Labor Market Search, Informality, and On-The-Job Human Capital Accumulation

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Motivation

- Most labor markets in developing countries are characterized by high levels of informality. Implications:
  - **Negative**: Low contributions and loss of benefits for a large portion of the labor force.
  - **Positive**: Lower negative employment effects induced by some labor market institutions.

- If informality is an optimal reaction to a given institutional context, then it is correlated with other labor market features that impact productivity.

- There is evidence on strong correlations between firm's productivity and formality status (Busso et al., 2012). An important channel is the *Distortions of firms' investment decisions* (Paula and Scheinkman, 2011; Ulyssea, 2015).

- The literature focusing on productivity and the worker side is scarce and rarely take into account workers' investment decisions.
  - Meghir et al. (2015) takes into account workers behavior and firms’ productivity but it does not allow for workers investment decision.
  - Bobba et al. (2017) focus on human capital accumulation decisions *before* entering the labor market.
This Paper

We analyze the dynamics of human capital accumulation that take place after entering the labor market when informality is high (human capital accumulation on-the-job).

Our Approach

- Develops a model where formality status and job search decisions are updated optimally when human capital levels change (upgrades or downgrades).
- Structurally estimates the model to match the Mexican labor market data.
- Performs policy experiments.

Preview of the Results

- Human capital accumulation on-the-job explains 1/3 of the overall production.
- Human capital upgrading is slower while working informally than formally (first entrants: 2 and 6 years to upgrade). Upgrading is harder the higher the level of human capital is.
- Labor market policies that encourage informality have negative effects on human capital accumulation.
This paper is related with various streams of literature.

1. **Informality**: Albrecht et.al. (2009); Bosch and Esteban-Pretel (2012); Busso et.al. (2012); Ulyssea (2015); Meghir et.al. (2015); Bobba et.al. (2017).

2. **Human Capital**: Bagger et.al. (2014); Flinn and Mullins (2015); Flinn et.al. (2017); Bobba et.al. (2017).

Institutional Setting

- **Informality**: Non-compliance with labor market regulations, particularly the failure to contribute to the social system – IMSS (Kanbur, 2009; Levy, 2008).

- Dual social security system in Mexico
  - Formal workers contribute 33% of their labor income: contributory benefits (housing, day care, pensions) + non-contributory benefits (health).
  - Informal workers (since early 2000s): non-contributory benefits (housing, retirement, pensions).

- There is no unemployment insurance and self-employment is viewed as a "necessity" labor market state (also as another searching state).

- There is a monetary penalty for hiring informally (20-350 daily minimum wage per worker). The imperfect enforcement of this rule makes informality an attractive device for firms to save labor costs.
Data

Data source: Mexico’s official labor force survey – *Encuesta Nacional de Ocupación y Empleo (ENOE)*

- Rotative panel: Households stay in the sample for 5 consecutive quarters.
- Due sample size issues, we stack two panels together (those starting in 2013q1 and in 2014q1).
- We have quarterly data on wages and labor market states that characterize the individual trajectories (job-to-job transitions).
- Sample restrictions:
  - non-agricultural, full-time, male, private-sector workers between the ages of 25 and 55 and with secondary schooling degree.
  - Outliers: earnings distributions trimmed at the top and bottom 1% in each labor market states.
- The final sample is a balanced panel dataset comprised of 3860 individual observed for 5 quarters.
**Descriptive Statistics, Cross-Section**

<table>
<thead>
<tr>
<th>Labor Market State</th>
<th>Proportions</th>
<th>Mean Hourly Wages</th>
<th>SD Hourly Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formal Employees</td>
<td>0.613</td>
<td>24.178</td>
<td>10.714</td>
</tr>
<tr>
<td>Informal Employees</td>
<td>0.223</td>
<td>18.051</td>
<td>7.101</td>
</tr>
<tr>
<td>Self-employed</td>
<td>0.123</td>
<td>22.394</td>
<td>15.449</td>
</tr>
<tr>
<td>Unemployed</td>
<td>0.041</td>
<td>.</td>
<td>.</td>
</tr>
</tbody>
</table>

**Note:** Data extracted from the first quarters of 2013 and 2014 of the Mexican labor force survey (N=3,860). Wages for employees and incomes for self-employed individuals are reported in Mexican pesos (exchange rate: 1 US dollars ≈ 13.5 Mex. pesos in 2014). The Formal status of the job is defined according to whether or not workers report having access to health care through their employers.
### Yearly Transition Rates

