

Duration Dependence and Business Cycles

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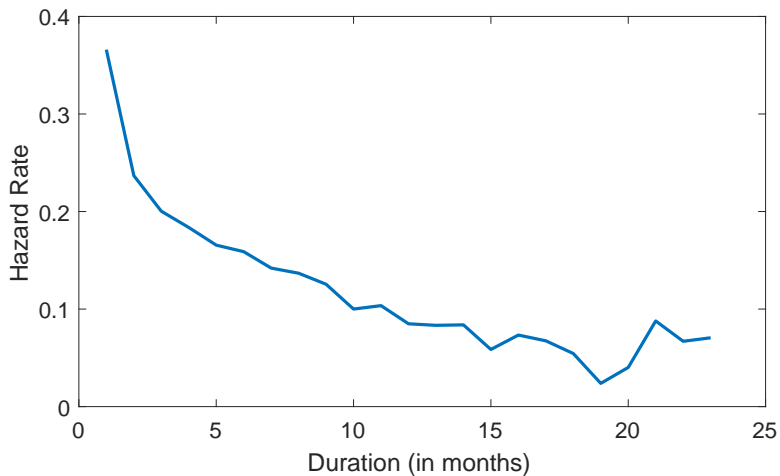
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Motivation

- ▶ Fact: Unemployment duration shows strong negative duration dependence in the US data.

Job Finding Rates by Unemployment Duration



Motivation

- ▶ Fact: Unemployment duration shows strong negative duration in the US data.
- ▶ What explains this feature?
 - ▶ Composition effect or Unobserved Heterogeneity: Good types find work quickly and leave the unemployment.
 - ▶ Skill depreciation: Workers lose their skills while unemployed.
 - ▶ Signal extraction: Firms infer about an applicant's ability by looking at his/her unemployment duration.
- ▶ Our goal is to decompose these potential channels.

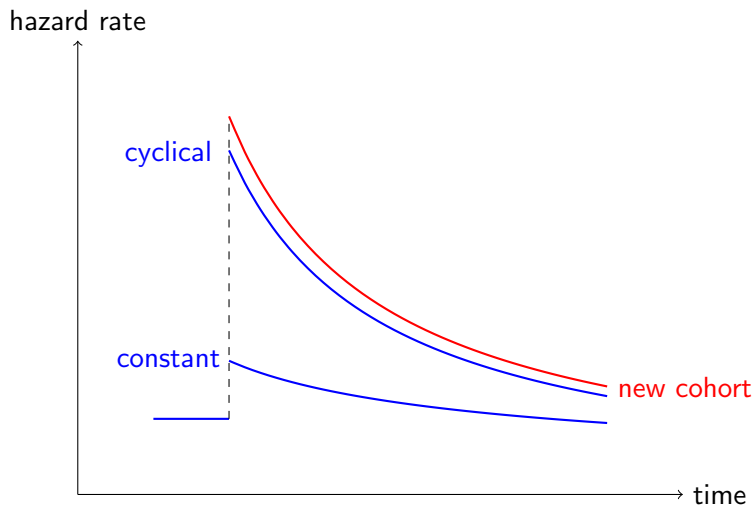
Our Goal

- ▶ Decompose these channels in a random matching model with aggregate shocks and learning about the type of unemployed.
- ▶ Identification:
 1. Skill depreciation is independent of the state of the economy.
 2. Signal extraction requires some sort of unobserved heterogeneity and is weaker in recessions (Kroft et al. (2014)).
 - ▶ Many struggle to find a job during a recession.

$$\text{resume}_{t+1} = \text{resume}_t - \gamma - \Delta h_t$$

- ▶ γ : state independent: skill depreciation.
- ▶ Δh_t : cyclical: difference in job finding rates of high and low ability workers

From Recession to Boom: Comparison of Two Cohorts



Preview

- ▶ Random matching model with aggregate shocks and learning about the type of unemployed.
 - ▶ Is matching efficiency pro-cyclical? Trending downward?
 - ▶ Barnichon and Figura (2017): Unemployment duration explains much of the fluctuations in matching efficiency (relative to a standard matching function).
 - ▶ Hall and Schulhofer-Wohl (2017): Matching efficiency is trending downward.
 - ▶ Sources of duration dependence?
 - ▶ Ross (2017) studies Bayesian updating in a (steady-state) directed search model.
 - ▶ Alvarez, Borovicka, and Shimer (2017): Decompose duration dependence in an optimal stopping time model.
- ▶ Counter-factual analysis:
 1. Shutting down statistical discrimination improves average job finding rate substantially.
 2. Job finding rates improve for long term unemployed only if both statistical discrimination and skill decay are eliminated.

