Information Frictions in Labor Markets: Cross-Country Evidence from Employment Durations

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April 12, 2019
Motivation:

- A third of the world's population is aged 16 to 35 and lives in a less developed country.

- A large number are unemployed or, more often, underemployed in that they have fewer hours of work than they would like at prevailing wages (Behrman 1999; World Bank 2012).

- Tackling unemployment is among the highest priorities in developing countries (World Bank 2012).
Motivation: Economic Development and Labor Markets

- High self-employment (Gollin, 2002)

- Average hours worked are higher in low-income countries - Bick, Fuchs-Schündeln & Lagakos (2018)

- Unemployment does not vary systematically with income per capita - Caselli (2005)

- Ratio of unemployment to the labor force excluding self-employment is much higher in poorer countries - Poschke (2018)

  
  ▶ Exit rates 3 times higher, and
  
  ▶ Job finding rates 2 times higher.
Motivation:
Economic Development and Labor Market Flows

There are reasons to believe that high degree of labor market turnover is costly to an economy:

- High returns to tenure and low returns to experience (Lagakos et al., 2018)

- Encourages low-productivity own-account work & self-employment (Poschke, 2013 & 2016)

- Small firms are less productive (Hsieh & Klenow 2009)
Motivation: Labor Market Flows and Frictions

Credit friction

- Impedes entrepreneurship, formation of new firms, and thereby slows reallocation of labor to non-ag. (Blattman, Fiala & Martinez, 2014, Bianchi & Bobba, 2013)

Matching friction

- Job training / Skill certification RCT (Adebe et al. 2017)


- Provision of information improves allocation of jobs and employee welfare (Banerjee & Chiplunkar, 2018)
Motivation: Research question

- How does labor market turnover evolve with economic development?
- Can information frictions rationalize the observed patterns?
- Information friction:
  - speed and scope of learning about worker’s productivity in a particular job
  - symmetric for worker and employer.
Motivation: Contributions

1. Consolidate 211 household and labor force surveys for 32 countries.

2. New stylized facts on labor market turnover and development.
   - Using distribution of *ongoing* employment durations we document that:
     - Labor market turnover is higher in low income countries.
     - Job stability is lower in low income countries.
   - Estimate hazard function and distribution of *completed* durations.

3. Estimate a model of labor market turnover to match the distribution of *completed* durations.
   - Separation cost
   - Noise of signal.
   - Variance of match quality.
Motivation: Outline of talk

1. Empirical Evidence
   - Cross-country patterns of labor market turnover.
   - Based on *ongoing* employment durations.

2. Measurement
   - Link *ongoing* employment durations and hazard function
   - Link hazard functions to *completed* employment durations
   - Account for reporting biases.
   - Estimate hazard rates.

3. Model of Labor Market Turnover to disentangle potential channels:
   - Low skill dispersion
   - Information friction
A dataset of labor market turnover: Overview

Harmonized cross-country dataset of labor force and household surveys from 32 countries.

- Repeated cross-sections containing individual information on labor market outcomes and employment duration.

- Questionnaire question:
  - "When did you start this job?"
  - "How long have you been doing this job?"

- Range from Niger ($745) to US ($50'000)

ongoing rotating panels and administrative data.
<table>
<thead>
<tr>
<th>Name</th>
<th>Years</th>
<th>Sample size (in thds)</th>
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Sub-sample

Employment duration

Hours worked

Wage workers

Ind. characteristics
A dataset of labor market turnover: Employment Duration

1. **Turnover**: Share of workers with $t < 24$ months.
   - There is more labor market turnover in low income countries.

2. **Job stability**: Share of worker with less than $t < 120$ months.
   - There is less job stability in low income countries.

3. **Separation rate**: Hazard function
   - We estimate *hazard functions* and *completed durations* that are consistent with reported *ongoing* employment duration.

→ Measurement
Measurement: From ongoing durations to hazard function

Dataset: we observe a density $f_d$ of ongoing employment durations based on 1 cross-section.