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Job change:</td>
<td>88.34 (Yes) 7.73</td>
<td>1.27</td>
<td>2.66</td>
<td></td>
</tr>
<tr>
<td>Formal Employee</td>
<td>88.34 7.73</td>
<td>1.27</td>
<td>2.66</td>
<td></td>
</tr>
<tr>
<td>Informal Employee</td>
<td>18.63 68.92</td>
<td>8.73</td>
<td>3.73</td>
<td></td>
</tr>
<tr>
<td>Self-employed</td>
<td>5.26 20.42</td>
<td>72.00</td>
<td>2.32</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>47.80 23.27</td>
<td>10.69</td>
<td>18.24</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Stacked panel of individuals who were followed for five quarters starting in the first quarters of 2013 and 2014 of the Mexican labor force survey (N=19,300).
### Environment of the Model

<table>
<thead>
<tr>
<th>State</th>
<th>Decision</th>
<th>Value Function</th>
<th>Shocks</th>
<th>Flow Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Workers:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemp.</td>
<td>$s = 0$</td>
<td>$V_0(k, q)$</td>
<td>$\lambda_0, \gamma_0, k$</td>
<td>$\xi + \beta_0 B_0$</td>
</tr>
<tr>
<td>Self-emp.</td>
<td>$s = 1$</td>
<td>$V_1(k, q)$</td>
<td>$\lambda_1, \gamma_1, k$</td>
<td>$q + \beta_0 B_0$</td>
</tr>
<tr>
<td>Informal Emp.</td>
<td>Y/N</td>
<td>$E_0(x; k, q)$</td>
<td>$\eta_0, \tau_0, k$</td>
<td>$w_0(x; k, q) + \beta_0 B_0$</td>
</tr>
<tr>
<td>Formal Emp.</td>
<td>Y/N</td>
<td>$E_1(x; k, q)$</td>
<td>$\eta_1, \tau_1, k$</td>
<td>$w_1(x; k, q) + \beta_1 \phi tw_1(x; k, q) + b_1$</td>
</tr>
<tr>
<td><strong>Firms:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informal Job</td>
<td>$f = 0$</td>
<td>$F_0(x; k, q)$</td>
<td>$\eta_0$</td>
<td>$a_k x - w_0(x; k, q) - ca_k x$</td>
</tr>
<tr>
<td>Formal Job</td>
<td>$f = 1$</td>
<td>$F_1(x; k, q)$</td>
<td>$\eta_1$</td>
<td>$a_k x - (1 + t)w_1(x; k, q)$</td>
</tr>
</tbody>
</table>

**Heterogeneity:** $q \sim R(q)$, $x \sim G(x)$, and $1 = a_1 < ... < a_K < \infty$. 

[Details of the Model]
The Model

Value Functions

• The flow value of the searching state in recursive form is:

\[
\tilde{\rho}_s V_s(k, q) = (1 - s) \xi + sq + \beta_0 B_0 \\
+ \lambda_s \int_x \max\{(1 - f) E_0(x; k, q) + f E_1(x; k, q) - V_s(k, q), 0\} dG(x) \\
+ \gamma_{s,k} \max\{V_0(k - 1, q) - V_s(k, q), V_1(k - 1, q) - V_s(k, q)\}
\]

• The flow value of the employee state in recursive form is:

\[
\tilde{\rho}_e E_f(x; k, q) = w_f(x; k, q) + (1 - f) \beta_0 B_0 + f [\beta_1 tw_1(x; k, q) + b_1] \\
+ \tau_{f,k} \max\{(1 - f) E_0(x; k + 1, q) + f E_1(x; k + 1, q), V_s(k + 1, q)\} - E_f(x; k, q)] \\
+ \eta_f [V_s(k, q) - E_f(x; k, q)]
\]

• The flow value of a filled job in recursive form is:

\[
\tilde{\rho}_f F_f(x; k, q) = (1 - f) \pi_0(x; k, q) - f \pi_1(x; k, q) - \eta_f F_f(x; k, q) \\
+ \tau_{f,k} \max\{F_0(x; k + 1, q), F_1(x; k + 1, q), 0\} - F_f(x; k, q))
\]
Identification

- The model is characterized by: \( \{ \rho, \delta, \tau_f, k, \gamma_s, k, \lambda_s, \eta_f, \xi, \alpha \} ; \{ G(x), R(q) \} ; \{ a_k \}_{k=1}^K ; \{ \beta_0, B_0, \phi, t, \beta_1, b_1, c \} \)

- Flinn and Heckman (1982): labor market parameters \( \{ \lambda_s, \eta_f, \xi \} \) and distributions \( G(x) \) and \( R(q) \).
  - Dynamics in the labor market + steady state conditions.
  - Recoverability condition: \( G(x) \) and \( R(q) \) are assumed Lognormal.

