Spatial Ver

$$C_r = \prod_{k=1}^{K} (C_{r.k})^{\alpha_k} . \qquad \sum_{k=1}^{K} \alpha_k = 1 .$$

$$U_{i.r} = C_{r.i}$$

$$\text{s.t. } \sum_{k=1}^{K} \int_0^1 p_{r.k}(x) \underbrace{dx}_{C_{r.k}(x)} \leq I_{i.r}$$

$$U_{i.r} = C_{r.i} \cdot A_r \cdot V_{i.r} .$$

$$Q_{r.k}(x) = \varphi_{r.k}(x) \cdot \left(\frac{H_{r.k}(x)}{1-\gamma_{rk}} \right)^{1-\gamma_{rk}} \prod_{s=1}^{K} \left(\frac{M_{r.s.k}(x)}{\gamma_{r.s.k}} \right)^{\gamma_{r.s.k}} \quad (1).$$

$$\left(\sum_{s=1}^{K} \gamma_{r.s.k} = \gamma_{r.k} . \right)$$

$$F_{r.k}(\varphi) = \exp\left[- \left(\frac{\varphi}{\varphi_{r.k}} \right)^{-\theta_k} \right] .$$

$$a = 0 \rightarrow B_k = \frac{1}{1-b_k}$$

$$\left(1 + \frac{1}{B_k}\right) w_{rk} = \left(1 + \frac{(1-b_k)}{\cancel{1-b_k}}\right) w_{rk} = (2-b_r) w_{rk} .$$

$$C_{rk} = (1-b_k) w_{rk} \leftarrow \text{hiring cost.}$$

given.

$$E_{rk}(x) = p_{rk}(x) Q_{rk}(x),$$

$$r_{rk}(x) = \frac{\partial E_{rk}(x)}{\partial H_{rk}(x)} .$$

$$= p_{rk}(x) \frac{\partial Q_{rk}(x)}{\partial H_{rk}(x)}$$

$$= p_{rk}(x) \cdot \varphi_{rk}(x) \cdot H_{rk}(x)^{-\gamma_{rk}} \prod_{k=1}^{K} \left(\frac{M_{rsk}(x)}{\gamma_{rsk}} \right)^{\gamma_{rsk}} .$$

$$\pi_{r.k}(x) = \overset{p_{r.k}(x)}{Q_{r.k}(x)} - [w_{r.k}(x) + c_{r.k}] H_{r.k}(x) - \sum_{s=1}^{K} P_{r.k} \cdot M_{r.s.k}(x).$$

The FoC: $\frac{\partial \pi_{r.k}(x)}{\partial H_{r.k}(x)} = 0.$

$$\therefore \frac{\partial p_{r.k}(x) Q_{r.k}(x)}{\partial H_{r.k}(x)} \equiv r_{r.k}(x) = w_{r.k}(x) + c_{r.k}.$$

Nash bargaining:

$$\max_{w} [r_{ck}(x) - w]^{1/2} [w - b_{r.k}]^{1/2}.$$

$$\max_{w} \frac{1}{2}\log(r_{r.k}(x) - w) + \frac{1}{2}\log(w - b_{r.k}) \equiv F(w).$$

FoC: $\frac{\partial F(w)}{\partial w} = \frac{1}{2}\frac{(-1)}{r_{r.k}(x) - w} + \frac{1}{2}\frac{1}{w - b_{r.k}} = 0.$

$$w - b_{r.k} = \underbrace{r_{r.k}(x) - w}_{c_{r.k}}$$

$$\cancel{2w = r_{r.}}$$

$$w = b_{r.k} + c_{r.k}.$$

$w = b_r w_{r.k} + c_{r.k}$

$c_{r.k} = (1 - b_r) w_{r.k}.$

Equilibrium: $\left(\underset{1}{\lambda}, \underset{N\times K}{w_{r.k}}, \underset{N}{L_r}, \underset{N\times K}{p_{r.k}}, \underset{N\times K}{\frac{L_{r.k}}{L_r}}, \underset{N\times K}{l_{r.k}}\right)$ c_r^k $N\times K$

$5NK + N + 1$ $2N?$

$$c_{ar}^k = \left[\left(1 + \frac{1}{B_{ar}}\right) w_{rk}\right]^{1-\gamma_{rk}} \cdot \prod_{k=1}^{K} (p_{rk})^{\gamma_{rsk}} \quad ① \quad N\times K$$

$$\frac{w_{rk}}{P_r} = B_r \left[\frac{(l_{rk})^{\lambda}}{\mu_{rk}}\right]^{\frac{1}{1-\lambda}}. \quad ② \quad N\times K$$

$\parallel$

$\omega_{r.k}$. $\quad B_r = \frac{1}{1 - b_r}$ $\quad \mu_{rk} \equiv \frac{\mu_{rk}}{(v_{rk})^{1-\lambda}}$

vacancy cost in terms of goods.

$$L_r = \sum_{k=1}^{K} L_{rk} \qquad (3) \; . \; N$$

$$\tilde{\omega}_r = \frac{\widetilde{\omega_{r.k}}}{t_{r.k}} = \frac{\omega_{r.k}\beta_{r.k}}{t_{r.k}}, \qquad (4) \qquad NK$$

where $\beta_{r.k} = l_{r.k} + (1 - l_{r.k}) b_r$.

$$E_{ij.k} = \pi_{ij.k} E_{jk}, \quad \&$$

$$\pi_{ij.k} = \left[\frac{I_{ijk} \frac{C_{ik}}{T_{ik}}}{\left[\sum_{i'=1}^{N} \left(\frac{I_{i'jk} C_{i'k}}{T_{i'k}} \right)^{-\theta_k} \right]^{-\frac{1}{\theta_k}}} \right]^{-\theta_k} . \qquad \cancel{(4)}\ (5) \qquad N \times N \times K$$

$$= \frac{T_{i.k}^{\theta_k} (I_{ijk} C_{ik})^{-\theta_k}}{\sum_{n=1}^{N} T_{n.k}^{\theta_k} (C_{n.k} I_{n.j.k})^{-\theta_k}} .$$

$$E_{rk} = \alpha_{k} I_r + \alpha_{k} \sum_{k=1}^{K} \mathbb{P}_r \cdot V_{r.k} \cdot V_{r.k} + \sum_{k=1}^{K} \gamma_{rks} \sum_{j=1}^{N} \pi_{rjs} E_{j.s} .$$

$$l_{r.k} = \frac{H_{r.k}}{L_{r.k}} = \frac{\tilde{\mu}_{r.k} V_{r.k}^{1-\lambda} L_{r.k}^{\lambda}}{L_{r.k}} = \tilde{\mu}_{r.k} \left(\frac{V_{r.k}}{L_{r.k}} \right)^{1-\lambda} .$$

$$l_{r.k}^{\frac{1}{1-\lambda}} = \tilde{\mu}_{r.k}^{\frac{1}{1-\lambda}} \cdot \frac{V_{r.k}}{L_{r.k}}$$

$$\therefore \quad V_{r.k} = \left(\frac{l_{r.k}}{\tilde{\mu}_{r.k}} \right)^{\frac{1}{1-\lambda}} \cdot \frac{1}{L_{r.k}} .$$

$$\therefore \quad E_{rk} = \alpha_k I_r + \alpha_k \sum_{k=1}^{K} \mathbb{P}_r \cdot V_{r.k} \cdot \underbrace{\left[\left(\frac{l_{r.k}}{\tilde{\mu}_{r.k}} \right)^{\frac{1}{1-\lambda}} \cdot \frac{1}{L_{r.k}} \right]}_{= V_{r.k}} \qquad NK \qquad \cancel{(5)}\ (6)$$

$$+ \sum_{k=1}^{K} \gamma_{r.k.s} \sum_{j=1}^{N} \pi_{rj}^{s} E_j^{s} .$$

$$I_r = \left(1 + \frac{1}{\beta_r} \right) \sum_{k=1}^{K} w_{r.k} H_{r.k} .$$

$$0 = \sum_{j=1}^{N} \sum_{k=1}^{K} \pi_{rj}^{k} E_j^{k} - \sum_{i=1}^{N} \sum_{k=1}^{K} \pi_{ir}^{k} E_r^{k} .$$ ~~6~~ 7 N ✓