Model: Overview

- ▶ Set up in continuous time.
- ▶ Labor market is frictional and segmented (denoted by i), e.g. by occupation.
- ▶ In each market segment, firms post vacancies at a flow cost of κ_i .
- ▶ Worker types (observable) are denoted by j , e.g. age, education, gender etc. No on-the-job-search.
- ▶ (Random) Matching technology: total matches are equal to $m(v_{it}, u_{it}) = \eta_i v_{it}^{1-\sigma} u_{it}^\sigma$.
 - ▶ Define market tightness: $\theta_{it} = \frac{v_{it}}{u_{it}}$.
 - ▶ Contact rate for workers: $\theta_{it} q(\theta_{it}) = \eta_i \theta_{it}^{1-\sigma}$
 - ▶ Contact rate for firms: $q(\theta_{it}) = \eta_i \theta_{it}^{-\sigma}$.
- ▶ Aggregate shocks, z_t , follow a first-order Markov process.

Model: Employment Decisions

- ▶ Two types of workers (unobservable) in each segment i :
 $s_{ji} = \{H, L\}$, e.g. skill.
- ▶ Idiosyncratic productivity shocks, ω_{jit} , follow a first-order Markov process and are skill dependent.
- ▶ $\Omega_H(\omega', \omega)$ first order stochastically dominates $\Omega_L(\omega', \omega)$.
- ▶ Firms observe the workers' *resume*: r_{jit} , probability of being a high type.
- ▶ Upon matching, worker-firm pair draws a match specific quality, q_{ji}^c , that remains constant over the course of employment.
- ▶ $q^c \sim N(\mu, 1)$ for the high productive worker and $q^c \sim N(-\mu, 1)$ for the low productive worker: High productive workers draw match specific shocks from a distribution that first-order stochastically dominates the one for low productive workers.
- ▶ Idiosyncratic productivity realizations: $q_{jit} = q_{ji}^c + \omega_{jit}$.

Model: Employment Decisions

- ▶ Denote the match surplus for a given q_{jit} at time t with $W_{jit} = W_{q,r,z}$.
 - ▶ We assume worker's have no bargaining power. Hence, the surplus function is independent of the distribution of r_{ijt} across workers.

$$\begin{aligned}\tilde{r}W_{q,r,z} = & \max(0, [y_{q,z,r} - b]) \\ & -\lambda W_{q,r,z} + \rho_z \mathbb{E}_z \max(0, W_{q,r,z'} - W_{q,r,z}) \\ & +\rho_q \mathbb{E}_q \max(0, W_{q',r',z} - W_{q,r,z})\end{aligned}$$

- ▶ \tilde{r} : discount rate.
- ▶ Output, $y_{q,z,r}$, increases in all of its arguments.
- ▶ Shocks arrive at a Poisson rate ρ_z . Firms update resumes for the employed when q changes at rate ρ_q .
- ▶ Employment decision has a cut-off property: hiring occurs if $q \geq \tilde{q}$.

Model: Hazard Rates

- ▶ The hazard rates for moving out of unemployment, respectively for H and L types, are equal to:

$$h_{jit}^H = \eta_i \theta_{it}^{1-\sigma} Pr(W_{q,r,z} \geq 0 \mid +\mu)$$

$$h_{jit}^L = \eta_i \theta_{it}^{1-\sigma} Pr(W_{q,r,z} \geq 0 \mid -\mu)$$

- ▶ Job acceptance probability: $Pr(W_{q,r,z} \geq 0 \mid \pm\mu)$
- ▶ High r workers (given true type) find jobs more quickly: their (expected) surplus is higher.
- ▶ High productive workers (given r) find jobs more quickly: they draw q^c from a more favorable distribution.