- Flinn et.al. (2017): Human capital dynamics \( (\tau_f, k, \gamma_s, k) \).
  - Wages growth within jobs, transitions between labor market states and changes in formality status within jobs.

\[
\tau_{f,k} \equiv \begin{cases} 
\tau_{f,1} a_k^{\tau_{f,2}} & \text{if } 1 \leq k < K \\
0 & \text{if } k = K
\end{cases}
\]

- Limited information on searching process: (1) durations and transitions over the searching states and (2) wages before and after the searching state.

\[
\gamma_{s,k} \equiv \begin{cases} 
\gamma_s & \text{if } 1 < k \leq K \\
0 & \text{if } k = 1
\end{cases}
\]

- Bobba et.al (2017): Informality parameters \( (c) \).
  - Overlapping between formal and informal wages distributions.
Estimation Method

• We estimate the parameters of the model using the Method of Simulated Moments (MSM).

\[ \hat{\Theta} = \arg\min_{\Theta} \left[ M_R(\Theta) - m_N \right]' W^{-1} \left[ M_R(\Theta) - m_N \right], \]

where:

\[ \Theta = \{ \tau_{f,1}, \tau_{f,2}, \gamma_{s,1}, \gamma_{s,2}, \lambda_s, \eta_f, \xi, \mu_x, \sigma_x, \mu_q, \sigma_q, c \}, \quad f = (0,1), s = (0,1) \]

• 62 moments \( m_N \): Labor market states, wages distributions (mean, variance and quintiles), overlapping of wages distributions, yearly transitions matrices, yearly wage growth within jobs (mean and quintiles), wage growth with a searching state in between.

• Given the size of the state space in the model we set a grid of 10 point between 1 and 3 for \( a_k \).

• Weighting Matrix \( W \): Matrix with a diagonal comprised by the bootstrapped variances of each moment.

• Fixed parameters: \( \{ \alpha, \beta_0, \beta_1, B_0, \phi, t, \rho, \delta \} \).
Results

Estimates of the Model Parameters

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{s=0}$</td>
<td>0.2995 0.01490</td>
</tr>
<tr>
<td>$\lambda_{s=1}$</td>
<td>0.0435 0.00098</td>
</tr>
<tr>
<td>$\eta_{f=0}$</td>
<td>0.0152 0.00017</td>
</tr>
<tr>
<td>$\eta_{f=1}$</td>
<td>0.0132 0.00006</td>
</tr>
<tr>
<td>$\gamma_{s=0}$</td>
<td>0.2027 0.00311</td>
</tr>
<tr>
<td>$\gamma_{s=1}$</td>
<td>0.0735 0.00294</td>
</tr>
<tr>
<td>$\tau_{f=0},1$</td>
<td>0.0160 0.00070</td>
</tr>
<tr>
<td>$\tau_{f=0},2$</td>
<td>-2.6241 0.02095</td>
</tr>
<tr>
<td>$\tau_{f=1},1$</td>
<td>0.0424 0.00229</td>
</tr>
<tr>
<td>$\tau_{f=1},2$</td>
<td>-2.7243 0.02391</td>
</tr>
<tr>
<td>$c$</td>
<td>0.1013 0.00113</td>
</tr>
<tr>
<td>$\xi$</td>
<td>-7.2292 0.10100</td>
</tr>
</tbody>
</table>

Predicted Values

<table>
<thead>
<tr>
<th>Predicted Values</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E(x)$</td>
<td>15.59</td>
</tr>
<tr>
<td>$SD(x)$</td>
<td>24.62</td>
</tr>
<tr>
<td>$E(q)$</td>
<td>8.12</td>
</tr>
<tr>
<td>$SD(q)$</td>
<td>5.69</td>
</tr>
<tr>
<td>Number of Individuals</td>
<td>3860</td>
</tr>
</tbody>
</table>
Results