$L_{rk} \cdot l_{rk}$.

$$0 = \nu \sum_{r=1}^{N} \sum_{k=1}^{K} H_{rk} w_{rk} - \sum_{r=1}^{N} \sum_{k=1}^{K} (1-\nu) b_r w_{rk} \left(L_{rk} - H_{rk} \right)$$ ~~7~~ 8 1 ✓

Recall:

$$\tilde{\omega}_r = \frac{\omega_{r.k} \beta_{r.k}}{f_{r.k}} = \frac{\frac{w_{r.k}}{P_r} \cdot \left[l_{r.k} + (1-l_{r.k}) b_r \right]}{f_{r.k}} .$$

$$\frac{L_r}{L} = \frac{\cancel{\beta}\cancel{A_r}\,\beta_r\, \tilde{\omega}_r^{\varepsilon}}{\sum_{n=1}^{N} \cancel{A_n}\,\beta_n\, \tilde{\omega}_n^{\varepsilon}} .$$ 9 . N ✓

$$P_{rk} = \text{"}T_{j.k}\text{"} \cdot \left[\Gamma\left(1 - \frac{1-\sigma_k}{\theta_k} \right) \right]^{\frac{1}{1-\sigma_k}}$$

in Carrere, Grujovic & Robert-Nicoud.

$$= \left[\sum_{i=1}^{N} \left(\tau_{ijk} \frac{c_{ik}}{T_{ik}} \right)^{-\theta_k} \right]^{-\frac{1}{\theta_k}} \cdot \cancel{A_k} \cdot \overbrace{\left[\Gamma\left(1 - \frac{1-\sigma_k}{\theta_k} \right) \right]^{\frac{1}{1-\sigma_k}}}^{A^k} .$$

10

NK –

Endogenous variables:

C_r^k, w_r^k, p_r^k, l_r^k, π_{ij}^k, E_j^k, L_r^k, I_r, L_r, ν

NK, NK, NK, NK, $N \times N \times K$, NK, NK, N, N, 1.

$$\begin{tikzcd}
w_r^k \arrow[dd] & p_r^k \arrow[d] & l_r^k \arrow[ddd] \\
 & P_r \arrow[dl] & \\
\omega_{r.k} \arrow[drr] & & \\
 & & \tilde{\omega}_r
\end{tikzcd}$$

- I've written a model that comprises
  - internal geography
  - unemployment.
- I haven't simulated an equilibrium.
- Regional variation in unemployment is largely higher than time variation.

- I've found a quantitative macro model of M&A.
  → trying to extend it to a many-country setting
  → but it's difficult, especially trade costs.

・モデルを書く.
・イートンにメール書く.
・コード書く.
(・employment share. x inequality.
(・labor union, minimum wage.

✓ M&A
・trade cost と productivity のかけ算を "真 productivity" として使う.
"destination-specific productivity."

- $\log(u_{it}) = \log(U_{it}) - \log(L_{it})$.

$$C_r^k = P_r v_r^k \frac{V_r^k}{H_r^k} \qquad H_r^k = \widetilde{\mu}_r^k (V_r^k)^{1-\lambda} (L_r^k)^{\lambda}.$$

$$= P_r v_r^k \frac{V_r^k}{\widetilde{\mu}_r^k (V_r^k)^{1-\lambda} (L_r^k)^{\lambda}} \qquad l_r^k = \frac{H_r^k}{L_r^k}.$$

$$\frac{H_r^k}{L_r^k} = \widetilde{\mu}_r^k (V_r^k)^{1-\lambda} (L_r^k)^{\lambda-1}$$

$$\therefore \frac{1}{\widetilde{\mu}_r^k} \cdot l_r^k \cdot (L_r^k)^{1-\lambda} = (V_r^k)^{1-\lambda}.$$

$$V_r^k = L_r^k \cdot (l_r^k)^{\frac{1}{1-\lambda}} \cdot \left(\frac{1}{\widetilde{\mu}_r^k}\right)^{\frac{1}{1-\lambda}}.$$

$$C_r^k = P_r v_r^k \frac{L_r^k \cdot (l_r^k)^{\frac{1}{1-\lambda}} \cdot \left(\frac{1}{\hat{a}_r^k}\right)^{\frac{1}{1-\lambda}}}{H_r^k}$$

$$= P_r v_r^k \cdot \left(\frac{H_r^k}{L_r^k}\right)^{-1} \cdot (l_r^k)^{\frac{1}{1-\lambda}} \cdot (\hat{a}_r^k)^{-\frac{1}{1-\lambda}}.$$

イートン大体 Munday.

$$= P_r v_r^k \cdot (l_r^k)^{-1} \cdot (l_r^k)^{\frac{1}{1-\lambda}} \cdot (\hat{a}_r^k)^{-\frac{1}{1-\lambda}}$$

$$= P_r v_r^k \cdot (l_r^k)^{\frac{1-(1-\lambda)}{1-\lambda}} \cdot (\hat{a}_r^k)^{-\frac{1}{1-\lambda}}$$

$$= P_r v_r^k \cdot (\hat{a}_r^k)^{-\frac{1}{1-\lambda}} \cdot (l_r^k)^{\frac{\lambda}{1-\lambda}}.$$

---

② : $$w_{r,k} = P_r \cdot \left(\frac{1}{1-b_r}\right) \cdot \left[\frac{(l_{r,k})^\lambda}{\mu_{r,k}}\right]^{\frac{1}{1-\lambda}}.$$

$$= \left[\prod_{k=1}^{K} (p_r^k)^k\right] \cdot \left(\frac{1}{1-b_r}\right) \cdot \left[\frac{(l_r^k)^\lambda}{\mu_{r,k}}\right]^{\frac{1}{1-\lambda}}.$$

⑩ : $$p_{r,k} = A^k \cdot \left[\sum_{i=1}^{N} \left(\tau_{ij}^k \cdot \frac{c_i^k}{T_i^k}\right)^{-\theta_k}\right]^{-\frac{1}{\theta_k}}.$$

① : $$C_r^k = \left[\left(1 + \frac{1}{B_r}\right) w_r^k\right]^{1-\gamma_r^k} \prod_{k=1}^{K} (p_r^k)^{\gamma_r^{s,k}}.$$

Given (w_r^k), iterate ⑪ & ① $\Rightarrow$ p_r^k & C_r^k
(as a function of w_r^k).

$w_{r,k}$ & $P_r \rightarrow \tilde{\omega}_r$: ④

$C_r^k \rightarrow \begin{cases} \pi_{r,j,k} : ⑤ \\ E_{i,j}^k \end{cases}$ Need E_{ij}^k.

