Online Appendix A: Conversion of Equations (6) through (23) in the text to percentage-change expressions.

It is convenient to interpret comparative statics in the model presented in the text by converting to expressions in percentage-change form (with the percentage-change in a variable denoted by a "^").

On p. 5 we have the expression $\Delta V(w_1,C^u{}_1) = V(w_1) - V(C^u{}_1)$: the difference in utility terms between employment and unemployment. It is a component of the optimal search effort in (6). The percentage-change in this in response to changes in w_1 and $C^u{}_1$ can be expressed:

$$\widehat{\Delta V} = ((\chi\text{-}1)(R_1{}^{\chi\text{-}1}/(1\text{-}R_1{}^{\chi\text{-}1}))\ \hat{w}_1 - ((\chi\text{-}1)(1/(1\text{-}R_1{}^{\chi\text{-}1})\ \hat{C}^u{}_1$$

$$= (\gamma\text{-}1)[\ \omega_w\ \hat{w}_1 - \omega_c\ \hat{C}^u{}_1]$$

with ω_w and ω_c defined below in terms of the optimal search intensity.

The determinants of optimal search effort from (6) are

$$\hat{e}_1{}^* = (\eta/(\gamma\text{-}1))\ \hat{\theta}_1 + ((\chi\text{-}1)/(\gamma\text{-}1))(R_1{}^{\chi\text{-}1}/(1\text{-}R_1{}^{\chi\text{-}1}))\ \hat{w}_1$$

$$- ((\chi\text{-}1)/(\gamma\text{-}1))(1/(1\text{-}R_1{}^{\chi\text{-}1})\ \hat{C}^u{}_1$$

$$= (\eta/(\gamma\text{-}1))\ \hat{\theta}_1 + \omega_w\ \hat{w}_1 - \omega_c\ \hat{C}^u{}_1 \qquad \text{(A6)}$$

From this derivation, I denote the elasticity of search effort with respect to increase in the unemployment benefit (ω_c, as reported in (19)) and with respect to an increase in wage (ω_w) as

$$- \omega_c = - ((\chi\text{-}1)/(\gamma\text{-}1))(1/(1\text{-}R_1{}^{\chi\text{-}1})) < 0$$

$$\omega_w = ((\chi\text{-}1)/(\gamma\text{-}1))(R_1{}^{\chi\text{-}1}/(1\text{-}R_1{}^{\chi\text{-}1})) > 0$$

Search intensity is rising in increasing labor-market tightness and wage, while it is falling with increases in UI payment. Defining $\varepsilon = V(C^u{}_1)/g_1$, the labor-force participation decision from (7) is:

$$\hat{g}_1 = (1\text{-}\ \varepsilon)\ \gamma\hat{e}_1{}^* + \varepsilon(\chi\text{-}1)\ \hat{C}^u{}_1 \qquad \text{(A7)}$$

As g_1 rises, the working-age population not in the labor force falls. As is evident in (A7), increasing either e_1^* or C^u_1 is associated with an increase in labor-force participation. As (A6) illustrates, however, an increase in C^u_1 will also reduce the optimal choice e_1^*. The net effect of increased C^u_1 on g_1 is ambiguous in sign.

The elasticity of labor-force participation with respect to an increase in the unemployment-insurance payment κ_c (as reported in (20)) and with respect to the wage κ_w is then

$$\kappa_c = [\varepsilon(\chi\text{-}1) - (1\text{-}\varepsilon)\,\gamma\omega_c)]$$

$$\kappa_w = (1\text{-}\varepsilon)\,\gamma\omega_w \;\; > 0$$

The κ_c elasticity is ambiguous in sign: labor-force participation is increasing in the real-income effect of an increase in C^u but is decreasing in the effect of rising C^u in reducing ΔV and thus reducing search intensity. The κ_w elasticity is positive through its effect in increasing ΔV.

For labor flows I will simplify the analytical expressions in this section using the condition $\sigma = 0$. The simulation model referenced in the text calibrates σ to a non-zero steady state value and replicates the qualitative findings of this section. Labor supply growth from (8) can be written:

$$\widehat{\ell^s}_1 = \hat{g}_1 + (\gamma\eta/(\gamma\text{-}1))\,\hat{\theta}_1 + (1/(\gamma\text{-}1))\,\widehat{\Delta V} \qquad \text{(A8)}$$

Labor supply rises with increased labor-force participation, with increased labor-market tightness, and with an increased gap between wage and C^u_1. This can be simplified further; that will be done in considering the differences of the "no change in labor market participation" case relative to the endogenous labor-market-participation case.

For constant productivity, labor demand growth from (12) is

$$\widehat{\ell^d}_1 = \text{-}\,(1/(1\text{-}\delta))[\,\alpha_1\,\hat{\theta}_1 + \hat{w}_1] \qquad \text{(A12)}$$

$$\alpha_1 = \delta\tau_1(1\text{-}\eta) > 0$$

and is declining in both increased market tightness and in increased wage.

Output growth from (10) for constant productivity is

$$\hat{y}_1 = \;\delta\,\widehat{n_1} \;= [\delta\,\widehat{\ell^d}_1 - \alpha_1\,\hat{\theta}_1]$$

$$= \text{-}\,(1/(1\text{-}\delta))[\alpha_1\,\hat{\theta}_1 + \delta\,\hat{w}_1] \qquad \text{(A10)}$$

An increase in labor tightness leads to a reduction in labor demand through the elasticity α_1. As labor tightness rises, more workers are diverted from production into worker-search activities for the firm. Labor demand also falls as the wage rises. Real output in the economy is falling as labor-market tightness rises or the wage rises.