Figure: Distribution of Arrival Rates of Human Capital Upgrading Shocks
Results

**Figure**: Distribution of On-The-Job Human Capital
## Results

**Output per Workers by Employment Status**

<table>
<thead>
<tr>
<th></th>
<th>Proportion Over All Employees</th>
<th>Average Value of Production</th>
<th>Contribution of Human Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Employees</strong></td>
<td>1.0000</td>
<td>42.2084</td>
<td>0.3393</td>
</tr>
<tr>
<td><strong>By Formality Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formal Employees</td>
<td>0.7099</td>
<td>52.1555</td>
<td>0.3429</td>
</tr>
<tr>
<td>Informal Employees</td>
<td>0.2901</td>
<td>17.8710</td>
<td>0.3137</td>
</tr>
<tr>
<td><strong>By Human Capital Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$a_1$</td>
<td>0.1391</td>
<td>24.6769</td>
<td>0.0000</td>
</tr>
<tr>
<td>$a_2$</td>
<td>0.2237</td>
<td>33.5628</td>
<td>0.1818</td>
</tr>
<tr>
<td>$a_3$</td>
<td>0.2359</td>
<td>39.5116</td>
<td>0.3077</td>
</tr>
<tr>
<td>$a_4$</td>
<td>0.1966</td>
<td>47.9012</td>
<td>0.4000</td>
</tr>
<tr>
<td>$a_5$</td>
<td>0.1204</td>
<td>56.6714</td>
<td>0.4706</td>
</tr>
<tr>
<td>$a_6$</td>
<td>0.0573</td>
<td>65.6566</td>
<td>0.5263</td>
</tr>
<tr>
<td>$a_7$</td>
<td>0.0217</td>
<td>70.5683</td>
<td>0.5714</td>
</tr>
<tr>
<td>$a_8$</td>
<td>0.0041</td>
<td>78.0250</td>
<td>0.6087</td>
</tr>
<tr>
<td>$a_9$</td>
<td>0.0010</td>
<td>51.1451</td>
<td>0.6400</td>
</tr>
<tr>
<td>$a_{10}$</td>
<td>0.0003</td>
<td>171.7176</td>
<td>0.6667</td>
</tr>
</tbody>
</table>

**Note:** Simulated samples of 5,000 worker-level observations for each quarter based on the estimated parameters.
Policy Experiments

- Our model incorporates the *dual social security system*: contributory benefits and non-contributory benefits.

- We focus on changes in two policy parameters:
  - The payroll contribution rate in formal jobs $t \in [0.1, 0.9]$
  - The per-capita level of the non-contributory social benefits $B_0 \in [0, 8]$ pesos per hour.

- These two parameters are considered crucial in generating the high level of informality since they directly affect the differential benefits and cost of working formally.
Policy Experiment 1: Contribution Rate

Figure: Impacts of Policy 1: Changes in the Contribution Rate $t$

(a) Informality Rates

(b) Value of Production (Benchmark = 1)

Note: Vertical lines are set at the institutional values for the Mexican labor market (2013-2014)
Policy Experiment 1: Contribution Rate

Figure: Impacts of Policy 1: Changes in the Contribution Rate \( t \) (cont...)

(a) Aggregate Human Capital (Benchmark = 1)

(b) Contribution of HC to Production

Note: Vertical lines are set at the institutional values for the Mexican labor market (2013-2014)
Policy Experiment 2: Non-contributory Benefit

Figure: Impacts of Policy 2: Changes in the Non-Contributory Benefit $B_0$

Note: Vertical lines are set at the institutional values for the Mexican labor market (2013-2014)
Policy Experiment 2: Non-contributory Benefit

**Figure:** Impacts of Policy 2: Changes in the Non-Contributory Benefit $B_0$ (cont...)

(a) Aggregate Human Capital (Benchmark = 1)  
(b) Contribution of HC to Production

**Note:** Vertical lines are set at the institutional values for the Mexican labor market (2013-2014)
Concluding Remarks

- We study how human capital accumulation in formal and informal jobs may impact labor market outcomes.

- We develop a search and matching model with endogenous formality and searching status that interact with the human capital dynamic on the job.

- We propose and implement an identification strategy for the structural parameters of the model using standard and representative labor market data for Mexico.

- The estimation results show that:
  - Human capital on the job accumulates at a lower rate when working informally.
  - The contribution of the accumulated human capital is about a third of the overall production.