⑥ : $$E_r^k = \alpha_k I_r + \alpha_k \sum_{k=1}^{K} P_r v_r^k \cdot \left[\left(\frac{l_r^k}{\hat{a}_r^k}\right)^{\frac{1}{1-\lambda}} \cdot \frac{1}{L_{r,k}}\right]$$
$$+ \sum_{k=1}^{K} \gamma_r^{k,s} \sum_{j=1}^{N} \pi_{r,j}^s E_j^s,$$

& $$I_r = \left(1 + \frac{1}{B_r}\right) \sum_{k=1}^{K} w_r^k l_r^k L_r^k.$$

⑤ → ⑦.

⑥ $\nu \sum_{r=1}^{N} \sum_{k=1}^{K} \cancel{\alpha} l_r^k L_r^k w_{rk} - \sum_{r=1}^{N} \sum_{k=1}^{K} (1-\nu) b_r w_r^k (L_r^k - L_r^k l_r^k) = 0.$

$$\therefore \nu \sum_{r=1}^{N} \sum_{k=1}^{K} l_r^k L_r^k w_r^k = (1-\nu) \sum_{r=1}^{N} \sum_{k=1}^{K} b_r w_r^k (1-l_r^k) L_r^k.$$

$$\therefore \nu \left[\sum_{r=1}^{N} \sum_{k=1}^{K} l_r^k L_r^k w_r^k + \sum_{r=1}^{N} \sum_{k=1}^{K} b_r w_r^k (1-l_r^k) L_r^k \right]$$

$$= \sum_{r=1}^{N} \sum_{k=1}^{K} b_r w_r^k (1-l_r^k) L_r^k$$

$$\nu = \frac{\sum_{r=1}^{N} \sum_{k=1}^{K} b_r w_r^k (1-l_r^k) L_r^k}{\sum_{r=1}^{N} \sum_{k=1}^{K} l_r^k L_r^k w_r^k + \sum_{r=1}^{N} \sum_{k=1}^{K} b_r w_r^k (1-l_r^k) L_r^k}.$$

$$\tilde{\omega}_r = \frac{\omega_{r,k}^k \beta_r^k}{f_{r,k}} = \frac{\frac{w_r^k}{P_r} \left[l_{r,k} + (1-l_r^k) b_r \right]}{f_{r,k}}. \quad ⑨$$

$$\& \ \frac{\cancel{\mu} L_r}{L} = \frac{B_r \tilde{\omega}_r^{\varepsilon}}{\sum_{n=1}^{N} B_n \tilde{\omega}_n^{-\varepsilon}}.$$

$$\tilde{\omega}_r P_r f_r^k = w_r^k \left[l_{r,k} + (1-l_r^k) b_r \right].$$

– Guess w_r^k, $\tilde{\omega}_r$, P_r, E_r^k.

$$\frac{\tilde{\omega}_r P_r f_r^k}{w_r} = (1-b_r) l_r^k + b_r.$$

$$\therefore (1-b_r) l_r^k = \frac{\tilde{\omega}_r P_r f_r^k}{w_r} - b_r$$

$$\therefore l_r^k = \frac{1}{1-b_r} \left[\frac{\tilde{\omega}_r P_r f_r^k}{w_r} - b_r \right].$$

→ iterate $\overset{⑩}{P_{r,k}}$ & $\overset{⑪}{C_r^k}$ → P_r^k & C_r^k. → New P_r.

→ π_{ij}^k.

→ ⑥. New E_r^k.

$$E_r^k = \alpha_k \left(1 + \frac{1}{B_r}\right) \sum_{k=1}^{K} w_r^k l_r^k L_r^k$$
$$+ \alpha_k \sum_{s=1}^{K} P_r \cdot \nu_r^s \cdot \left[\left(\frac{l_r^s}{\pi_r^s}\right)^{\frac{1}{1-\lambda}} \cdot \frac{1}{L_r^s} \right]$$
$$+ \sum_{s=1}^{K} \gamma_r^{k,s} \sum_{j=1}^{N} \pi_{r,j}^s E_j^s .$$

(suppose that I can solve this for E_r^k s exactly.

⑦ $\text{Surplus} = 0 = \sum_{j=1}^{N} \sum_{k=1}^{K} \pi_{rj}^k E_j^k - \sum_{i=1}^{N} \sum_{k=1}^{K} \pi_{ir}^k E_r^k .$

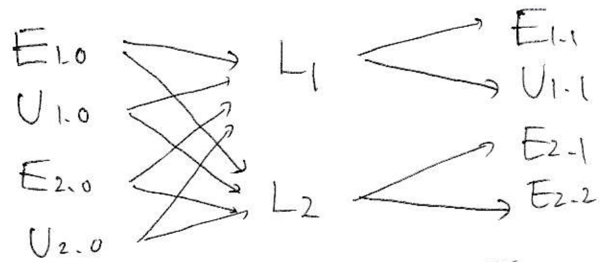
$$\sum_{t=0}^{\infty} \beta^t \log C_{i,t} + V_{i,t}^{(r,k),(r',k')} .$$

$$\cancel{V_{i,t}^{(r,k)} = \log C_{i,t}}$$
$$\cancel{V_{i,t}^{(e,r,k)} = \log (}$$

$$V_{i,t}^{(e,r)} = \log\left(\frac{w_r}{P_r}\right) + \beta \left\{ E V_{i,t+1} \right.$$

---

period 0 :
$(E_{j,0})_{j=1}^N , \quad (U_{j,0})_{j=1}^N .$



$$
\begin{array}{l}
E_{1.0} \xrightarrow{1-\chi} E_{1.1} \\
E_{1.0} \xrightarrow{\chi} L_{1.1} \\
L_{1.1} \xrightarrow{e_{1.1}} E_{1.1} \\
L_{1.1} \xrightarrow{1-e_{1.1}} U_{1.1}.
\end{array}
$$

$$v_0^{1,e} = U\left(\frac{w_0^1}{p_j^1}\right) + \max\left\{(1-\chi) v_1^{1,e} + \chi v_1^{1,u},\ \max_{j\in\{1,\dots,N\}\setminus\{1\}} E v_1^{j,L}\right\}$$

$$\cancel{E_{1.1} = (1-\chi) E_{1.0} + (L_{1.1})^{\mu} (V_{1.1})^{1-\mu}.}$$

$$v_t^{j,e} = U\left(\frac{w_t^j}{p_t^j}\right)$$

$$+\max\left\{(1-\chi) E v_{t+1}^{j,e} + \chi E v_{t+1}^{j,u} - \tau^{jj} + \nu \varepsilon_t^{jj},\ \max_{n\in\{1,\dots,N\}\setminus\{j\}} e_{t+1}^{n} E v_{t+1}^{j,e} + (1-e_{t+1}^{n}) E v_{t+1}^{j,u} - \tau^{j,n} + \nu \varepsilon_t^{j,n}\right\}$$

$$v_t^{j,u} = U(b_t^j)$$

$$+\max_{n\in\{1,\dots,N\}}\left\{e_{t+1}^{n} v_{t+1}^{n,e} + (1-e_{t+1}^{n}) v_{t-1}^{n,u} - \tau^{j,n} + \nu\varepsilon_t^{j,n}\right\}.$$

$$\mu_t^{e,j,n\neq j|e} = \frac{\exp\left(e_{t+1}^{n} V_{t+1}^{n,e} + (1-e_{t+1}^{n}) V_{t+1}^{n,u} - \tau^{j,n}\right)^{1/\nu}}{\exp\left(\chi V_{t+1}^{j,e} + (1-\chi) V_{t+1}^{j,u} - \tau^{jj}\right)^{1/\nu} + \prod_{n\neq j} \exp\left(e_{t+1}^{n} V_{t+1}^{n,e} + (1-e_{t+1}^{n}) V_{t+1}^{n,u} - \tau^{j,n}\right)^{1/\nu}}$$

