A Dynamic Empirical Model of Frictional Spatial Job Search

Christian Schluter and Guillaume Wilemme

(Aix Marseille School of Economics)

Low spatial mobility - an empirical puzzle ?

Why is geographic mobility across local labour markets (LLMs) so low?

1. Observe large geographical disparities within a country
   - wages, productivity and unemployment
2. but only low internal migration (and age-dependent)
   - 3% US (inter-state), 1% European (regional) p.a.
   - Molloy et al. (2014): US interstate migration rate of 3.3% for workers aged 20-24, 1.5% for workers aged 35-44, and rates of no more than 0.9% for older workers

Research objective: quantify the different channels that explain this peculiar mobility pattern: Incentives v. constraints

- gains to move: labour market outcomes, amenities
- barriers to mobility: mobility costs, information

We estimate a model of location choices with

- spatial job search frictions
- a life-cycle perspective (different investment horizons)

By interpreting job search literally as spatial search, and modelling the incentives and constraints to mobility we marry two distinct research perspectives (search and matching + urban economics).

Combining several strands in the literature

- The dynamic problem of **location choice** without search frictions: Kennan & Walker (2011)
  - How large are mobility costs? 300,000 USD for movers

Risk of bias in estimating mobility costs, since search frictions prevent instantaneous trade on markets, and searcher might receive less information about job opportunities from distant labour markets.

- location choice by homogeneous workers, with **search frictions** but without life-cycle considerations: Schmutz & Sidibé (2018)
  - 15,000 EUR with search frictions v. 100,000 without in France

- The **life cycle** with frictional labour market, without space
  - focus on the general equilibrium properties
    Chéron et al. (2013), Menzio et al. (2016)
  - focus on the empirics of workers' career
    Bagger et al. (2016)

Our contributions

We propose an equilibrium model of location choice across the life-cycle

- dynamic programming: search decisions within and across local labour markets
- constrained by spatial job search frictions: ''search-then-move"
- on-the-job search

We obtain a **tractable** model from merging two frameworks

- Search and Matching: directed search model
  -block-recursive equilibrium-
- Urban Economics: random utility model
  -closed-form solution for discrete choices-

Empirical contributions due to tractability

The tractability of our model enables us to accommodate a rich level of observed individual heterogeneity (age, education), model firm behaviour, and to consider a large number of locations.

Our model is structural estimated on French matched employer-employee administrative data using individual transitions.

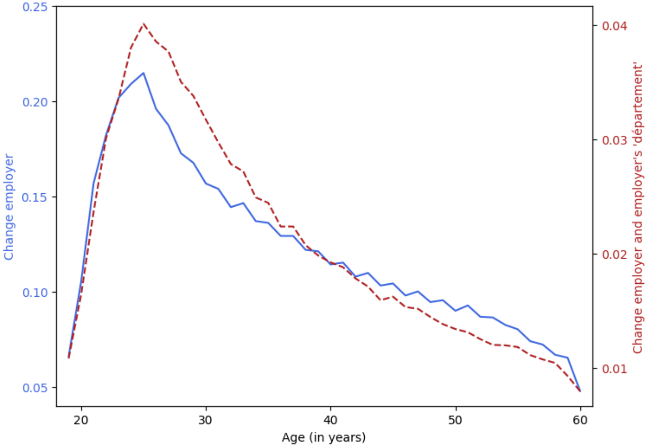
Data: An admin. French employer-employee panel

- Rich administrative data in France (DADS)
- A random sample of private-sector French workers
  - 1993-2007
- annualized data
  - considered unemployed if spent 15 days unemployed
  - define location as employer's establishment location
- unbalanced panel of 186,000 workers and 1,152,000 annual observations

Summary Statistics

	Min	Q1	Median	Mean	Q3	Max
Age at first observation (in years)	18	30	38	38.02	46	57
Mean hourly wage (EUR)	3.99	8.34	10.21	11.39	13.2	34.4
Education [%]						
No deg.				18.5		
Vocational				41.8		
High-school				17.3		
Bachelor				14.1		
>Bachelor				8.3		
# observations per individual	4	6	6	6.19	6	15
# observations as employed	0	5	6	5.61	6	15
# job transitions per individual [%]						
0 obs				56.4		
1 obs				24.4		
2 obs				13.2		
3 obs				4.3		
>3 obs				1.8		
# spatial moves per individual [%]						
0 obs				94.3		
1 obs				4.3		
2 obs				1.2		
3 obs				0.16		
>3 obs				0.03		

Job mobility, relocations, and the life-cycle



1/6 job changes implies a change in "departement"

