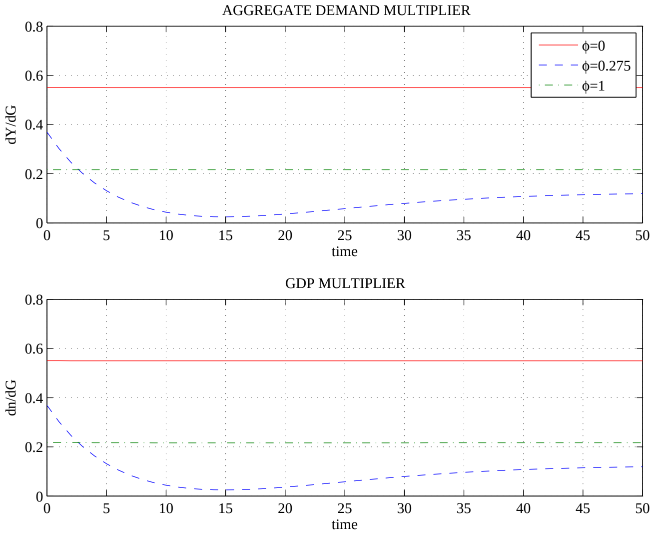
Back to sticky prices
Demand stimulus under lump-sum taxation



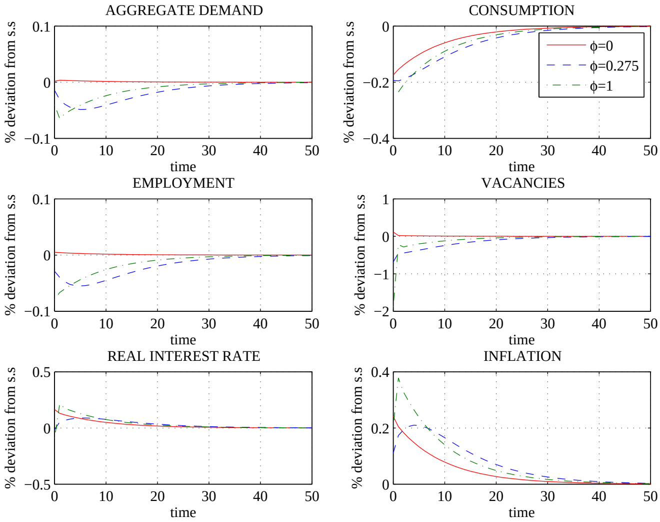
IRF's in the NK model with Walrasian labor market



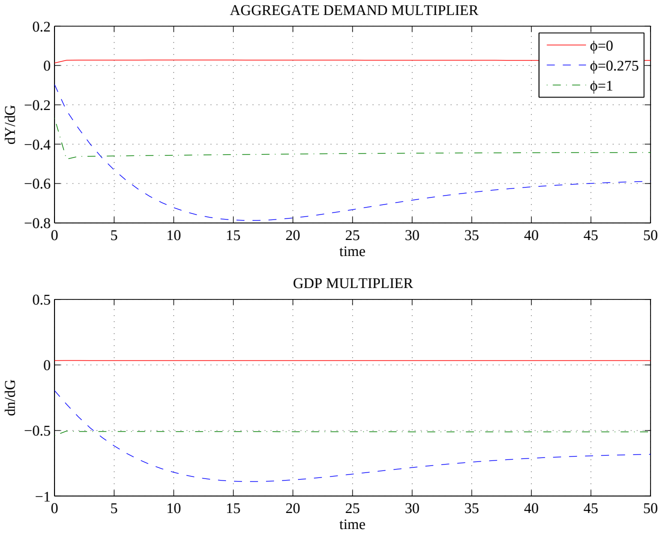
Fiscal multipliers



IRF's in the NK model with matching frictions



Fiscal multipliers



Fiscal multipliers

	$\phi = 0$		$\phi = 0.275$	
	SRM	LRM	SRM	LRM
Demand stimulus				
Baseline model	0.0327	0.0327	-0.1958	-0.6665
Flexible prices ($\psi = 0$)	-0.0173	-0.0324	-0.0965	-0.7281
Walrasian labor market	0.5501	0.5499	0.3687	0.1251
Walrasian / $\psi = 0$	0.5407	0.5407	0.4690	0.1218

Short **R**un **M**ultiplier $= \frac{dGDP_0}{dG_0}$, **L**ong **R**un **M**ultiplier $= \sum_{t=0}^{\infty} \beta^t \frac{dGDP_t}{dG_t}$

- $\Rightarrow$ Lump-sum taxation: Positive effect on aggregate demand due to price rigidity is barely enough to compensate for the negative labor demand effect
- $\Rightarrow$ With distortionary taxation, multipliers turn negative

Robustness checks

Reassess government consumption multipliers

- for different degrees of nominal price rigidity
- when considering real wage rigidity $w_t = \gamma w_{t-1} + (1 - \gamma) w_t^*$
- when varying worker's bargaining power