$$\mu_t^{j,j|e} = \frac{\exp\left(\chi v_{t+1}^{j,e} + (1-\chi) v_{t+1}^{j,u} - \tau^{jj}\right)^{1/\nu}}{\exp\left(\chi v_{t+1}^{j,e} + (1-\chi) v_{t+1}^{j,u} - \tau^{jj}\right)^{1/\nu} + \prod_{n\neq j} \exp\left(e_{t+1}^{n} v_{t+1}^{n,e} + (1-e_{t+1}^{n}) v_{t+1}^{n,u} - \tau^{j,n}\right)^{1/\nu}}.$$

$$E_{t+1}^{j} = \chi \mu_t^{j,j|e} E_t^{j} + \underbrace{m^j (N_{t+1}^{j})^{\zeta} (V_{t+1}^{j})^{1-\zeta}}_{M_{t+1}^{j}}.$$

$$U_{t+1}^{j} = L_{t+1}^{j} - E_{t+1}^{j}$$

$$= (1-\chi)\mu_t^{j,j|e} E_t^{j} + (N_{t+1}^{j} - M_{t+1}^{j}).$$

$$L_{t+1}^{j} = \cancel{\mu_t^{j,j|e} E_t^{j}} \sum_{n=1}^{N} \mu_t^{n,j|e} E_t^{n} + \sum_{n=1}^{N} \mu_t^{n,j|u} U_t^{n}.$$

$$\mu_t^{j,n|u} = \frac{\exp\left(e_{t+1}^{n} V_{t+1}^{n,e} + (1-e_{t+1}^{n}) V_{t+1}^{n,u} - \tau^{j,n}\right)^{1/\nu}}{\sum_{l} \exp\left(e_{t+1}^{l} V_{t+1}^{l,e} + (1-e_{t+1}^{l}) V_{t+1}^{l,u} - \tau^{j,l}\right)^{1/\nu}}.$$

for any n.

$$N_{t+1}^{j} = \sum_{n \neq j} \mu_t^{n,j|e} E_t^{n} + \sum_{n} \mu_t^{n,j|u} U_t^{n}$$

$$\boxed{\text{Asp}: \ \chi > e_t^{j} \ \text{for any } t, j.}$$

$$\begin{cases} V_t^{j,e} = U\left(\frac{w_t^{j}}{P_t^{j}}\right) + \nu \log\left[\cancel{(1-\chi)} \exp\left((1-\chi) V_{t+1}^{j,e} + \chi V_{t+1}^{j,u}\right)^{1/\nu} + \sum_{n \neq j} \exp\left(e_{t+1}^{n} V_{t+1}^{n,e} + (1-e_{t+1}^{n}) V_{t+1}^{n,u}\right)^{1/\nu}\right] \\ V_t^{j,u} = U(b_t^{j}) + \nu \log\left[\sum_{n} \exp\left(e_{t+1}^{n} V_{t+1}^{n,e} + (1-e_{t+1}^{n}) V_{t+1}^{n,u}\right)^{1/\nu}\right] \end{cases}$$

Static production.

$$q_t^{j} = \Gamma_t^{j} z^{j} \left(\frac{E_t^{j}}{1-\alpha}\right)^{\alpha^{j}} \left(\frac{M_t^{j}}{\alpha}\right)^{1-\alpha} + \Delta_t^{j}.$$

unit price

$$x_t^{j} = (w_t^{j})^{\alpha} (P_t^{j})^{1-\alpha} + \Delta_t^{j}.$$

unit cost: $$c_t^{j} = \frac{(w_t^{j})^{\alpha} (P_t^{j})^{1-\alpha}}{\Gamma_t^{j} \ z^{j}}.$$

$$\boxed{\begin{array}{c} \exp\{-(z^{n})^{-\theta}\} \to 1. \\ z^{n} \to \infty \end{array}}$$

$$p_t^{n}(z^{n}) = \min_j \left\{ \kappa^{jn} c_t^{jn} \right\}.$$

$$Q_t^{n} = \left(\int_{z \in \mathbb{R}_+} \tilde{q}_t^{n}(z)^{1-1/\eta} \, d\phi(z)\right)^{\eta/(\eta-1)},$$

$$P_t^{n} = \Gamma^{n} \left(\sum_{j=1}^{N} (x_t^{j} \kappa_t^{j,n})^{-\theta} (T_t^{j})^{\theta}\right)^{-1/\theta}.$$

joint distribution

$$\phi(z) = \exp\left\{-\sum_{n=1}^{N} (z^{n})^{-\theta}\right\}.$$

$$\phi(z^{n}) = \exp\left\{-(z^{n})^{-\theta}\right\}$$

marginal dist^{n}.

$$\pi_t^{nj} = \frac{(x_t^{n}\kappa_t^{nj})^{-\theta}(T_t^{n})^{\theta}}{\sum_{m=1}^{N}(x_t^{m}\kappa_t^{mj})^{-\theta}(T_t^{m})^{\theta}}.$$

$$X_t^{nj} = (1-\alpha)\sum_{m=1}^{N}\pi_t^{jm}X_t^{m} + \cancel{w^n E_t^n \left(+ b_t^n P_t^n U_t^n\right)}.$$

Version with a constant replacement rate & a fixed federal labor income tax.

$$v_t^{j,e} = U\left((1-\tau)\frac{w_t^j}{P_t^j}\right)$$
$$+\max\Big\{\beta x\left[(1-\chi)E v_{t+1}^{j,e} + \chi E v_{t+1}^{j,u}\right] - \tau^{jj} + \nu\varepsilon_t^{jj},$$
$$\max_{n\in\{1,\dots,N\}\setminus\{j\}}\left\{\beta\left[e_{t+1}^{n}E v_{t+1}^{n,e} + (1-e_{t+1}^{n})E v_{t+1}^{n,u}\right] - \tau^{jn} + \nu\varepsilon_t^{jn}\right\}\Big\}$$

$$v_t^{j,u} = U\left(\frac{b^j w_t^j}{P_t^j}(1-\tau)\right)$$
$$+\max_n\left\{\beta\left[e_{t+1}^{n}E v_{t+1}^{n,e} + (1-e_{t+1}^{n})E v_{t+1}^{n,u}\right] - \tau^{jn} + \nu\varepsilon_t^{jn}\right\}.$$

$$\Rightarrow V_t^{j,e} = U\left((1-\tau)\frac{w_t^j}{P_t^j}\right) + \nu\log\Big[\exp\left(\beta x\left[(1-\chi)V_{t+1}^{j,e} + \chi V_{t+1}^{j,u}\right] - \tau^{jj}\right)^{1/\nu}$$
$$+\sum_{n\neq j}\exp\left(\beta x\left[e_{t+1}^{n}V_{t+1}^{n,e} + (1-e_{t+1}^{n})V_{t+1}^{n,u}\right] - \tau^{jn}\right)^{1/\nu}\Big]$$

$$V_t^{j,u} = U\left((1-\tau)\frac{b^j w_t^j}{P_t^j}\right) + \nu\log\left[\sum_{n=1}^{N}\exp\left(\beta x\left[e_{t+1}^{n}V_{t+1}^{n,e} + (1-e_{t+1}^{n})V_{t+1}^{n,u}\right] - \tau^{jn}\right)^{1/\nu}\right].$$