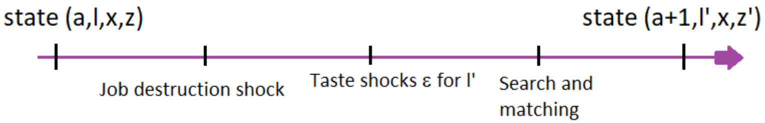
The model : The environment (1/2)

- Geography: L distinct locations
- Workers: skill x, live from age $\underline{a}$ to $\bar{a}$
- Firms: create immobile jobs within locations, with constant returns to scale
- Jobs produce $y(a, x, z)$
  - match component z is job type, drawn form location-dependent $\mathcal{F}_l(.)$
  - gives a wage to the employee

The environment (2/2)

- Workers discount expected utility, $\mathbb{E}\left[\sum_{t=a}^{\bar{a}} \beta^{t-a} u_t\right]$
- The per-period utility is the sum of 4 terms
  1. a wage or unemployment income
  2. additive local amenities
  3. a search cost, whether search is successful or not
  4. a mobility cost, if the worker changes location
- They make search decisions that affect the probability to change state from (a, l, x, z) to $(a+1, l', x, z')$
- Unemployed and employed have to find a job to move

Timing of events



1. Employed workers discover whether they will loose their job or not
2. Each worker draws preference shocks on search costs $\{\epsilon_{l'}\}$
3. Firms open vacancies, workers choose only one submarket
4. Worker-firm matches draw the job type z from $\mathcal{F}_l(.)$.

Segmentation and directed search (1/2)

- There is a segmentation by workers' characteristics (a, x)
  - a worker (a, x) in l can search like a worker (a, x) in l'
- In each location l, there are different submarkets for workers (a, x)
  - submarkets (θ, W) differs in i) the likelihood to get a job, and ii) the utility the job provides
- Search in location l is directed, as in Menzio and Shi (2011)
- Labour demand: free entry condition defines the set of submarkets

Segmentation and directed search (2/2)

- A search decision is a joint choice of
  - a location to prospect
  - a submarket (θ, W) within the location
- Search can be unsuccessful, jobs can be lost
- Workers follow search strategies
  - anticipate future search decisions

How space matters: mobility costs and spatial job search frictions

- A worker living in location l can look for a job in l' with two constraints
- Mobility costs $mc_{all'}$
  - paid when moving
  - affects the choice of submarket in favour of promised utility
- Search costs $sc_{all'} - \epsilon_{l'}$
  - paid whether search is successful or not
  - random part $\epsilon_{l'}$
- The variance of ϵ captures how random (vs directed) search across location is

Job contract and wage setting

- When firms advertise jobs, they commit on a promised expected utility W
- Bilaterally efficient contract
  - workers choose a search strategy that is optimal for both them and their current employer
  - many contingent wage profiles satisfy bilateral efficiency, wages still undetermined
- Suppose firms commit on a constant bargaining rule ρ over the employment spell
  - wages solve a Nash bargaining problem
  - submarkets differ in the bargaining rule firms propose
  - Acemoglu & Shimer (1999)

Equilibrium definition

- An equilibrium is defined by
  - Expected utilities at each state
  - Utility-maximising search decisions at each state
  - Profit-maximising job opening decisions on each submarket
  - Wages that satisfy job contracts

  –A Tree, with values and transition probabilities–

- AND a distribution of workers across space, age, employment status, job types, and wages
  –number of individuals at each node of the tree–

- A priori, solving for an equilibrium is very complex
  - optimised decisions (search and job openings) should depend on the distribution of workers, and vice versa

Tractability 1: directness of search

- First property of the model that implies tractability in estimation

  Proposition *The equations defining the first part of the equilibrium do not depend on the distribution of workers.*

- The model can be solved in two steps
  1. find the value functions and the policy functions that determine transitions probabilities and wages
  2. given an initial distribution of workers at entry age, follow a tree representation to get the full distribution of jobs and workers
- Critical reduction in numerical complexity

Tractability 2: random utility framework

- Second property of the model that implies tractability in estimation

  If the taste shocks follow an type 1 extreme value distribution, then the choice of a location to prospect and the expected utility have closed-form expressions

- Common result in discrete choice models

Parametrisations

- Job types distribution $\mathcal{F}_l$, Beta distributions
- Productivity, $\log y(a, x, z) = \alpha_1 a + \alpha_2 a + \alpha_x + z$
- Amenities v_l
- To reduce the dimensionality of the problem, we parametrise search costs

$$sc^s_{alk} = \beta^{sc}_1 + \beta^{sc}_2 \mathbf{1}(s = e) + \beta^{sc}_3 a + \beta^{sc}_4 \mathbf{1}(k \in Bord(l)) + \beta^{sc}_5 \mathbf{1}(l \neq k) + \beta^{sc}$$

and mobility costs

$$mc_{alk} = [mc_1 + mc_2 a + mc_3 \mathbf{1}(k \in Bord(l))].\mathbf{1}(k \neq l)$$

- The dummy variables $\mathbf{1}(k \in Bord(l))$ account for geographical proximity. Searching in another location, $\mathbf{1}(l \neq k)$, might be harder.