Model: Resume Updating

- ▶ Based on the differences in job finding rates, firms can infer about the true type of a worker and update the resumes accordingly.
- ▶ Define Δh_{jit} as the hazard rate differences between high and low type workers for a given resume, \hat{r} as the log of the odds ratio, $\dot{\hat{r}}$ as its time derivative. Then, **Bayesian** updating implies:

$$\dot{\hat{r}}_{jit} = -\gamma_i - \Delta h_{jit}$$

- ▶ Some high type workers become low type at Poisson rate γ_i , e.g., skill depreciation.
- ▶ Resumes are downgraded based the differences in hazard rates between high and low type workers.
 - ▶ Stronger in booms because θ_{it} is high.
 - ▶ Increases in z_t may dampen this effect: job acceptance probability may increase more for the low type workers.

Model: Free Entry

- ▶ θ_{it} is determined in equilibrium via a free-entry condition:

$$\kappa_i = \eta_i \theta_{it}^{-\sigma} \mathbb{E}_{q,z,\Gamma_i(r)} W_{q,r,z}$$

- ▶ Note that equilibrium market tightness is a function of the distribution of resumes even though the surplus function does not depend on it: $\theta_{it} = \theta_{z,\Gamma_i(r)}$.
- ▶ Finally, $\Gamma_i(r)$ evolves endogenously over time.

Data

- ▶ We use basic *monthly* files from CPS downloaded from IPUMS-CPS.
- ▶ Currently, we cover the period from Sep 95 to Dec 16. (Extend later to Jan 76).
- ▶ Individuals are interviewed on a 4-8-4 rotation system.
- ▶ Employment status (E,U,N) is reported. Unemployed individuals report their unemployment duration.
- ▶ Four occupation groups: based on IPUMS-CPS 1990 classification.
- ▶ Individual characteristics: age, education, gender, reason for unemployment, region, marital status, class of worker, race.

Data

- ▶ We measure aggregate fluctuations as log-deviations of *quarterly* GDP from its HP trend. (FRED)
- ▶ Market tightness: HWOL series from Barnichon (2010) updated to Dec 16. Available only at aggregate level.
- ▶ Productivity difference: proxy with the residuals from wage regressions obtained from ASEC Supplement.
 - ▶ Use the same individual characteristics.
 - ▶ Calculate 90-10 percentiles in residuals and set as high-low productivity.
 - ▶ Run separately for each occupation group for every year.
 - ▶ Available annually.
 - ▶ Role of skill-biased technological shocks?

Estimation

- ▶ We start by defining the *flow* value of surplus, w_{jit} , conditional on observables as follows:

$$w(q, r, z, x) = \exp(q + x\beta_x + z\beta_z + g(r)) - b,$$

where $g(r) = \log(r \exp(\omega^H) + (1 - r) \exp(\omega^L))$.

- ▶ We approximate the total surplus value as follows:

$$W(q, r, z, x) = [w(q, r, z, x) - \text{cons}] \psi(q, r, z, x)$$

- ▶ Standard DMP model: $\text{cons} = 0$ and $\psi = \frac{1}{\tilde{r} + \lambda}$.

Estimation

- ▶ Job acceptance probability becomes a linear function:

$$\begin{aligned} Pr(W(q,r,z,x) \geq 0) &= Pr(w(q,r,z,x) \geq \text{cons}) \\ &= F(x\beta_x + z\beta_z + g(r) + \text{cons}_2 \pm \mu) \end{aligned}$$

- ▶ F is the standard normal cdf.
- ▶ The hazard rates are:

$$h(q,r,z,x) = \eta_i \theta_{it}^{1-\sigma} F(x\beta_x + z\beta_z + g(r) + \text{cons}_2 \pm \mu)$$

- ▶ Given (the estimate) initial resume, r_0 , and other parameter values we can calculate the resume values for every individual at each point in time using the updating formula.
- ▶ We estimate this model with MLE.