$$\mu_t^{j,n|e}\ (n\neq j) = \frac{\exp\left(e_{t+1}^{n}V_{t+1}^{n,e} + (1-e_{t+1}^{n})V_{t+1}^{n,u} - \tau^{jn}\right)^{1/\nu}}{\exp\left((1-\chi)V_{t+1}^{j,e} + \chi V_{t+1}^{j,u} - \tau^{jj}\right)^{1/\nu} + \sum_{n\neq j}\exp\left(e_{t+1}^{n}V_{t+1}^{n,e} + (1-e_{t+1}^{n})V_{t+1}^{n,u} - \tau^{jn}\right)^{1/\nu}}.$$

$$\mu_t^{jj|e} = \frac{\exp\left((1-\chi)V_{t+1}^{j,e} + \chi V_{t+1}^{j,u} - \tau^{jj}\right)^{1/\nu}}{\exp\left((1-\chi)V_{t+1}^{j,e} + \chi V_{t+1}^{j,u} - \tau^{jj}\right)^{1/\nu} + \sum_{n\neq j}\exp\left(e_{t+1}^{n}V_{t+1}^{n,e} + (1-e_{t+1}^{n})V_{t+1}^{n,u} - \tau^{jn}\right)^{1/\nu}}.$$

$$\mu_t^{j,n|u} = \frac{\exp\left(e_{t+1}^n V_{t+1}^{n,e} + (1-e_{t+1}^n) V_{t+1}^{n,u} - \tau^{j,n}\right)^{1/\nu}}{\sum_m \exp\left(e_{t+1}^m V_{t+1}^{m,e} + (1-e_{t+1}^n) V_{t+1}^{m,u} - \tau^{j,m}\right)^{1/\nu}}.$$

$$\phi_{t+1}^n = \frac{M_{t+1}^n}{N_{t+1}^n} = \Xi^n \left(\frac{V_{t+1}^n}{N_{t+1}^n}\right)^{1-\zeta}$$

$$= \Xi^n \left(\cancel{\theta}\lambda_{t+1}^n\right)^{1-\zeta}.$$

$$\lambda_{t+1}^n = \frac{V_{t+1}^n}{N_{t+1}^n}$$: labor market tightness.

$$e_{t+1}^n = \frac{E_{t+1}^n}{L_{t+1}^n} = \frac{\chi \mu_t^{n,n|e} E_t^n + M_{t+1}^n}{\sum_m \mu_t^{m,n|e} E_t^m + \sum_m \mu_t^{m,n|u} U_t^m}.$$

@ Production & Labor market friction.

$$C_t^{*n} = (\underbrace{w_t^n}_{+\Delta_t^n})^{\beta} (P_t^n)^{1-\beta}.$$

$$\Delta_t^n \cdot E_t^n = \nu^n \cdot \underbrace{V_t^n}_{P_{t*}^n}$$

~~predetermin~~

$$= \nu^n \cdot P_{t*}^n \cdot \cancel{\theta}\lambda_t^n \cdot N_t^n.$$ predetermined.

Think period t.

Predetermined variables in period $t-1$:

$\mu_t^{j,n|e}$, $\mu_t^{j,n|u}$, L_t^j, N_t^j.

Endogenous variables:

r_t, X_t^{nj}, V_t^j, E_t^j, U_t^j, w_t^j, P_t^j, (Δ_t^j), $\cancel{\theta}\lambda_t^j$, X_t^j, (m_t^j)

(π_t^{nj}) ~~(I_t^j)~~

X_t^{nj}	r	E	U	w	P	λ
1	N×N	N	N	N	N	N.	N

$\cancel{8}\,6 N + N^2 + 1.$

$$W_t^r = \overbrace{b^r \cdot w_t^r}^{b_t^r} + \Delta_t^r.$$

$$\Delta_t^r = (1-b^r) w_t^r.$$

Then the total labor cost is:

$$w_t^r + \Delta_t^r = (2-b^r) w_t^r.$$

$\cancel{C_t^r}$ $$q_t^r(\omega) = z_t^r(\omega) \cdot \left(\frac{\cancel{\ } E_t^r(\omega)}{1-\beta}\right)^{\beta} \left(\frac{M_t^r(\omega)}{\beta}\right)^{1-\beta}. \qquad z_t^r(\omega) \sim \text{Frechet}(T_t^r, \theta)$$

$$C_t^r = T_t^r \cdot (w_t^r + \Delta_t^r)^{\beta} (P_t^r)^{1-\beta}.$$

$$\pi_t^{nj} = \frac{(T_t^n)^{\theta} \left[(w_t^n + \Delta_t^n)^{\beta} (P_t^n)^{1-\beta} \cdot d^{nj}\right]^{-\theta}}{\sum_m (T_t^m)^{\theta} \left[(w_t^m + \Delta_t^m)^{\beta} (P_t^m)^{1-\beta} d^{mj}\right]^{-\theta}}$$

$$X_t^{j} = I_t^j + \frac{(1-\beta)}{\beta} \left[w_t^j \cdot E_t^j + \Delta_t^j E_t^j\right]$$

$$\left(\begin{aligned} &= (w_t^j E_t^j + b^j w_t^j U_t^j) \\ &\quad + \frac{1-\beta}{\beta} \left[w_t^j E_t^j + \nu^n P_t^n \theta_t^n \cdot N_t^n\right]. \end{aligned} \right) \qquad ① \; N$$

$$= (w_t^j E_t^j + b^j w_t^j U_t^j) + \frac{1-\beta}{\beta} (2-b^j) w_t^j E_t^j.$$ ← balanced trade.

$$X_t^{nj} = \pi_t^{nj} X_t^j. \qquad \pi_t^{nj} = \frac{X_t^{nj}}{X_t^j}. \qquad ② \; N \times N$$

$$P_t^n = \Gamma\left(1 + \frac{1-\sigma}{\theta}\right)^{\frac{1}{1-\sigma}} \cdot \left(\sum_{j=1}^{N} (T_t^j)^{\theta} \left[((2-b^j) w_t^j)^{\beta} (P_t^j)^{1-\beta} d^{jn}\right]^{-\theta}\right)^{-1/\theta} \qquad ③ \; N$$

$$\nu_t \sum_{n=1}^{N} \left[w_t^n E_t^n + b^r w_t^n U_t^n\right] = \sum_{n=1}^{N} b^r w_t^n U_t^n.$$

$$\nu_t = \frac{\sum_{n=1}^{N} b^r w_t^n U_t^n}{\sum_{n=1}^{N} \left[w_t^n E_t^n + b^r w_t^n U_t^n\right]} \qquad ④ \; 1$$

$$m_t^j = \Xi^j \cdot (\lambda_t^n)^{1-\xi}$$

$$\frac{M_t^j}{N_t^j}$$

$$\boxed{\lambda_t^n = \frac{V_t^n}{N_t^n}}$$

$$E_t^j = \chi \mu_{t-1}^{j,j\,le} E_{t-1}^j + M_t^j \quad (5) \sim$$

$$= \chi \mu_{t-1}^{j,j\,le} E_{t-1}^j + N_t^j m_t^j .$$

$$U_t^j = L_t^j - E_t^j . \quad (7) \sim$$

$$\Delta_t^j \cdot E_t^j = \nu^j P_t^j V_t^j$$

$$\therefore (1-b^j) w_t^j \cdot E_t^j = \nu^j P_t^j V_t^j \cdot \quad (6) \sim$$

$$= \nu^j P_t^j N_t^j \lambda_t^j$$

$$\underbrace{\cancel{w_t^j}}_{(2-b^j)w_t^j} E_t^j = \beta \cdot \sum_{n=1}^{N} \pi_{jn} X_n . \quad (8) \sim .$$

Given $\{\mu_{t-1}^{j,nle}, \mu_{t-1}^{j,nlu}, L_t^j, N_t^j, E_{t-1}^j, U_{t-1}^j\}$.