Identification (1/2)

We show formally (in the paper) how the parameters of the structural model are identified using individual level data on labour market transitions and wage changes across the life cycle, and across (and within) locations.

We have a rich set of variations to exploit:

- Wages following a transition from unemployment and from employment and life-cycle variations, by backward induction, starting with the final transition between $\bar{a} - 1$ and $\bar{a}$.
- This identifies the job quality distributions $\mathcal{F}_l$, the productivity $y(\bar{a}, z)$, vacancy costs μ_k and job destruction shocks δ_l, and
- the parameters $v_k - v_l - (1 + r)mc_{\bar{a}-1lk}$.

Identification (2/2)

- Form observable geographical transition frequencies, we identify the choice probabilities, and their variations allows us to identify $sc^{e}_{\bar{a}-1lk}$, $sc^{u}_{\bar{a}-1lk}$, and σ.
- Having previously identified $v_k - v_l - (1+r)mc_{\bar{a}-1lk}$, we can now disentangle the age-invariant amenity differentials $v_k - v_l$ from mobility costs m_{alk}, using age comparisons.
- Identification from within-job wage growth: Since within-job wage growth does not depend on the bargaining rule, one can recover the job type z.

Estimation technique (1/2): Simulation + indirect inference

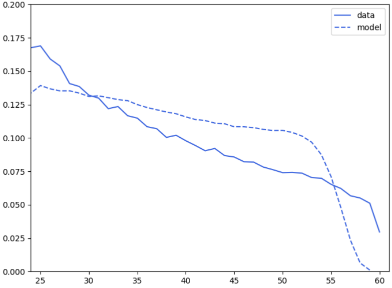
- The model is simulated.
- Data targets: transitions
  - joint observation of current location-employment-wage
  - conditional on age, education, previous location-employment-wage
- Method of moments would consist in targeting conditional expectations
  - very conservative discretisation (3 age groups, 3 wage groups) : 300,000 moments !

Estimation technique (2/2)

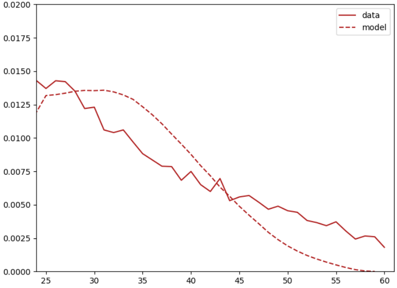
- Indirect inference method
- We proceed as follows on transitions
  - we regress: current location, current employment status, current wage
  - with regressors: past situation, age, education
  - targets are coefficients instead of conditional expectations
- We discipline the model by adding the same regressions on levels
- 1,500 coefficients

Results: Model Fit

Figure: Model fit of aggregate mobility rates (not targeted)



(a) Job mobility



(b) Geographical mobility

Spatial search frictions & moving costs, by age

Average mobility costs at 32 EUR/hour (58,000 EUR yearly), average search costs to search within the same region is 76 EUR/hour, add 436 EUR/h to search abroad.