Model in steady state:

- At each duration $t$, there is a separation probability $s_t$.
  \[ \dot{f}_t = -s_t f_t \]
- $E_0$ are (constant) per period employment inflows
  \[ f_t = \exp(-\int_0^t s_t \, dt) E_0 \]
- Total employment is $E = \int_{0}^{\infty} f_t \, dt$

We observe:

\[ f_{[t, \bar{t}]} = \frac{\int_{t}^{\bar{t}} f_t \, dt}{E} = \frac{\int_{t}^{\bar{t}} \exp(-\int_0^t s_t \, dt) \, dt}{\int_{0}^{\infty} \exp(-\int_0^t s_t \, dt) \, dt} \]

\[ \rightarrow \text{We assume a functional form for } s_t \text{ and estimate its parameters using data on } f_{[t, \bar{t}]} \]
Measurement: From hazard function to completed durations

Let $\bar{f}_t$ and $\bar{F}_t$ be the pdf and cdf of completed durations. The hazard function is:

$$s_t = \frac{\bar{f}_t}{1 - \bar{F}_t}$$

Integrating $s_t$ and reshuffling yields:

$$\bar{f}_t = s_t \exp\left(-\int_0^t s_t \, dt\right) = \frac{s_t f_t}{E_0}$$

Let $s$ be the average hazard. In steady state, $\frac{E_0}{E} = s$ holds. Hence:

$$\bar{f}_t = \frac{s_t f_t}{s E}$$
Measurement: Duration Reporting

Reported durations feature:

1. Rounding

2. Right-censoring

3. Heaping
   - Annual/bi-annual heaping/no heaping
   - Diebold (1997)

4. Heterogenous reporting across surveys
Measurement: A model of duration reporting

We assume that $f_t$ follows a log-logistic distribution and estimate following parameters by maximum likelihood:

1. Scale parameter ($\alpha$)
2. Shape parameter ($\beta$)
3. Misreport weight ($\delta$)
4. Distaste in over-reporting ($\lambda$)
5. Distaste in year-rounding relative to half-year rounding ($\gamma$)
Measurement: Estimated hazards

Estimated parameters shape parameter

GDP per capita ppp

USA
Measurement: Estimated hazards

Estimated parameters scale parameter

GDP per capita ppp

Estimated parameters scale parameter

0 1 2 3 4 5

GDP per capita ppp

10

4

1.1

1.2

1.3

1.4

1.5

1.6

1.7

1.8

1.9

2

2

1.1

1.2

1.3

1.4

1.5

1.6

1.7

1.8

1.9

2

USA
Measurement: Summary

- Documented stylized facts based on ongoing durations
- Linked ongoing durations to hazard rates and completed durations
- Estimated the scale and shape parameters
- We now turn to the off-the-shelf labor market turnover model
Distribution of completed employment durations are

1. hump-shaped and decrease with tenure
2. 

- DMP model: (exogenous) constant separation rate.
- counterfactual distribution of employment duration
- Jovanovic learning model of labor market turnover: endogenous separation rate.
- in line with our empirical evidence
- Suggests two channels that drive labor market turnover:
  - \( s \) How much is there to learn from employer employer matches?
  - \( \sigma \) How long does it take to learn the match quality?
- We estimate the model to our datasets and disentangle the two mechanisms.
Model:

- Model of labor market turnover (Jovanovic, 1979a)
  - No unemployment / self-employment.
  - Focus on extensive margin.

- Firm worker match quality
  - $\mu \sim \mathcal{N}(m, s)$ is a measure of the quality of the match.
  - $\mu$ is unknown when match is formed.

- Output is observed with some noise $\sigma$
  - Identical for each firm-worker match.

- Separation rate varies with employment duration.
Model: Workers

- Risk neutral & infinitely lived.

- Let $X(t)$ be the output of worker
  \[ X(t) = \mu t + \sigma z(t) \]
  where $z(t)$ is a Wiener Process.

- Draws of $\mu$ i.i.d. $\rightarrow$ firm-specific capital.
Model: Firms

- Risk neutral & maximize profits.

- Constant returns to scale technology
  - Labor is the only factor of production.

- Demand conditions are stationary.

- Labor demand
  - Competes for workers by offering wage contracts.
  - Lays-off workers by lowering wages.
At tenure $t$, a worker has cumulative output $X(t) = x$.