Def 1: a temporary equilibrium is

~~EI~~ $\{\iota_t, X_t^j, X_t^{nj}, E_t^{nj}, U_t^j, w_t^j, P_t^j, \lambda_t^j\}_{j=1, n=1}^{N \quad N}$ ~~given~~

such that

Not necessary

σ.

$$X_t^j = (w_t^j E_t^j + b^j w_t^j U_t^j) + \frac{1-\beta}{\beta} (2-b^j) w_t^j E_t^j \quad (1).$$

$$X_t^{nj} = \pi_t^{nj} X_t^j ,$$

where

$$\pi_t^{nj} = \frac{(T_t^n)^\theta [((2-b^j) w_t^j)^\beta (P_t^j)^{1-\beta} \cdot d^{nj}]^{-\theta}}{\sum_m (T_t^m)^\theta [((2-b^m) w_t^m)^\beta (P_t^m)^{1-\beta} d^{mj}]^{-\theta}} \quad (2)$$

$$P_t^j = G \cdot \left(\sum_{n=1}^{N} (T_t^n)^\theta [((2-b^n) w_t^n)^\beta (P_t^n)^{1-\beta} d^{nj}]^{-\theta} \right)^{-1/\theta} . \quad (3).$$

$$\iota_t = \frac{\sum_{n=1}^{N} b^n w_t^n U_t^n}{\sum_{n=1}^{N} [w_t^n E_t^n + b^n w_t^n U_t^n]} . \quad (4)$$

$$E_t^j = \chi \mu_{t-1}^{j,j|e} E_{t-1}^j + N_t^j \cdot \Xi^j (\lambda_t^j)^{1-\zeta} \qquad (5)$$

$$(1-b^{r,j}) w_t^j E_t^j = \nu^j P_t^j N_t^j \lambda_t^j \qquad (6)$$

$$U_t^j = L_t^j - E_t^j \qquad (7)$$ ← N_t necessary.

$$(2-b^j) w_t^j E_t^j = \beta \sum_{n=1}^{N} \pi_{jn} X_n \qquad (8)$$

Def 2: Given $\{L_0^j, E_0^j, U_0^j\}$, a sequential equilibrium is $\{\mu_t^{j,n|e}, \mu_t^{j,n|u}\}_{t=0}^{\infty}$, $\{V_t^{j,e}, V_t^{j,u}\}_{t=1}^{\infty}$, $\{L_t^j, E_t^j, U_t^j, N_t^j\}_{t=1}^{\infty}$, $\{\nu_t, X_t^j, X_t^{n,j}, E_t^{n,j}, w_t^j, P_t^j, \lambda_t^j\}_{t=1}^{\infty}$ s.t.

$$V_t^{j,e} = U\left((1-\nu_t)\frac{w_t^j}{P_t^j}\right) + \nu \log\Big[\exp\left(\beta\left((1-\chi)V_{t+1}^{j,e} + \chi V_{t+1}^{j,u}\right) - \tau^{j,j}\right)^{1/\nu} + \sum_{n\neq j}\exp\Big(\beta\Big(\underbrace{\Xi^n(\lambda_{t+1}^n)^{1-\zeta}}_{m_{t+1}^j} V_{t+1}^{n,e} + \left(1-\Xi^n(\lambda_{t+1}^n)^{1-\zeta}\right)V_{t+1}^{n,u}\Big) - \tau^{j,n}\Big)^{1/\nu}\Big] \qquad (a)$$

$$V_t^{j,u} = U\left((1-\nu_t)\frac{b^j w_t^j}{P_t^j}\right) + \nu\log\Big[\sum_{n=1}^{N}\exp\Big(\beta\Big(\underbrace{\Xi^n(\lambda_{t+1}^n)^{1-\zeta}}_{m_{t+1}^n} V_{t+1}^{n,e} + \left(1-\Xi^n(\lambda_{t+1}^n)^{1-\zeta}\right)V_{t+1}^{n,u}\Big) - \tau^{j,n}\Big)^{1/\nu}\Big] \qquad (b)$$

$$\mu_t^{j,n\neq j|e} = \frac{\exp\left(\beta\left(m_{t+1}^n V_{t+1}^{n,e} + (1-m_{t+1}^n)V_{t+1}^{n,u}\right) - \tau^{j,n}\right)^{1/\nu}}{\exp\left(\beta\left((1-\chi)V_{t+1}^{j,e}+\chi V_{t+1}^{j,u}\right) - \tau^{j,j}\right)^{1/\nu} + \sum_{n\neq j}\exp\left(\beta\left(m_{t+1}^n V_{t+1}^{n,e} + (1-m_{t+1}^n)V_{t+1}^{n,u}\right) - \tau^{j,n}\right)^{1/\nu}} \qquad (c)$$

$$\mu_t^{j,j|e} = \frac{\exp\left(\beta\left((1-\chi)V_{t+1}^{j,e} + \chi V_{t+1}^{j,u}\right) - \tau^{j,j}\right)^{1/\nu}}{\exp\left(\beta\left((1-\chi)V_{t+1}^{j,e}+\chi V_{t+1}^{j,u}\right) - \tau^{j,j}\right)^{1/\nu} + \sum_{n\neq j}\exp\left(\beta\left(m_{t+1}^n V_{t+1}^{n,e} + (1-m_{t+1}^n)V_{t+1}^{n,u}\right) - \tau^{j,n}\right)^{1/\nu}} \qquad (d)$$

$$\mu_t^{j,n|u} = \frac{\exp\left(\beta\left(m_{t+1}^n V_{t+1}^{n,e} + (1-m_{t+1}^n)V_{t+1}^{n,u}\right) - \tau^{j,n}\right)^{1/\nu}}{\sum_{k}\exp\left(\beta\left(m_{t+1}^k V_{t+1}^{k,e} + (1-m_{t+1}^k)V_{t+1}^{k,u}\right) - \tau^{j,k}\right)^{1/\nu}} \qquad (e)$$

$$L_t^j = \sum_{n=1}^{N}\mu_{t-1}^{n,j|e}E_{t-1}^n + \sum_{n=1}^{N}\mu_{t-1}^{n,j|u}U_{t-1}^n \qquad (f)$$

$$N_t^j = \sum_{n\neq j}\mu_{t-1}^{n,j|e}E_{t-1}^n + \sum_{n=1}^{N}\mu_{t-1}^{n,j|u}U_{t-1}^n = L_t^j - \mu_{t-1}^{j,j|e}E_{t-1}^j \qquad (g)$$

Steady state: A stationary sequilibrium is a sequential equilibrium s.t. $\{\mu_t^e, \mu_t^u, V_t^e, V_t^u, L_t, E_t, U_t, N_t, \nu_t, X_t, \pi, w_t, P_t, \lambda_t\}$ are constant for all t.