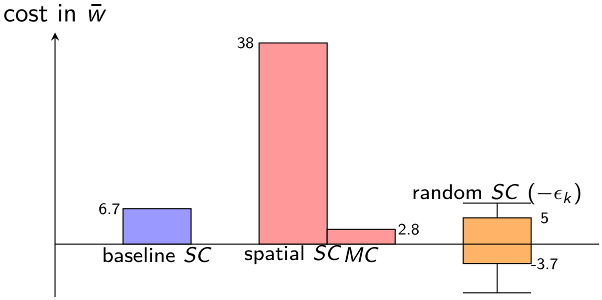


Figure: Baseline average costs at age 40, normalised by mean wage

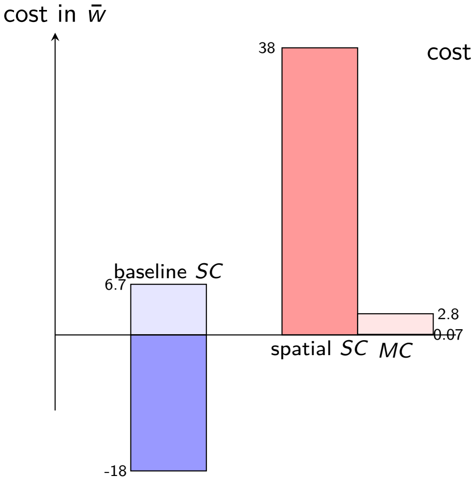


Figure: Average costs at 25

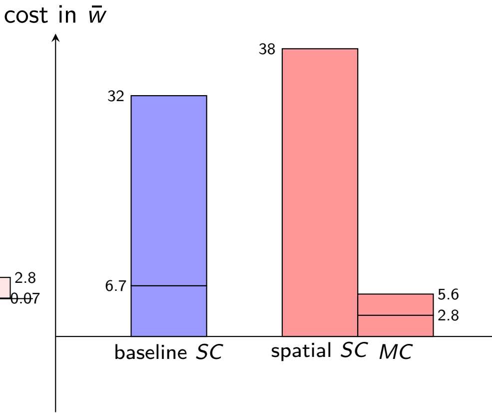


Figure: Average costs at 55

Having estimated the model, we can then study several counterfactual experiments.

- Life-cycle inequality: What is the contribution of spatial immobility?

Conclusion

- Geographical mobility is a life-cycle problem, and frictions on the labour market play a key role
- The model preserves tractability for the estimation
  - block-recursive property of directed search
  - nested random-utility framework
- Quantitative assessment on the barriers to mobility in France
  - less important than spatial job search frictions
  - increasing with age
  - but middle-age workers are the most constrained

Bellman equations: unemployment

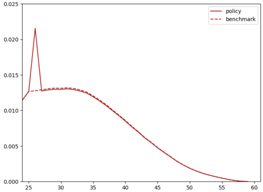
$$U_{al}(x) = b + v_l$$
$$+\mathbb{E}_\epsilon \max_{\substack{k\in\{0,..,L\} \\ (\theta,W)\in\mathcal{M}_{ak}(x)}} \Big\{ - sc^u_{alk} + \epsilon_k - p(\theta)mc_{alk} +$$
$$\frac{1}{1+r}\left[p(\theta)W + (1-p(\theta))U_{a+1,l}(x)\right]\Big\}$$

Bellman equations: employment

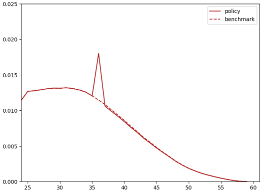
$$V_{al}(x,z) = y(a,x,z) + v_l \; + \delta_l . \mathbb{E}_\epsilon \max_{\substack{k\in\{0,..,L\} \\ (\theta,W)\in\mathcal{M}_{ak}(x)}} \Big\{ - sc^u_{alk} + \epsilon_k - p(\theta) mc_{alk} + \frac{1}{1+r}\left[p(\theta)W + (1-p(\theta))U_{a+1,l}(x)\right] \Big\}$$

$$+ (1-\delta_l) . \mathbb{E}_\epsilon \max_{\substack{k\in\{0,..,L\} \\ (\theta,W)\in\mathcal{M}_{ak}(x)}} \Big\{ - sc^e_{alk} + \epsilon_k - p(\theta) mc_{alk} + \frac{1}{1+r}\left[p(\theta)W + (1-p(\theta))V_{a+1,l}(x,z)\right] \Big\}$$

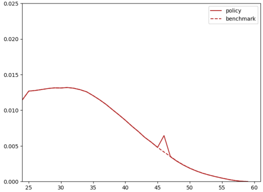
One-off subsidy 58,000 EUR to MC by age



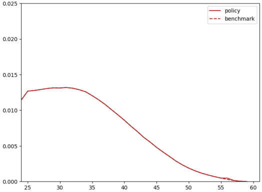
(a) Age 25



(b) Age 35

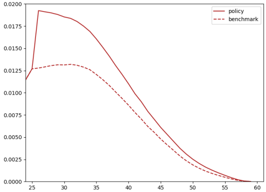


(c) Age 45

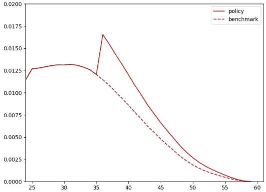


(d) Age 55

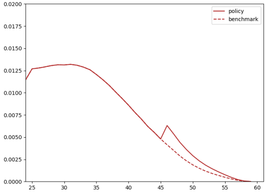
Permanent subsidy 58,000 EUR to MC by age



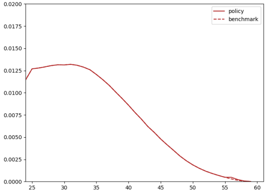
(a) Age 25



(b) Age 35



(c) Age 45



(d) Age 55