Online Appendix C: Calibrating the theoretical model to the US economy

The benchmark model of the text is calibrated to fit the aggregate equilibrium outcomes in the US in the period before the financial crisis. I then undertake two comparative-static simulations: the first with g_1 fixed at 0.668 and the second with g_1 determined endogenously in the model.

1. Parameter values of the model. The parameters of the model are calibrated in four steps. First, the match parameter $\eta = 0.5$ fits in the range proposed by Petrongolo and Pissarides (2001). The production function parameter δ ensures decreasing returns to scale and a pre-tax profit of 10.3 percent. The working-age population is normalized to one, the total-factor-productivity parameter μ is set at 0.98, the wage w to 0.89 and the disutility of search effort γ to 2.5 to yield the unemployment rate of 5.8 percent and labor-force-participation rate of 66.6 percent observed in 2000. The value of ρ chosen results in 2.5 percent of employees working in recruiting, as Landais et al. (2018b) reported from the 1997 National Employment Survey. The UI payments of $C^u = .376$ in the benchmark simulation and $C^u_1 = .254$ in the post-reform simulations generate the replacement rates ($R_1 = C^u_1/w_1$) of 0.42 and 0.28.[1] E_o, N_o, and U_o are set to 0.64, 0.33 and 0.03 respectively to match the 2000 labor shares and and $\sigma = 0.61$ ensures a steady state in benchmark equilibrium: with no exogenous shocks, E_1, N_1 and U_1 will equal their previous-period values. The three utility parameters (χ, ι, Γ) were chosen to ensure that (a) $V(x) > 0$ for $x=C^u,w > .1$ and (b) $V(.1) = 0$. I do not consider values of C^u_1 or w_1 less than 0.1 in these simulations.

Table C1: Parameters used in calibration.

Parameter	Calibrated	Variable	Value Matched	Source
δ	0.9	Decreasing-returns-to-scale production		
η	0.5	Match variable	0.5	Petrongolo and Pissarides (2001)
μ	0.98	u_1	5.8 percent	2000 value
w	0.90	Working-age population	1 (normalization)	
υ	0.95	Pre-tax profits/wages and salaries	0.139	BLS, 2000 values
C^u_1 (pre-reform)	0.37	R_1 (pre-reform)	0.42	Landais et al. (2018b), 1990-2014 average
C^u_1 (post-reform)	0.264	R_1 (post-reform)	0.28	Landais et al. (2018b), 0.28 average after 2014
γ	2.5	LFP rate	0.66	2000 value
E_o	0.64	E_1	0.64	Ensuring steady-state consistency
N_o	0.33	N_1	0.33	
U_o	0.03	U_1	0.03	
σ	0.81			
χ	2			Author's calculations
Γ	5/6	V(.1)	0	
ι	12	V(z)	V(z)> 0 for z>.1	
ρ	0.013	Share of workers in recruiting	.025	1997 National Employment Survey
ψ	0.5	Share of unemployed applying for UI payments	0.5	Vroman (2009)

[1] Landais et al. (2018b) reported that the effective replacement rate for the period 1990-2014 is 0.42. After 2014 (and the many UI reforms) it reported that the effective average replacement rate across the US was 0.28.

The parameter ψ is added to the simulation model to reflect the fact that only ½ of those losing their jobs for no fault of their own in the 2000s filed for UI payments. This is not an implication of the theoretical model of the text but is reported by Vroman (2009) in his analysis of evidence from CPS supplements. He finds that the reason most often given for this decision was that the individuals did not believe that they qualified for these payments. The choices of these individuals in the simulation model reflect their optimal choices in $\bar{e}_1^*$ and $\bar{g}_1$.

2. Equilibrium values in the benchmark simulation.

The bottom five rows of Table C2 illustrate the welfare implications of this model. (I subtract the average cost g for each category of searching worker.) Each worker who remains employed in her period-zero job receives $\mathcal{U}^{Ce}$ of 0.740. Each searching worker who becomes employed receives $\mathcal{U}^{e}$ of 0.368, derived from the utility of the wage minus the disutility of worker search on average for those searching. Each searching worker who remains unemployed has the same search effort disutility but receives only the UI benefit of $C^u = 0.378$ with utility on net $\mathcal{U}^{u}$ of 0.242. Labor-force non-participants receive zero but find that better in expected value than participating in the labor market due to higher non-pecuniary search costs.