Fiscal multipliers

Varying the degree of nominal price rigidity

	$\phi = 0$		$\phi = 0.275$	
	SRM	LRM	SRM	LRM
Demand stimulus				
Baseline model	0.0327	0.0327	-0.1958	-0.6665
Flexible prices ($\psi = 0$)	-0.0173	-0.0324	-0.0965	-0.7281
Price rigidity $\psi = 9.9010$	-0.0072	-0.0110	-0.1159	-0.7106
Price rigidity $\psi = 58.2524$	0.1207	0.0922	-0.2739	-0.5554
Walrasian labor market	0.5501	0.5499	0.3687	0.1251
Walrasian / $\psi = 0$	0.5407	0.5407	0.4690	0.1218
Walrasian / $\psi = 9.9010$	0.5441	0.5440	0.4233	0.1173
Walrasian / $\psi = 58.2524$	0.5579	0.5576	0.2651	0.2638

SRM=$dGDP_0 \,/\, dcost_0$, LRM=$\sum_{t=0}^{\infty} \beta^t \, dGDP_t \,/\, dcost_t$

$\Rightarrow$ Higher price rigidity increases fiscal multipliers

$\Rightarrow$ Independently of the degree of price rigidity, matching frictions dampen fiscal multipliers

Fiscal multipliers

Considering real wage rigidity

	$\phi = 0$		$\phi = 0.275$	
	SRM	LRM	SRM	LRM
Demand stimulus				
Baseline model	0.0327	0.0327	-0.1958	-0.6665
Real wage rigidity ($\gamma = 0.9$)	0.1412	0.0287	-0.1478	-0.6182
Walrasian labor market	0.5501	0.5499	0.3687	0.1251

SRM=$dGDP_0 \,/\, dcost_0$, LRM=$\sum_{t=0}^{\infty} \beta^t \, dGDP_t \,/\, dcost_t$

- $\Rightarrow$ Aggregate demand $\uparrow$ $\rightarrow$ wages $\uparrow$ $\rightarrow$ vacancy posting $\downarrow$
- $\Rightarrow$ Real wage rigidity dampens the upward pressure on wages $\Rightarrow$ multipliers $\uparrow$
- $\Rightarrow$ Effects still considerably smaller compared to Walrasian labor market model

Fiscal multipliers

Varying worker's bargaining power

	$\phi = 0$		$\phi = 0.275$	
	SRM	LRM	SRM	LRM
Demand stimulus				
Baseline model	0.0327	0.0327	-0.1958	-0.6665
Bargaining power $\varsigma = 0.9$	0.0426	0.0500	-0.1599	-0.6833
Bargaining power $\varsigma = 0.3$	0.0108	0.0078	-0.2748	-0.6421
Walrasian labor market	0.5501	0.5499	0.3687	0.1251

SRM=$dGDP_0\,/\,dcost_0$, LRM=$\sum_{t=0}^{\infty} \beta^t\, dGDP_t\,/\,dcost_t$

$\Rightarrow$ Insignificant changes

A brief summary of the findings so far

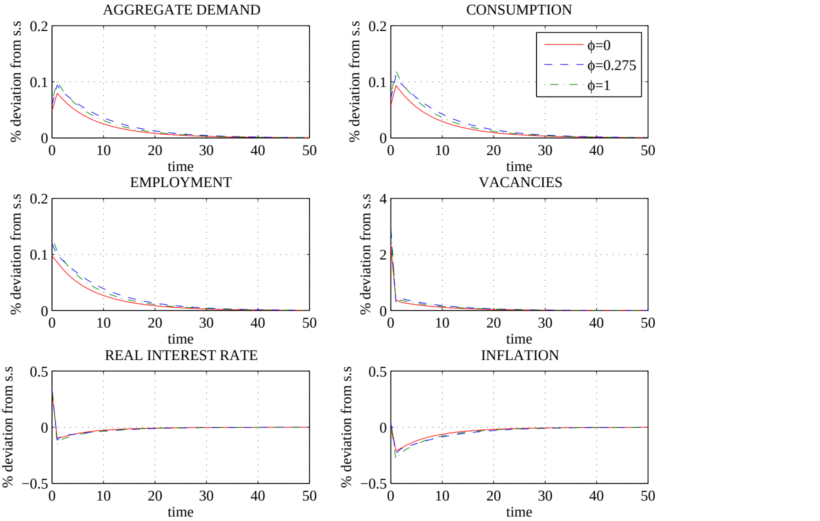
- Government consumption multipliers are nearly zero and turn even negative when financed with distortionary taxation
- True also for other forms of aggregate demand stimuli (decrease in consumption taxes)
- Other forms of fiscal stimuli

