# The Effect of Expected Income on Individual Migration Decisions (Kennan & Walker, 2011)

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# Motivation

- Most current models "describe patterns in the data"
- Can we build a model that allows for return migration *and* can be estimated?
- The main contribution is methodological, no insights about how migration decisions are made.
- Smart discritization allows for tractable likelihood function...
  - ... but they still have to assume that some distributions have supports of 3 points, otherwise it blows up.

# Features of the model

- Many locations: allows for non-trivial reverse migration
- Migration is search. Workers move to find out the wage in a location (only choice).
- Partial equilibrium: wages don't adjust to flows

# Wages

- Wage $w_{ij}(a) = \mu_j + v_{ij} + G\left(X_i, a, t\right) + \eta_i + \varepsilon_{ij}(a)$
  - $\mu_j$ is average wage in $j$,
    estimated outside from US Census for each age
  - $v_{ij}$ is the "match quality" that is learned once and forever, does not change. Prospects at unvisited locations are random.
  - $G(a, x, t)$ is time effect and the effects of observables
  - $\eta_i$ is individual fixed effect
  - $\varepsilon_{ij}(a)$ should be simply $\varepsilon_{ijt}$ (they just emphasize it's a different draw every year).

# Utility

- $u_h(x,j) = \alpha_0 w\left(\ell^0,\omega\right) + \sum_{k=1}^{K} \alpha_k Y_k\left(\ell^0\right) + \alpha^H \mathbb{1}\left(\ell^0 = h\right) + \xi\left(\ell^0,\omega\right) - \Delta_\tau(x,j)$
  - $\ell = (\ell^0, \ell^1, \ell^2, \ell^3, ..., \ell^{M-1})$ reflects all previously visited locations. History is limited to $M$ periods
  - $x = (\ell, \omega, a)$ is state vector: visited locations, wage and utility info obtained there, age.
  - $w(\ell^0, \omega)$ is wage in the current location, given the wage and utility information $\omega$.
  - $\sum_{k=1}^{K} \alpha_k Y_k$ is the "amenity values" at current location
  - $\alpha^H$ is the premium for being in "home" location
  - $\xi(\ell^0)$ is (individual?) location match
  - $\Delta_\tau(x,j)$ is moving cost

# Moving costs

- $\Delta_\tau(x,j) = \left(\gamma_{0\tau} + \gamma_1 D\left(\ell^0, j\right) - \gamma_2 \mathbb{1}_{j\in\mathbb{A}(\ell^0)} - \gamma_3 \mathbb{1}_{j=\ell^1} + \gamma_4 a - \gamma_5 n_j\right)\mathbb{1}_{j\neq\ell^0}$
  - $\gamma_{0\tau}$ is heterogenous, indexed by $\tau$
  - $\gamma_1$ for distance, $\gamma_2$ for adjacency, $\gamma_3$ for returning to prev. location
  - $\gamma_4$ for age
  - $\gamma_5$ for the population size in destination

# Value function

- Workers choose destination $j$

$$V(x,\zeta) = \max_j \left(u(x,j) + \zeta_j + \beta \sum_{x'} p\left(x'|x,j\right) E_\zeta V(x',\zeta)\right)$$

- If $\zeta_j \sim$ Type I EV, then

$$p(x,j) = \exp(\bar{\gamma} + u(x,j) + \beta \sum_{x'} p\left(x'|x,j\right) E_\zeta V(x',\zeta) - E_\zeta V(x,\zeta))$$

# Transition probabilities

Workers can stay, return, or move to new location:

$$p\left(x'|x,j\right)=\begin{cases}1, & \text{if } j=\ell^0, \tilde{x}'=\tilde{x}, a'=a+1\\ 1, & \text{if } j=\ell^1, \tilde{x}'=\left(\ell^1,\ell^0,x_v^1,x_v^0,x_\xi^1,x_\xi^0\right), a'=a+1\\ \frac{1}{n^2}, & \text{if } j\notin\left\{\ell^0,\ell^1\right\}, \tilde{x}'=\left(j,\ell^0,s_v,x_v^0,s_\xi,x_\xi^0\right)\\ & (1,1)\le\left(s_v,s_\xi\right)\le\left(n_v,n_\xi\right), a'=a+1\\ 0, & \text{otherwise.}\end{cases}$$

Why $\frac{1}{n^2}$? Because the support for $v_{ij}$ and for $\xi$ for have $n_v=n_\xi=n$ points.