Table C2: Simulations of the Labor Search Model

		UI Reform:	UI Reform:
	Benchmark	Exogenous g_1	Endogenous g_1
μ	0.988	0.988	0.988
ρ	0.013	0.013	0.013
C^u	0.378	0.252	0.252
C^e (= wage)	0.900	0.900	0.900
ΔC	0.522	0.648	0.648
$\omega(C^u)$	1.149	0.926	0.926
$\kappa(C^u)$	0.678	n.a.	0.273
θ_1	7.279	5.772	6.449
e^*_1	0.267	0.374	0.388
g_1	0.668	0.668	0.644
N	0.332	0.332	0.356
ℓ^s	0.629	0.654	0.642
Unemployment rate	0.058	0.021	0.003
y_1	0.630	0.655	0.643
τ	0.036	0.032	0.034
π_1	0.062	0.064	0.063
UI payment total	0.007	0.004	0.000
v_1 (vacancies)	1.944	2.159	2.502
$\bar{e}_1$	0.370	0.416	0.394
$\bar{g}_1$	0.657	0.629	0.644
$\mathcal{U}^{Ce}$	0.741	0.741	0.741
$\mathcal{U}^{e}$ (average $g< g_1$)	0.370	0.321	0.324
$\mathcal{U}^{u}$ (average $g < g_1$)	0.242	0.083	0.076
$\mathcal{U}^{FE}$ (average $g< g_1$)	0.323	0.295	0.322
$\mathcal{U}^{FU}$ (average $g< g_1$)	-0.418	-0.446	-0.419
Aggregate worker utility	0.374	0.368	0.368
After-tax π rate	0.085	0.093	0.096

Total worker welfare is given by aggregate worker utility = 0.374, and is the weighted average of the unemployed, employed and non-participating utilities, with the weights equal to the share of each group in the total of working-age individuals. The after-tax profit rate accrues to the employer and is in percentage, not utility units.

The remaining simulations illustrate the impact of UI reform. The simulation reported in the third column introduces that change while keeping labor-force participation constant. The simulation in the fourth column introduces the endogeneity of labor-force participation. The theoretical predictions of Table 1 are confirmed in these simulations.[2] If we begin by comparing the second column of Table 1 to the "fixed g_1" simulation of Table C2, we observe that θ_1 falls with UI reform. Search intensity rises. Employment rises, as does output, while the unemployment rate falls. These are all results anticipated in the moral hazard argument of the theoretical literature.

Worker welfare for those who do search is reduced in this equilibrium. For those not needing to search, $\mathcal{U}^{Ce}$ remains 0.741. $\mathcal{U}^{e}$, the utility of the wage reduced by the average disutility of increased search effort, falls from 0.370 to 0.321 due to greater search intensity e_1^*. For the unemployed, $\mathcal{U}^{u}$ is reduced both because of the reduction in C^u and the disutility of increased search effort. Total worker utility falls slightly due both to non-pecuniary search cost and to falling UI payments to the unemployed. After-tax profit rate rises.

The coefficients in the final column in Table C2 can be compared to the prediction from the third column of Table 1 and illustrate the impact of UI reform when the change in labor-force participation is incorporated. The key finding of this paper is replicated: UI reform as implemented here leads to a reduction in labor-market participation. There is an increase in labor supply when compared to the benchmark, but the size of the increase is less than observed in the "exogenous g_1" case of the second column. Search intensity for those remaining in the labor market is increased, while labor-market tightness is less than in the benchmark but more than observed for exogenous g_1. The unemployment rate falls from 5.8 percent in the benchmark to 0.3 percent after reform, but that is due in large part to the increased non-participation in the labor force: N_1 rises by 2.4 percent of the working-age population.

The results reported here are contingent on the calibration adopted. Note, though, that this calibration generates shares of the population out of the labor force consistent with the aggregate US labor-market data.

3. Equilibrium using a wage-bill-based UI tax to fund UI payment.

The model presented here uses the simplification that UI payments are financed through corporate taxes to maintain the focus on the impact of UI payments on labor-force participation. It is more realistic to think of the financing for UI payment through taxes on the wage bill. This introduces a distortion to the firm's hiring decision that complicates the expressions presented but does not change the qualitative results. In the text a corporate profit tax funds UI payments. In most states, however, firms pay a UI tax per dollar paid in wages (denoted t^e) to fund the UI program. This tax introduces a distortion to the labor-demand decision. In this section, I explore the implications of that type of tax.

In this case, the producer chooses ℓ^d to maximize after-tax profit π:

$$\text{Max}_{\ell}\ \pi^e = y(\ell^d/(1 + \tau(\theta))) - ((1+t^e)*w)\ \ell^d \qquad \text{(C1)}$$

With first order condition:

$$y'(n) = (1+\tau(\theta_1))\ ((1+t^e)*w) \qquad \text{(C2)}$$

[2] Recall that the comparative statics of Table 1 are derived for an increase in C^u. We should find the opposite sign from what is predicted there with this reform that reduces C^u.