$$X^d = (1-\nu)\cdot(w^d E^d + b^d w^d U^d) + \frac{1-\beta}{\beta}(2-b^d) w^d E^d \quad (1)$$

$$X^{nd} = \pi^{nd} X^d$$

where

$$\pi^{nd} = \frac{(T^n)^\theta [((2-b^n)w^n)^\beta (P^n)^{1-\beta} d^{nd}]^{-\theta}}{\sum_m (T^m)^\theta [((2-b^m)w^m)^\beta (P^m)^{1-\beta} d^{md}]^{-\theta}} \quad (2)$$

$$P^d = G \cdot \left(\sum_{n=1}^N (T^n)^\theta [((2-b^n)w^n)^\beta (P^n)^{1-\beta} d^{nd}]^{-\theta}\right)^{-1/\theta} \quad (3) \qquad G = \left[\Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)\right]^{1/(1-\sigma)}$$

$$\nu = \frac{\sum_{n=1}^N b^n w^n U^n}{\sum_{n=1}^N [w^n E^n + b^n w^n U^n]} \quad (4)$$

$$(1-\chi\mu^{d,idle})E^d = N^d m^d.$$

$$E^d = \chi\mu^{d,idle} E^d + N^d \underbrace{\cancel{\Xi^d (\lambda^m)}}_{m^d} \quad (5)$$

$$U^d = L^d - E^d \quad (6)$$

$$m^d = \Xi^d (\lambda^m)^{1-\xi} \qquad (\lambda^m) = (\Xi^d)^{-\frac{1}{1-\xi}} (m^d)^{\frac{1}{1-\xi}} \quad (7)$$

$$(1-b^d) w^d E^d = \iota^d P^d N^d \lambda^d \quad (8)$$

$$(2-b^d) w^d E^d = \beta \sum_{n=1}^N \pi^{dn} X_n \quad (9)$$

$$V^{d,e} = U\left((1-\nu)\frac{w^d}{P^d}\right) + \nu \log\Big[\exp\left(\beta[(1-\chi)V^{d,e} + \chi V^{d,u}] - \tau^{dd}\right)^{1/\nu} + \sum_{n\neq d} \exp\left(\beta[m^d V^{n,e} + (1-m^d)V^{n,u}] - \tau^{d,n}\right)^{1/\nu}\Big] \quad (a)$$

$$V^{d,u} = U\left((1-\nu)\frac{b^d w^d}{P^d}\right) + \nu \log\Big[\sum_{n=1}^N \exp\left(\beta(m^n V^{n,e} + (1-m^n)V^{n,u}) - \tau^{d,n}\right)^{1/\nu}\Big] \quad (b)$$

$$\mu^{j,n\neq j|e} = \frac{\exp\left(\beta\left(m^n V^{n,e} + (1-m^n) V^{n,u}\right) - \tau^{j,n}\right)^{1/\lambda}}{\exp\left(\beta\left((1-\chi)V^{j,e} + \chi V^{j,u}\right) - \tau^{jj}\right)^{1/\lambda} + \sum_{m\neq j} \exp\left[\beta\left(m^m V^{m,e} + (1-m^m) V^{m,u}\right) - \tau^{j,m}\right]^{1/\lambda}} \quad (c)$$

$$\mu^{j,j|e} = \frac{\exp\left[\beta\left((1-\chi)V^{j,e} + \chi V^{j,u}\right) - \tau^{jj}\right]^{1/\lambda}}{\exp\left[\beta\left((1-\chi)V^{j,e} + \chi V^{j,u}\right) - \tau^{jj}\right]^{1/\lambda} + \sum_{n\neq j} \exp\left[\beta\left(m^n V^{n,e} + (1-m^n) V^{n,u}\right) - \tau^{j,n}\right]^{1/\lambda}} \quad (d)$$

$$\mu^{j,n|u} = \frac{\exp\left[\cancel{m}\beta\left(m^n V^{n,e} + (1-m^n) V^{n,u}\right) - \tau^{j,n}\right]^{1/\lambda}}{\sum_{k=1}^{N} \exp\left[\beta\left(m^k V^{k,e} + (1-m^k) V^{k,u}\right) - \tau^{j,k}\right]^{1/\lambda}} \quad (e)$$

$$L^j = \sum_{n=1}^{N} \mu^{n,j|e} E^n + \sum_{n=1}^{N} \mu^{n,j|u} U^n \quad (f)$$

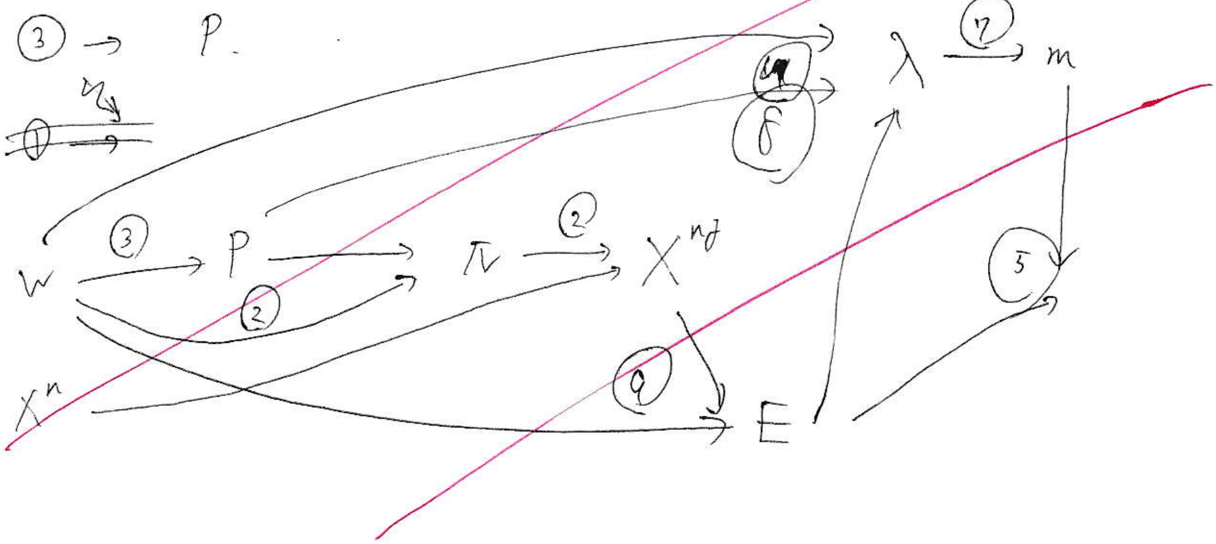
$$N^j = \sum_{n\neq j} \mu^{n,j|e} E^n + \sum_{n=1}^{N} \mu^{n,j|u} U^n \quad (g)$$
$$= L^j - \mu^{j,j|e} E^j$$