# Data

- NLSY79, 432 people, aged 20+, 4274 person-years
- 124 Interstate moves (only 2.9% of total person years)
- Locations are States, Home state is state of residence at age 20
- $\mu_i$ from 1990 US Census (self-reported)

# Estimation

- They have to assume only one past wage is remembered, otherwise state space is too big
  - A very disappointing assumption, what kind of learning is it then?
- Distribution of match effect $v_{ij}$ is discritized, assumed symmetric and mean-zero
- $n = 3$, so $v_{ij} \in \{-\tau_v; 0, \tau_v\}$. $\tau_v$ is estimated
- "*The location match component of preferences* $[\xi]$ *is handled in similar way*"
- $n = 7$ for the person fixed effect $\eta_i$
- $n = 4$ for $\sigma_\varepsilon(i)$, individual level variance for the Worker $i$ wage, $\varepsilon(i) \sim N(0, \sigma_\varepsilon(i))$

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# Estimation: likelihood

- Everything is discritized at quartiles, so all possible realizations of $\omega^i = \{\omega^i_\xi, \omega^i_\eta, \omega^i_\varepsilon, \omega^i_v(1), ...\omega^i_v(N_i)\}$ are equally likely.
- Ind. likelihood for wage is (recall $\varepsilon(i) \sim N(0, \sigma_\varepsilon(i))$:

$$\psi_{it}\left(\omega_i, \theta_\tau\right) \quad = \frac{1}{\sigma_\varepsilon\left(\omega^i_\varepsilon\right)} \phi \left( \frac{w_{it} - \mu^0_\ell(i,t) - G\left(X_i, a_{it}, \theta_\tau\right) - v\left(\omega^i_v\left(\kappa^0_{it}\right)\right) - \eta\left(\omega^i_\eta\right)}{\sigma_\varepsilon\left(\omega^i_\varepsilon\right)} \right)$$

- Prob of indiv. history is

$$L_i\left(\theta_\tau\right) \frac{1}{n_\eta n_\varepsilon n_\xi \left(n_v\right)^{N_i}} \times \sum_{\omega^i \in \Omega(N_i)} \left( \prod_{t=1}^{T_i} \psi_{it}\left(\omega^i, \theta_\tau\right) \lambda_{it}\left(\omega^i, \theta_\tau\right) \right)$$

$$\lambda_{it}\left(\omega^i, \theta_\tau\right) = \rho_{h(i)}\left(\ell(i,t), \omega^i_v(\kappa^0_{it}), \omega^i_v(\kappa^1_{it}), \omega^i_\xi\left(\kappa^0_{it}\right)\ \omega^i_\xi(\kappa^1_{it}), a_{it}, \ell^0(i, t+1), \theta_\tau\right)$$