Profit-maximizing hiring $\ell^d(\theta_1,w,t^e)$ is decreasing in w, t^e and θ_1 for decreasing-returns-to-scale technology.

$$\ell^d(\theta_1,w,t^e) = (1/(1+\tau(\theta_1)))^{\delta/(1-\delta)}(\mu\delta/((1+t^e)w))^{1/(1-\delta)}$$
$$t^e = (g_1-\ell_1)\, C^u/w\ell_1$$

There is an instability inherent in this tax scheme in equilibrium. For simplicity, consider the case of constant g_1, μ and w.

$$\widehat{\ell^d}_1 = (-1/(1-\delta))[((t^e/(1+t^e))\,\hat{t}^e + \alpha\,\hat{\theta}_1 \quad \text{(C3)}$$
$$\hat{t}^e = \hat{C}^u - (g_1/(g_1-\ell))\,\widehat{\ell^d}_1 \quad \text{(C4)}$$
$$\widehat{\ell^d} = -(1/((1-\delta)\varsigma_1))[((t^e/(1+t^e)\,\hat{C}^u + \alpha\,\hat{\theta}_1] \quad \text{(C5)}$$
$$\varsigma_1 = [(1-\delta) - (t^e/(1+t^e))(g_1/(g_1-\ell_1))]$$

For $\varsigma_1 > 0$ we will observe the same qualitative results as in the previous section: as C^u rises or θ_1 rises, the demand for labor will fall. However $\varsigma_1 < 0$ is a believable outcome as well: as the number of unemployed tends to zero, the ratio $g_1/(g_1-\ell_1)$ will become very large and ς_1 will be negative. The instability is due to the distortion built into the hiring decision through the tax on the wage bill: increasing C^u causes a rise in t^e sufficient to reduce employment and cause a fiscal shortfall in funding the UI payments.

In Table C3, I repeat the simulations undertaken with the calibrated model but using this UI tax. Given the instability, I do not solve endogenously for the equilibrium tax rate; instead, I impose a one percent tax on the wage bill.[3] If that tax rate does not cover the total cost of UI payments, I subtract the balance from corporate profit. All other parametric assumptions are identical to those of Table C2.

The first conclusion from this exercise is found by comparing the benchmark results in Tables C2 and C3. The distortion associated with this UI tax is a costly one: the share of the working-age population employed falls by three percentage points, and the share of the working age population out of the labor force rises by 1.2 percentage points. Real output falls by about four percent. Aggregate worker utility falls from 0.374 to 0.364 but the after-tax profit rate rises slightly.

The second conclusion is that the two UI reform simulations exhibit very similar implications to those fixed g_1; employment and output grow strongly with the reform. When g_1 is allowed to change, though, there is a flow of potential workers out of the labor force. The unemployment rate falls sharply, but most of this is due to potential workers exiting the labor force. After-tax profits rise.

While the benchmark case is a stable equilibrium, the size of the reduction in UI payments that matches the available data leads to instability in the results. ς_1 is negative in both simulations, leading to a much larger response in the case of fixed g than when g_1 is determined endogenously.

[3] The standard UI tax rate on wage payments for new employers in North Carolina, for example, is 1.2 percent. That rate is reduced for employers that establish positive experience ratings.

Table C3: Simulations of the Labor Search Model with UI tax on the wage bill

	Benchmark	UI Reform: Exogenous g_1	UI Reform: Endogenous g_1
μ	0.988	0.988	0.988
ρ	0.013	0.013	0.013
C^u	0.378	0.252	0.252
w^m	0.900	0.900	0.900
ΔC	0.522	0.648	0.648
$\omega(C^u)$	1.149	0.926	0.926
$\kappa(C^u)$	0.744	n.a.	0.369
θ_1	5.405	4.327	5.208
e^*	0.242	0.340	0.362
g_1	0.656	0.656	0.621
N	0.344	0.344	0.379
ℓ^s	0.597	0.616	0.600
Unemployment rate	0.090	0.061	0.034
Y	0.604	0.623	0.607
T	0.031	0.028	0.030
π (pre-tax)	0.065	0.006	0.065
UI payment	0.011	0.005	0.003
v (vacancies)	1.308	1.471	1.885
$\bar{e}_1$	0.430	0.481	0.438
$\bar{g}_1$	0.620	n.a.	0.614
t^e	0.01	0.01	0.01
$\mathcal{U}^{Ce}$	0.741	0.741	0.741
$\mathcal{U}^e$ (average $g< g_1$)	0.384	0.346	0.352
$\mathcal{U}^u$ (average $g < g_1$)	0.256	0.107	0.114
$\mathcal{U}^{FE}$ (average $g< g_1$)	0.291	0.253	0.303
$\mathcal{U}^{FU}$ (average $g< g_1$)	-0.449	-0.488	-0.437
Aggregate worker utility	0.364	0.356	0.356
After-tax π rate	0.088	0.096	0.101