Growth in the unemployment rate (u_1) in the economy is represented from (13) as

$$\hat{u}_1 = (\ell_1/(g_1-\ell_1))[-(\eta\gamma/(\gamma-1))\,\hat{\theta}_1 + \omega_c\,\hat{C}^u{}_1 - \omega_w\,\hat{w}_1\,] \quad \text{(A13)}$$

It is rising with an increase in the UI payment as more of those of working age are drawn into the labor force. It is falling with an increase in labor-market tightness and with an increase in wage.

Equilibrium market tightness is derived by equating (A8) and (A12). I consider two versions of this equilibrium – the first with exogenous (and unchanging) labor-force participation and the second with endogenous labor-force participation.

In the first case, for $\widehat{\ell^s}_1 = \widehat{\ell^d}_1$:

$$\hat{\theta}_1 = (\omega_c/\varphi)\,\hat{C}^u{}_1 - (((1/(1-\delta)) + \omega_w)/\varphi)\,\hat{w}_1 \quad (21)$$

$$\varphi = \eta(\gamma/(\gamma-1)) + \alpha_1/(1-\delta) > 0$$

Market tightness rises unambiguously with an increase in $C^u{}_1$ from the moral-hazard effect. Market tightness decreases unambiguously with an increase in wage.

In the second case, for $\widehat{\ell^s}_1 = \widehat{\ell^d}_1$:

$$\hat{\theta}_1 = ([\omega_c - \kappa_c)]/\varphi^+)\,\hat{C}^u{}_1 - ((1/(1-\delta)) + \omega_w + \kappa_w)/\varphi^+)\,\hat{w}_1 \quad (23)$$

$$\varphi^+ = [\varphi + (1-\varepsilon)(\eta\gamma/(\gamma-1))] > 0$$

Market tightness changes ambiguously after an increase in $C^u{}_1$. There are three possibilities:

1. For $\kappa_c < 0$, the moral-hazard effect on market tightness will be amplified.
2. For $\kappa_c > 0$ but $\kappa_c < \omega_c$, the moral-hazard effect will be dominant in determining market tightness but the magnitude of the $C^u{}_1$ effect on market tightness will be reduced.

3. For $\kappa_c > 0$ and $\kappa_c > \omega_c$, the labor-force-participation effect on market tightness will outweigh the moral-hazard effect.

Market tightness, by contrast, is unambiguously reduced by an increase in wage.

Wage determination in the Nash bargaining case depends upon the evolution of the surplus (S_1) as defined on p. 17. For constant productivity and minimum wage and with optimal labor choice it can be stated:

$$\hat{S}_1 = - (t_1/(1-t_1))\, \hat{t}_1 \;-\; \alpha_1\, \hat{\theta}_1$$

The surplus available for Nash bargaining is shrinking with the size of the UI tax rate and labor-market tightness. The wage-earners then receive a fixed percent ν of the surplus through Nash bargaining. For $\nu > 0$, the wage will be rising as the labor-market tightens and will be falling as the UI tax rate rises.

$$\begin{aligned} \hat{w}_1 &= (\hat{S}_1 - \hat{\ell}_1)(\, w_1 - w^m)/w_1) \\ &= [(w_1 - w^m)/w_1][\, (\delta/(1-\delta))\, \alpha_1\, \hat{\theta}_1 - (t_1/(1-t_1))\, \hat{t}_1 \;+ (1/(1-\delta))\, \hat{w}_1] \end{aligned} \qquad \text{(A18)}$$

The UI tax rate will balance government spending and receipts on UI payments, and as such is determined in general equilibrium. It is useful to highlight the role of the UI payment ($C^u{}_1$) and the number in the labor force unemployed and eligible for UI payments ($g_1 - \ell_1$). From (16) in the text:

$$\begin{aligned} \hat{t}_1 &= \hat{C}^u{}_1 + \widehat{g1 - l1} && \text{(A16)} \\ &= (1+\omega_c)\, \hat{C}^u{}_1 - (\eta\gamma/(\gamma-1))\, \hat{\theta}_1 \;-\; \omega_w\, \hat{w}_1 \end{aligned}$$

The UI tax rate rises with increases in the UI payment both directly (higher payment for each unemployed worker) and indirectly through its effect in discouraging search. Rising wage lowers the tax rate indirectly through increasing search. A tighter job market, other things equal, is associated with lower UI tax rates through the reduction in unemployed. Combining (A18) and (A16) illustrates an important tension in this model with Nash bargaining: with rising $\hat{C}^u{}_1$ there will be reductions in the surplus and (for $\nu > 0$) reductions in the wage received by those employed.

The simultaneous determination of equilibrium $\hat{\theta}_1$ and $\hat{w}_1$ is done through simultaneous solution of (20) and (A18) for exogenous g_1 or by (23) and (A18) for endogenous g_1. The results reported in the text are for the simplification of $\nu = 0$ and thus $w_1 = w^m$. More generally, for the exogenous-g_1 case:

$$\begin{bmatrix} \varphi & \omega_w + (1/(1-\delta)) \\ (\delta/(1-\delta))\alpha_1((w_1 - w^m)/w_1) & \alpha_1 \end{bmatrix} = \begin{bmatrix} \hat{\theta}_1 \\ \hat{w}_1 \end{bmatrix} \begin{bmatrix} \omega_c \\ -(t_1/(1-t_1)((w_1 - w^m)/w_1) \end{bmatrix} \hat{C}^u{}_1 -$$