Alternative Forms of Fiscal Stimuli

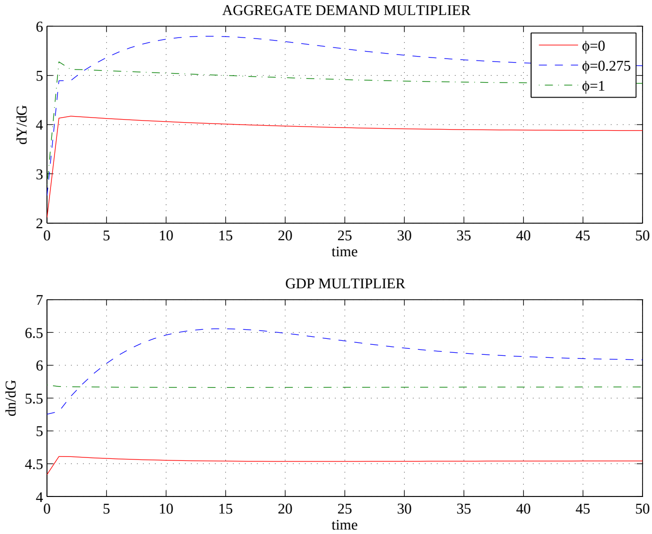
- Increase in unemployment benefits:
  - $\Rightarrow$ Delivers negative multipliers since it raises wages
  - $\Rightarrow$ Increase in wages leads to a fall in labor demand and employment
  - $\Rightarrow$ Increase in unemployment benefits may be beneficial when frictions occur also along the labor supply schedule
- Increase in hiring subsidies

$$\frac{\tau_t^k}{\tau^k} = \left(\frac{\tau_{t-1}^k}{\tau^k}\right)^{\rho_{\tau^k}} + \varepsilon_t^{\tau^k}$$

Impulse responses to an increase in hiring subsidies



Fiscal multipliers for an increase in hiring subsidies



Robustness checks

Starting from a recession scenario

Compare effects of a persistent one percent drop in total factor productivity with and without policy intervention

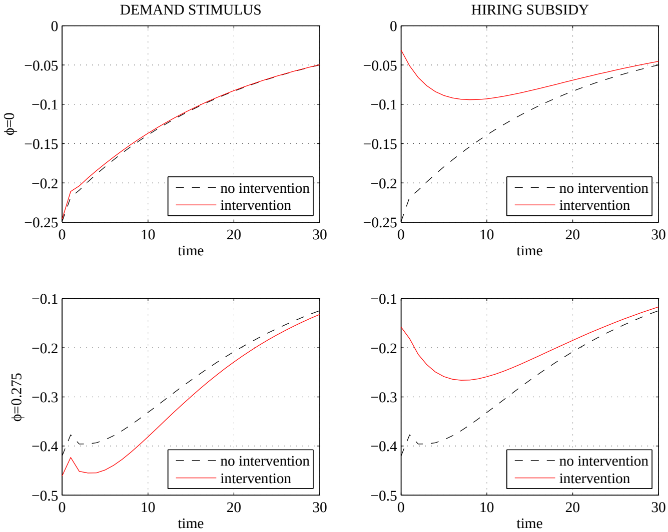
Interest rate peg

Monetary authority keeps the nominal interest rate constant for one year

Does the result of Christiano, Eichenbaum and Rebelo (2009) survive when matching frictions are considered?

Starting from a recession scenario

Response of employment



	$\phi = 0$		$\phi = 0.275$	
	SRM	LRM	SRM	LRM
Demand stimulus				
Baseline model	0.0125	0.0262	-0.0968	-0.5739
Interest rate peg	0.6369	0.2073	0.4342	-0.3296
Walrasian labor market	0.5500	0.5499	0.3687	0.1245
Walrasian / Interest rate peg	0.9858	0.6416	0.7852	0.2508
Increase in hiring subsidies				
Baseline model	2.1121	3.8749	2.5570	5.1683
Interest rate peg	-0.9784	2.6204	-0.2292	3.4805

SRM=$dy_0 \,/\, dcost_0$, LRM=$\sum_{t=0}^{\infty} \beta^t dy_t \,/\, dcost_t$

$\Rightarrow$ Demand stimulus: Larger multipliers also with search frictions

$\Rightarrow$ Hiring subsidies: policy only successful when accompanied by a fall in the nominal interest rate
Reason: real interest rate jumps up $\rightarrow$ discounted future values of new vacancies decrease

Conclusion

- Non-Walrasian labor markets are a crucial dimension in evaluating fiscal multipliers
- Frictions in the labor market dampens effects of demand stimuli
  - $\Rightarrow$ Contrast the common wisdom that sees fiscal stimuli helpful exactly when unemployment is high
  - $\Rightarrow$ Literature may overestimate the actual demand stimulus
- Policies targeted towards the labor demand schedule are effective in boosting employment and output

Future work

- Add frictions along the labor supply schedule (endogenous labor market participation)
- Simplicity of our model allows to explain the key mechanism and to compare fiscal multipliers under different labor market regimes
- To come out with some real quantitative statements about fiscal stimuli we have to bring the model to the data