Available information on $\mu$ at time $t$

$$E_{x,t}(\mu) = \frac{m/s + x/\sigma^2}{1/s + t/\sigma^2}$$

$$S(t) = \frac{1}{1/s + t/\sigma^2}$$

$E_{x,t}(\mu) \sim \mathcal{N}(m, s - S(t))$

As $t \to \infty$, $S(t) \to 0$

State variables are $\{x, t\}$. 
Model: Workers

- Worker choice
  1. If stay, receives wage $w[X(t), t]$
  2. If quit, incurs job switching cost $c$

- Present value of:
  1. Quit: $Q$
  2. Job: $\alpha(Q, w[X(t), t])$

$$Q = \alpha(Q, w[X(t), t]) - c$$
Workers choose both $f$ and $h$ s.t.: Present value of a job with a firm that offers $w[X(t), t]$ when the value of quitting is $Q$:

$$\alpha(Q, [w]) = \int_{0}^{\infty} e^{-rt} \int_{-\infty}^{\infty} wh \, dx \, dt + Q \int_{0}^{\infty} e^{-rt} f \, dt$$

$h(x, t|w[X(t), t], Q) = \text{probability that the worker does not quit before } t$

$f(t|w[X(t), t], Q) = \text{the probability that the worker quits before tenure } t$

Firms maximize the discounted expected net revenue from employment of an employee with $Q$ by setting wage contract $[w]$

$$\pi(Q, w[X(t), t]) = \int_{0}^{\infty} \int_{-\infty}^{\infty} E_{xt}(\mu) h \, dx \, dt - \alpha(Q, [w]) + Q \int_{0}^{\infty} e^{-rt} f \, dt$$
The equilibrium wage contract states that the worker will be paid his expected match productivity

\[ w(t) = m + l(t) \]

\[ w(t) \sim \mathcal{N}(m, s - S(t)) \]

The endogenous equilibrium object is \( Q(s, \sigma, c) \) the value of quitting.

\[ Q^* = Q(w^*(x, t)) \]

Comparative statics \( Q(s, \sigma, c) \):

- Higher variance in match quality *increases* the value of quitting (option value).
- Higher noise *increases* the value of quitting.
- Higher separation cost *reduces* the value of quitting.
Model: Implications for employment duration

- Given $Q$ and wage policy $w$, the distribution of completed employment duration is

$$f(t) = \phi \left( \frac{rQ - m}{p(t)^{1/2}} \right) (m - rQ)p(t)^{-3/2} \frac{S(t)^2}{\sigma^2}$$

where $p(t) = s - S(t)$ is the precision of the signal at time $t$, and $\phi$ is the normal pdf.

- It is non-monotonic, with a peak in $t^*$.

- Comparative statics of $t^*$
  - Higher variance in match quality *reduces* the peak of employment duration.
  - Higher variance of noise *increases* the peak of employment duration - it takes longer to learn.
  - Higher separation cost *increases* the peak of employment duration - outside option is less attractive.
Model: Implications for returns to tenure

- Given $Q$ and wage policy $w$, the pdf of wage tenure profile $w(t)$ is:

$$w(t) = \frac{1}{\sqrt{p(t)}} \left[ \phi \left( \frac{y - m}{\sqrt{p(t)}} \right) - \phi \left( \frac{2rQ - m - y}{\sqrt{p(t)}} \right) \right]$$

where $\phi$ is the normal pdf.

- Probability of absorption decreases in $y$.

- Comparative statics of $\bar{w}$ w.r.t.
  - $s$: Higher variance increase returns to tenure
  - $\sigma$: Higher variance of noise increases returns to tenure
  - $c$: Higher separation cost lowers returns to tenure.
Calibration:

- We calibrate the model to monthly frequency.

- Use $s$ to hit return to tenure

- Use $\sigma$ and $c$ to hit distribution of employment duration

- We estimate $(s, c, \sigma)$ for each country by SMM s.t. we match the distribution of completed employment durations:

$$\min_{s,c,\sigma}(f(t|w, Q) - \bar{f}_t)1(f(t|w, Q) - \bar{f}_t)'$$
Conclusion:

- We document that labor market turnover is higher and job stability lower in low income countries for permanent wage workers in urban labor markets.

- We estimate hazard function and completed employment durations for 31 countries.

- Lean on the standard model of labor market turnover to analyze cross-country pattern of employment durations.