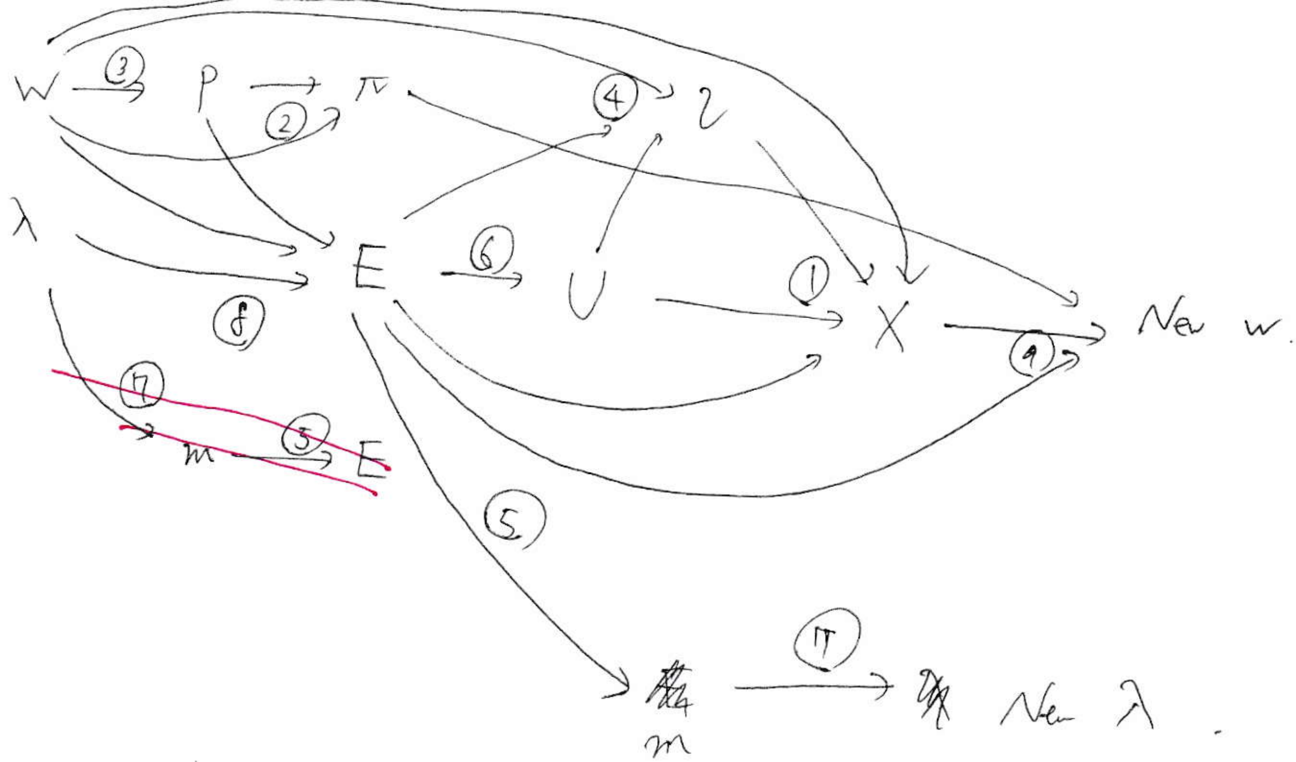
Outer loop L, N, μ, V
inner loop EK

Start w/ inner loop:

Guess w.

③ → P.





Outer loop:

~~$V^e \longrightarrow \mu^e$~~

~~$V^u \longrightarrow \mu^u$~~

Static variables that are used in the dynamic problem.

m, w, P, E, U.

V, L, N, ~~mote~~ → static problem → m, w, P, E, U

$\downarrow$ ⓐ, ⓑ

New V^e, V^u

$\downarrow$ ⓒ, ⓓ, ⓔ

New μ^e, μ^u

$\downarrow$ ⓕ, ⓖ

New L, N.

$$(P^j)^{-\theta} = \underbrace{G^{-\theta} \sum_{n=1}^{N} (T^n)^{\theta} (2-b^n)^{-\theta\beta} (w^n)^{-\theta\beta} (p^n)^{-\theta(1+\beta)} (d^{nj})^{-\theta}}_{\Phi_j}$$

$$P^j = G\, \Phi_j^{-\frac{1}{\theta}}$$

$$den(\pi^{nj}) = (T^n)^{\theta} (2-b^n)^{-\theta\beta} (w^n)^{-\theta\beta} (p^n)^{-\theta(1+\beta)} (d^{nj})^{-\theta}.$$

$$⑧ : E^j = \frac{\nu^j P^j N^j \lambda^j}{(1-b^j)\cancel{\ }\, w^j}.$$

$$⑥\quad \Delta_t^j E_t^j = \nu_t^j P_t^j \cdot \frac{\cancel{M_t^j}}{V_t}. \qquad \text{(originally)}$$

$$\frac{(1-\chi)\cancel{E_{t}}\, u_{t-1}^{idle} E_{t-1}}{V_t^j} \rightarrow \text{hire the employed last period}$$

$$\frac{M_t^j}{V_t^j} \rightarrow \text{hire (a new comer job seeker.}$$

$$\left(E^{j}_{t+1} = \cancel{\square^{j}_{t+1}} \cdot \left(a^e \mu_t^{j,j,le} E_t^j + \cancel{a^N}_{(2-a^e)} N^j_{t+1} \right)^{\zeta} \left(V^j_{t+1}\right)^{1-\zeta} . \right) \quad ア$$

$$m_t^e = \frac{M_t^e}{\mu_t^{j,j,le} E^j_{t-1}} > \frac{M_t^N}{N_t} = m_t^N .$$

$$E^j_{t+1} = \left(a^e \mu_t^{j,j,le} E_t^j + a^N N^j_{t+1} \right)^{\zeta} \left(V^j_{t+1}\right)^{1-\zeta}$$

$$\frac{E^j_{t+1}}{V^j_{t+1}} = \left(\frac{a^e \mu_t^{j,j,le} E_t^j + a^N N^j_{t+1}}{V^j_{t+1}} \right)^{\zeta}$$

$$L^j_{t+1} = \mu_t^{j,j,le} E_t^j + N^j_{t+1} .$$

Want: $m^{j,e}_{t+1} \mu_t^{j,j,le} E_t^j + m^{j,N}_{t+1} N^j_{t+1} = E^j_{t+1}$.

$$\tilde{L}^j_{t+1} = a^e \mu_t^{j,j,le} E_t^j + a^N N^j_{t+1} .$$

$$\lambda^j_{t+1} = \frac{V^j_{t+1}}{\tilde{L}_{t+1}} \quad \& \quad E^j_{t+1} = \left(\lambda^j_{t+1}\right)^{1-\zeta} .$$

$$\frac{\partial E^j_{t+1}}{\partial N^j_{t+1}} = \left(V^j_{t+1}\right)^{1-\zeta} \cdot \zeta \left(\tilde{L}_{t+1}\right)^{\zeta-1} \cdot a^N .$$

$$= \zeta \left(\lambda^j_{t+1}\right)^{1-\zeta} a^N .$$

$$\frac{\partial E^j_{t+1}}{\partial \left(\mu_t^{j,j,le} E_t^j\right)} = \zeta \left(\lambda^j_{t+1}\right)^{1-\zeta} a^e .$$

$$m^j_{t+1} \underbrace{\left(a^e \mu_t^{j,j,le} E_t^j + a^N N^j_{t+1} \right)}_{\tilde{L}^j_{t+1}} = E^j_{t+1} \qquad m^j_{t+1} = \square^j_{t+1} \left(\lambda^j_t\right)^{1-\zeta} .$$

$$e^{j,le}_{t+1} = a^e m^j_{t+1} \qquad e^{j,N}_{t+1} = a^N m^j_{t+1} .$$

- Meeting 7/7.

1. Variation in unemployment across ~~regions~~ states is larger than variation ~~across~~ over time. except for the great recession

2. a model of unemployment, trade & dynamic migration

3. scheduling a comprehensive exam.

- hiring
- separation

Robert Hall.
spatial.

hiker layoff.

cycle.

on-the-job search.

- Mogar.
- Recession.
- left
- graving attract.

- states
- graving or desirability.

- pipeline.
- high unemployment.

- whether unemployed.