# Results

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Utility and cost* | | | | | | | | |
| Disutility of moving ($\gamma_0$) | 4.790 | 0.565 | 4.514 | 0.523 | 4.864 | 0.601 | 4.851 | 0.604 |
| Distance ($\gamma_1$) (1000 miles) | 0.265 | 0.182 | 0.280 | 0.178 | 0.311 | 0.187 | 0.270 | 0.184 |
| Adjacent location ($\gamma_2$) | 0.808 | 0.214 | 0.787 | 0.211 | 0.773 | 0.220 | 0.804 | 0.216 |
| Home premium ($\alpha^H$) | 0.331 | 0.041 | 0.267 | 0.031 | 0.332 | 0.047 | 0.337 | 0.045 |
| Previous location ($\gamma_3$) | 2.757 | 0.356 | 2.544 | 0.300 | 3.082 | 0.449 | 2.818 | 0.416 |
| Age ($\gamma_4$) | 0.055 | 0.020 | 0.062 | 0.019 | 0.060 | 0.020 | 0.054 | 0.020 |
| Population ($\gamma_5$) (millions) | 0.653 | 0.179 | 0.653 | 0.178 | 0.635 | 0.177 | 0.652 | 0.179 |
| Stayer probability | 0.510 | 0.078 | 0.520 | 0.079 | 0.495 | 0.087 | 0.508 | 0.082 |
| Cooling ($\alpha_1$) (1000 degree-days) | 0.055 | 0.019 | 0.036 | 0.019 | 0.048 | 0.018 | 0.056 | 0.019 |
| Income ($\alpha_0$) | 0.312 | 0.100 | – | | – | | 0.297 | 0.116 |
| Location match preference ($\tau_\xi$) | – | | – | | 0.168 | 0.049 | 0.070 | 0.099 |
| *Wages* | | | | | | | | |
| Wage intercept | −5.165 | 0.244 | −5.175 | 0.246 | −5.175 | 0.246 | −5.168 | 0.244 |
| Time trend | −0.035 | 0.008 | −0.033 | 0.008 | −0.033 | 0.008 | −0.035 | 0.008 |
| Age effect (linear) | 7.865 | 0.354 | 7.876 | 0.356 | 7.877 | 0.356 | 7.870 | 0.355 |
| Age effect (quadratic) | −2.364 | 0.129 | −2.381 | 0.130 | −2.381 | 0.130 | −2.367 | 0.129 |
| Ability (AFQT) | 0.014 | 0.065 | 0.015 | 0.066 | 0.014 | 0.066 | 0.014 | 0.065 |
| Interaction (Age, AFQT) | 0.147 | 0.040 | 0.152 | 0.040 | 0.152 | 0.040 | 0.147 | 0.040 |
| Transient s.d. 1 | 0.217 | 0.007 | 0.218 | 0.007 | 0.218 | 0.007 | 0.217 | 0.007 |
| Transient s.d. 2 | 0.375 | 0.015 | 0.375 | 0.015 | 0.375 | 0.015 | 0.375 | 0.015 |
| Transient s.d. 3 | 0.546 | 0.017 | 0.547 | 0.017 | 0.547 | 0.017 | 0.546 | 0.017 |
| Transient s.d. 4 | 1.306 | 0.028 | 1.307 | 0.028 | 1.307 | 0.028 | 1.306 | 0.028 |
| Fixed effect 1 | 0.113 | 0.035 | 0.112 | 0.035 | 0.112 | 0.035 | 0.113 | 0.035 |
| Fixed effect 2 | 0.298 | 0.035 | 0.296 | 0.035 | 0.296 | 0.035 | 0.298 | 0.035 |
| Fixed effect 3 | 0.936 | 0.017 | 0.934 | 0.017 | 0.934 | 0.017 | 0.936 | 0.017 |
| Wage match ($\tau_v$) | 0.384 | 0.017 | 0.387 | 0.018 | 0.387 | 0.018 | 0.384 | 0.018 |
| *Log likelihood* | −4,214.880 | | −4,221.426 | | −4,218.800 | | −4,214.834 | |
| Exclude income: $\chi^2(1)$ | | | 13.09 | | 7.93 | | | |
| Exclude match preference: $\chi^2(1)$ | 0.09 | | 5.25 | | | | | |

# Results-2

TABLE III

WAGE PARAMETER ESTIMATES (IN 2010 DOLLARS)

| | AFQT Percentile | | |
|---|---|---|---|
| | 25 | 50 | 75 |
| *Average wages* | | | |
| Age 20 in 1979 | 25,827 | 27,522 | 29,216 |
| Age 20 in 1989 | 18,472 | 20,166 | 21,861 |
| Age 30 in 1989 | 40,360 | 42,850 | 45,340 |

| | Low | | | Middle | | | High |
|---|---|---|---|---|---|---|---|
| Location match | −8,366 | | | 0 | | | 8,366 |
| Fixed effect support | −20,411 | −6,498 | −2,454 | 0 | 2,454 | 6,498 | 20,411 |
| State means | Low (WV) | Rank 5 (OK) | | Median (MO) | Rank 45 (RI) | | High (MD) |
| | 12,698 | 14,530 | | 16,978 | 19,276 | | 22,229 |