- We perform policy experiments changing two crucial parameters of the social security system.
  - Higher payroll taxes reduce productivity by imposing a tax on more productive matches and also by reducing human capital upgrading on the job.
  - Higher contributions incentivize informality and reduces overall production by reducing human capital accumulation and generating lower productivity matches.
Thank you!!
The Model

Environment

- Time is continuous and the environment is stationary. Agents discount the future at rate $\rho$ and die at Poisson rate $\delta$.

- Four labor market states: unemployment, self-employment, informal employment and formal employment.

- Only unemployed and self-employed individuals search for a job. Endogenous searching status: $s \in \{0, 1\}$, with 1 indicating self-employment.

- Labor income as self-employed is $q \sim R(q)$. The flow utility while searching as unemployed is $\xi$.

- Agents meet employers at the Poisson rate $\lambda_s$ and a match-specific productivity $x \sim G(x)$ is realized upon a meeting.

- Endogenous formality status: $f \in \{0, 1\}$, with 1 indicating a formal labor contract.

- Wages are bargained bilaterally and matches are terminated at the Poisson rate $\eta_f$. 
The Model

Environment

- The human capital distribution is discrete \(1 = a_1 < \ldots < a_K < \infty\) and the total productivity of a match is \(y(x, k) = a_k x\)

- While working as employee, a worker receives human capital upgrading shocks at the Poisson rate \(\tau_f, k\).

- A searcher receives human capital downgrading shocks at the Poisson rate \(\gamma_s, k\).

- Individuals are risk neutral. Given the social security system the flow utilities are:

\[
\begin{align*}
\xi & + \beta_0 B_0 \\
q & + \beta_0 B_0 \\
w_0(x; k, q) & + \beta_0 B_0 \\
w_1(x; k, q) & + \beta_1 \phi t w_1(x; k, q) + b_1
\end{align*}
\]

- Firms post vacancies at no cost and receive a flow profit:

\[
\begin{align*}
\pi_1(x; k, q) & = y(x, k) - (1 + t) w_1(x; k, q) \\
\pi_0(x; k, q) & = y(x, k) - w_0(x; k, q) - cy(x, k)
\end{align*}
\]
The Model
Wages and Equilibrium

- Wages are set by bargaining. We use the axiomatic Nash-bargaining solution:

\[ w_f(x; k, q) = \arg \max_w [E_f(x; k, q) - V_s(k, q)]^{\alpha} [F_f(x; k, q)]^{(1-\alpha)} \]

- Formality status is decided by the firms:

\[ f \equiv f(x; k, q) = \begin{cases} 
1 & \text{if } F_1(x; k, q) \geq F_0(x; k, q) \\
0 & \text{otherwise} 
\end{cases} \quad \rightarrow \tilde{x}(k, q) : F_1(\tilde{x}; k, q) = F_0(\tilde{x}; k, q) \]

- Individual decide to search as unemployed or self-employed solving:

\[ \max_s \{ V_0(k, q), V_1(k, q) \} \rightarrow q^*(k) : V_0(k, q^*(k)) = V_1(k, q^*(k)) \]

- Acceptable matches for workers and firms:

\[ x_f^*(k, q) : F_f(x_f^*; k, q) = 0 \iff E_f(x_f^*; k, q) = V_s(k, q) \]
## The Model

### Estimation Method

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>0.5000</td>
<td>Symmetric Bargaining case (Binmore et.al., 2006)</td>
</tr>
<tr>
<td>$\beta_0$</td>
<td>0.9082</td>
<td>Bobba et.al. (2017)</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>0.6705</td>
<td>Bobba et.al. (2017)</td>
</tr>
<tr>
<td>$B_0$</td>
<td>4.2700</td>
<td>Updated from Bobba et.al. (2017)</td>
</tr>
<tr>
<td>$\phi$</td>
<td>0.5500</td>
<td>Levy (2008)</td>
</tr>
<tr>
<td>$t$</td>
<td>0.3300</td>
<td>Anton et.al. (2012)</td>
</tr>
<tr>
<td>$b_1$</td>
<td>4.5470</td>
<td>Based on average observed wages</td>
</tr>
<tr>
<td>$\rho$</td>
<td>0.0500</td>
<td>Previous literature (Eckstein and van den Berg, 2007)</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.0013</td>
<td>Based on average life of 65 years</td>
</tr>
</tbody>
</table>