- Work in progress.
  - Heterogeneity: Estimate hazards controlling for individual characteristics.
  - Estimate $s, c, \sigma$ for each country.
Appendix: A Model of Duration Reporting

- The employment durations of individual $i$ follows a log-logistic distribution with scale $\alpha$ and shape parameter $\beta$:

$$D_i^* \sim F(\alpha, \beta)$$

- Each individual has some preference for reporting captured by $U_i$.

$$U_i \sim U[0, 1]$$

- An individual $i \in I$ is characterized by $(D_i^*, U_i)$ where $\{(D_i^*, U_i)\}_{i \in I}$ is i.i.d.
Appendix: A Model of Duration Reporting

Given $D_i^*$, an agent $i$ has the following choice set:

$$
C(D_i^*) = \{D_0(D_i^*), D_s,+(D_i^*), D_s,-(D_i^*), D_b,+(D_i^*), D_b,-(D_i^*)\}
$$

1. **Mere-Rounding (MR)**

2. **Small-Over-Reporting (SOR)**

3. **Small-Under-Reporting (SUR)**

4. **Big-Over-Reporting (BOR)**

5. **Big-Under-Reporting (BUR)**
Appendix: A Model of Duration Reporting

Given $D^*_i$, an agent $i$ has the following choice set:

$$
C(D^*_i) = \{ D_0(D^*_i), D_{s,+}(D^*_i), D_{s,-}(D^*_i), D_{b,+}(D^*_i), D_{b,-}(D^*_i) \}
$$

1. **Mere-Rounding (MR)** $D_0(D^*_i) = \lfloor D^*_i \rfloor$

2. **Small-Over-Reporting (SOR)**

3. **Small-Under-Reporting (SUR)**

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1. **Mere-Rounding (MR)**

2. **Small-Over-Reporting (SOR)**

   $$D_{s,+}(D_i^*) = \begin{cases} \min_{m \in \mathbb{N}} \{ c_s \cdot m : c_s \cdot m - D_i^* \geq 0, 1 \leq m \leq \bar{m} \} & \text{if } D_i^* \leq c_s \bar{m} \\ \infty & \text{otherwise} \end{cases}$$

3. **Small-Under-Reporting (SUR)**

4. **Big-Over-Reporting (BOR)**

5. **Big-Under-Reporting (BUR)**
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\[
C(D_i^*) = \{ D_0(D_i^*), D_s,(D_i^*), D_s,-(D_i^*), D_b,+(D_i^*), D_b,-(D_i^*) \}
\]

1. **Mere-Rounding (MR)**

2. **Small-Over-Reporting (SOR)**

3. **Small-Under-Reporting (SUR)**

\[
D_{s,-}(D_i^*) = \begin{cases}
\min_{m \in \mathbb{N}} \{ c_s \cdot m : D_i^* - c_s \cdot m \geq 0, 1 \leq m \leq \bar{m} \} & \text{if } D_i^* \leq c_s \bar{m} \\
\infty & \text{otherwise}
\end{cases}
\]

4. **Big-Over-Reporting (BOR)**

5. **Big-Under-Reporting (BUR)**
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1. Mere-Rounding (MR)
2. Small-Over-Reporting (SOR)
3. Small-Under-Reporting (SUR)
4. Big-Over-Reporting (BOR)
   
   \[ D_{b,+}(D_i^*) = \min_{m \in \mathbb{N}} \{ c_b \cdot m : c_b \cdot m - D_i^* \geq 0 \} \]
5. Big-Under-Reporting (BUR)
Appendix: A Model of Duration Reporting

Given $D_i^*$, an agent $i$ has the following choice set:

$$C(D_i^*) = \{D_0(D_i^*), D_s,+(D_i^*), D_s,-(D_i^*), D_b,+(D_i^*), D_b,-(D_i^*)\}$$

1. **Mere-Rounding (MR)**
2. **Small-Over-Reporting (SOR)**
3. **Small-Under-Reporting (SUR)**
4. **Big-Over-Reporting (BOR)**
5. **Big-Under-Reporting (BUR)**

$$D_{b,-}(D_i^*) = \min_{m \in \mathbb{N}} \{c_b \cdot m : D_i^* - c_b \cdot m \geq 0\}$$