Identification and Some Other Issues

1. Data is discrete. We update resumes every month using a discrete version of the updating formula.
2. Matching efficiency and the constant term are not identified together. We set the constant term equal to zero (calibrate?).
3. We allow r_0 to be cyclical, i.e. it depends on z .
4. Seasonal adjustment on individual weights.
5. Weights are not longitudinally consistent. Use histories only to calculate resume values. Then, treat each individual independently (logit/probit like estimation).

Identification and Some Other Issues

6. We do not observe θ_{it} .

- ▶ Assuming that κ_i is proportional to the long run average of the surplus function, W_i , the free entry conditions imply:

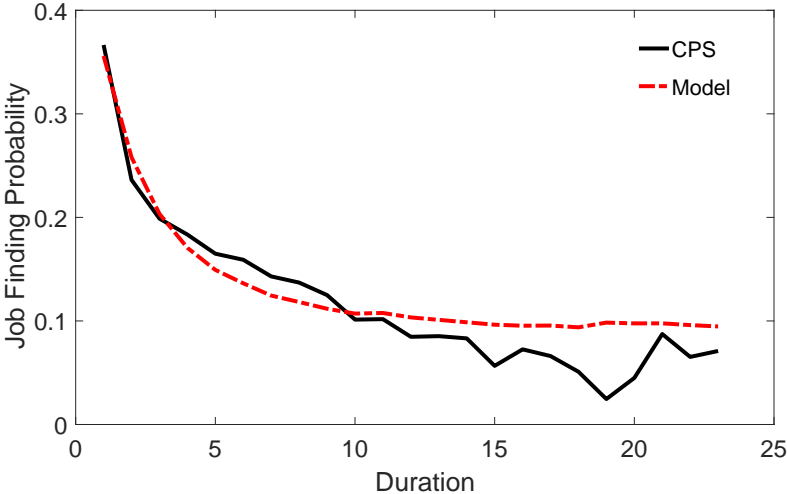
$$\theta_t = \sum_I \left(\frac{\eta_i}{\bar{\kappa}} \frac{W_{it}}{W_i} \right)^{\frac{1}{\sigma}} \frac{u_{it}}{u_i}$$

- ▶ We cannot calculate W_{jit} 's, but only follow values, w_{jit} . We assume:

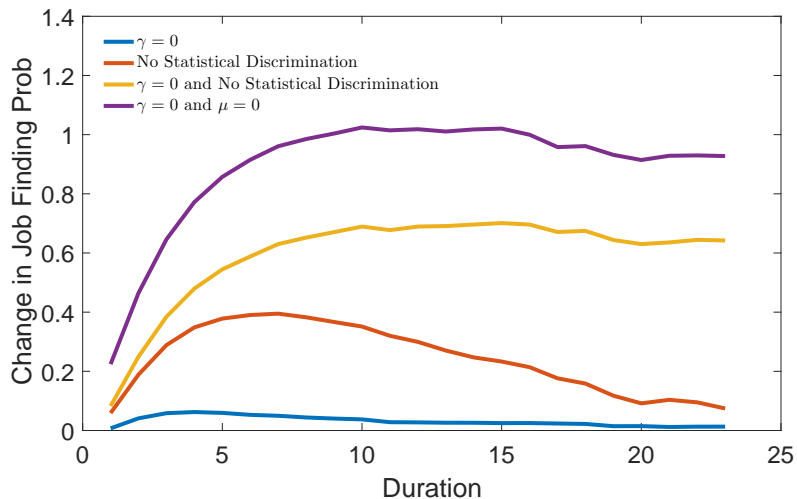
$$W_{jit} = w_{jit}^\alpha$$

- ▶ Run the regression on this equation (in logs) and choose α so that the slope is equal to 1. Calculate θ_{it} .
- ▶ Error terms? Interpret as fluctuations in $\bar{\kappa}$.

Model Fit



Counterfactual Analysis



Conclusion

- ▶ Statistical discrimination alone has a relatively bigger impact on job finding rates of short-medium term unemployed: due to increase in market tightness before skilled workers lose their skills.
- ▶ Parametrize Bayesian updating?
- ▶ Job finding rates of the long term unemployed substantially increases only if both statistical discrimination and skill decay channels are shut down.