Ex: parameter choice - EU LFS $c_b = 12$ - ETH

$c_s = 6, c_b = 12, \bar{m} = 6$
Appendix: A Model of Duration Reporting

Define a distance function $\rho (D^*_i, D_k)$

$$\rho (D^*_i, D_k) = \begin{cases} |D^*_i - D_0| & \text{if } D_k = D_0 (D^*_i) \\ \lambda |D^*_i - D_k| / (\delta D^2_i) & \text{if } D_k = D_{s,+} (D^*_i) \\ |D^*_i - D_k| / (\delta D^2_i) & \text{if } D_k = D_{s,-} (D^*_i) \\ \lambda \gamma |D^*_i - D_k| / (\delta D^2_i) & \text{if } D_k = D_{b,+} (D^*_i) \\ \gamma |D^*_i - D_k| / (\delta D^2_i) & \text{if } D_k = D_{b,-} (D^*_i) \end{cases}$$

The conditional probability of reporting the duration $D^*_k \in C$ given $D^*_i$ is

$$\Pr (D_k | D^*_i) = \frac{1/\rho (D^*_i, d_k)}{\sum_{k'} 1/\rho (D^*_i, d_{k'})}.$$ 

The choice is deterministic for $i$, i.e. the location of $U_i$ determines which of $D_k$ is reported.
<table>
<thead>
<tr>
<th></th>
<th>Mean employment duration</th>
<th></th>
<th>Var of employment duration, log</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>GDP per capita, log</td>
<td>13.51***</td>
<td>−13.67***</td>
<td>−21.29***</td>
</tr>
<tr>
<td></td>
<td>(1.40)</td>
<td>(5.02)</td>
<td>(6.66)</td>
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<tr>
<td>EPLEX</td>
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<td></td>
<td>−75.52</td>
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<tr>
<td></td>
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<td>(51.10)</td>
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<td>Sample average</td>
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<td>108.5</td>
<td>108.5</td>
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<td>N</td>
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<td>Year FE</td>
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<td>Observations</td>
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<tr>
<td>$R^2$</td>
<td>0.30</td>
<td>0.92</td>
<td>0.96</td>
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Note: *p<0.1; **p<0.05; ***p<0.01
## Appendix: Regressions

<table>
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<th>Employment duration</th>
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<tr>
<td>Gender</td>
<td>$-8.08^{***}$</td>
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<tr>
<td>Age 26-36</td>
<td>$45.33^{***}$</td>
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<td>(0.15)</td>
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<td>Age 36-46</td>
<td>$87.02^{***}$</td>
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<td>(0.23)</td>
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<tr>
<td>Age 46-56</td>
<td>$138.93^{***}$</td>
<td>$136.54^{***}$</td>
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<td>(0.15)</td>
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<tr>
<td>Age 56-66</td>
<td>$204.04^{***}$</td>
<td>$204.30^{***}$</td>
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<td></td>
<td>(0.18)</td>
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<td>Secondary</td>
<td>$15.56^{***}$</td>
<td>$24.50^{***}$</td>
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<td></td>
<td>(0.26)</td>
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<tr>
<td>Tertiary</td>
<td>$17.04^{***}$</td>
<td>$29.57^{***}$</td>
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<td></td>
<td>(0.26)</td>
<td>(0.28)</td>
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</table>

*Note:*  
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$
Appendix: Dataset

Mean employment duration

Definition of dependent variable: Duration in months

Sample restriction(s): Age: 15−55, wage workers, private sector, permanent jobs, urban
Appendix: Dataset

Sample restriction(s): Age: 15–55
Appendix: Dataset

Share of wage workers

Definition of dependent variable: Wage workers / (Working Population + Unemployed)

Sample restriction(s): Age: 15–55
<table>
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<th>Name</th>
<th>Years</th>
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<th>Source</th>
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</table>

Sample restriction: individuals aged 20-65, urban, permanent wage workers.
Appendix: Dataset

Percentage share with employment duration less or equal 24 months

Log[GDP per capita (PPP), Country–Mean]

Sample restriction(s): Age: 15–55, wage workers, private sector, permanent jobs, urban
Appendix: Descriptives

Percentage share with employment duration less or equal 120 months

Log[GDP per capita (PPP), Country-Mean]

Sample restriction(s): Age: 15–55, wage workers, private sector, permanent jobs, urban
Appendix: Cross-Country Dataset

Harmonize following information:

- Individual characteristics: age, education, gender.
- Employment status
- Hours worked
- Labor income
- Employment duration
- Contract type
- Industry, occupation
- Location identifiers
Appendix: Empirical model fit: ETH