Informality, Trade, and Development

Part II: A GE Model of Trade with Informality

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Based on:

“Trade and Informality in the Presence of Labor Market Frictions and Regulations” (2021)

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Penny Goldberg (Yale)
Costas Meghir (Yale)
Gabriel Ulyssea (UCL)
Review from Lecture 1

- Informality is a major feature of labor markets in developing countries.

- It represents a substantial share of the labor force in developing countries. In South America: 35% (Chile) to 80% (Peru) – Perry et al (2007).

- Broadly speaking informality reflects an attempt to bypass taxes, regulations and bureaucratic complications associated with formal firms.
  - Informal sector jobs widely considered as low quality.
Shifts into/out of informality and unemployment are important margins of adjustment to trade (e.g. McCaig and Pavcnik, 2017; Dix-Carneiro and Kovak, 2019).


Labor market effects of trade depend on stringency of labor market regulations (Ponczek and Ulyssea, 2021).
Review from Lecture 1

- Given recent empirical results (based on Diff-in-Diffs), studying the labor market and welfare effects of globalization in a model of trade with informality, unemployment and regulations is a first order question.
  - Aggregate effects
  - Welfare analysis

- Trade models typically abstract from informality
Informality

Definitions:

(i) Informal firms: those that do not register with tax authorities, invisible to the government.

(ii) Informal workers: not covered by labor regulations (no formal contract, “sem carteira assinada”).

Potential Consequences:

- Tax avoidance, hindering the provision of public goods.
- Misallocation of resources.
- Informal workers: no unemployment insurance, no employer social security contributions.
  - No job stability.
- However, informality may provide *de facto* flexibility for firms and workers to cope with adverse shocks.
Our approach

We develop an **equilibrium** model that builds on Cosar, Guner and Tybout (2016) and features:

- Heterogeneous firms choose to operate in the informal sector (but can be caught) or in the formal sector (and are subject to regulations).

- Search and matching frictions in the labor market.

- Rich institutional setting:
  - Government imposes minimum wages; firing costs; payroll and value added taxes; import tariffs.

- Taxes and labor market regulations are imperfectly enforced by the government → informality.

- International trade: (a) Imports affect **ALL** firms in the economy through aggregate demand and input-output links; (b) firms export subject to fixed export costs and variable trade costs (as in Melitz).
Our approach

- We estimate the model using several data sources from Brazil:
  - ECINF / Economia Informal Urbana – “Informality Survey”
  - RAIS / All formal sector firms and workers – Admin Data
  - SECEX – Customs data
  - PIA, PAS, PAC – Firm-level Surveys
  - PME – Household Survey, worker level

- We use the estimated model to perform counterfactual simulations to understand and quantify the effects of trade in the presence of a large informal sector.
Five Facts on Formal and Informal Firms in Brazil
(for more facts, see Ulyssea (ARE 2020)

▶ **Fact 1**: (a) Brazil has a large informal sector (48% of employment). (b) Transitions from Unemployment to Informal are more than twice as likely than transitions from Unemployment to Formal.

▶ **Fact 2**: The probability that a firm is informal declines sharply with its employment size.

▶ **Fact 3**: Informal firms are, on average, less productive than formal firms.

▶ **Fact 4**: The average informal worker is paid lower wages than the average formal worker.

▶ **Fact 5**: Firm-level labor turnover tends to decline with firm-level employment size. However, conditional on size, exporters tend to have higher turnover.
Fact 1: Informality and Transitions

Table: Employment Shares and Transition Rates

<table>
<thead>
<tr>
<th></th>
<th>Share of Workers</th>
<th>Transition Rates From Unemp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informal Tradable (Ci)</td>
<td>0.059</td>
<td>0.064</td>
</tr>
<tr>
<td>Formal Tradable (Cf)</td>
<td>0.106</td>
<td>0.050</td>
</tr>
<tr>
<td>Informal Non-Tradable (Si)</td>
<td>0.351</td>
<td>0.389</td>
</tr>
<tr>
<td>Formal Non-Tradable (Sf)</td>
<td>0.334</td>
<td>0.161</td>
</tr>
<tr>
<td>Unemployment</td>
<td>0.150</td>
<td>0.336</td>
</tr>
<tr>
<td>Share of Informal Employment</td>
<td></td>
<td>0.482</td>
</tr>
<tr>
<td>Transition Rate from Unemp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>to Informal Employment</td>
<td></td>
<td>0.453</td>
</tr>
<tr>
<td>to Formal Employment</td>
<td></td>
<td>0.211</td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td>2.146</td>
</tr>
</tbody>
</table>

Data source: 2003 PME.
Fact 5: Turnover, Firm Size and Export Status

Table: Turnover, Firm Size and Export Status

<table>
<thead>
<tr>
<th></th>
<th>C sector</th>
<th>S sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.741</td>
<td>0.645</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>log(ℓ_\text{i})</td>
<td>-0.126</td>
<td>-0.096</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Exporter_i (Dummy)</td>
<td>0.071</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>20,342</td>
<td>147,936</td>
</tr>
</tbody>
</table>

Data Sources: 2003 and 2004 RAIS and 2003 SECEX. Turnover of firm \( i \) between 2003 and 2004 measured as: \( \text{Turnover}_i = \frac{|\ell_{i,2004} - \ell_{i,2003}|}{0.5 \times (\ell_{i,2004} + \ell_{i,2003})} \). Standard errors in parentheses.
The Model

- Economy is populated by homogeneous, infinitely-lived workers-consumers with utility

\[
U = \sum_{t=1}^{\infty} \frac{C_t S_t^{1-\zeta}}{(1 + r)^t}
\]

\[
C_t = \left( \int_{0}^{N_{C_t}} c_t(n) \frac{\sigma_{C-1}}{\sigma_C} \, dn \right)^{\frac{\sigma_C}{\sigma_{C-1}}}
\]

\[
S_t = \left( \int_{0}^{N_{S_t}} s_t(n) \frac{\sigma_{S-1}}{\sigma_S} \, dn \right)^{\frac{\sigma_S}{\sigma_{S-1}}}
\]

- \(C = \) Manufacturing / tradable
- \(S = \) Services / non-tradable
The Model

- Sector $k \in \{C, S\}$ goods are produced by heterogeneous firms, which produce a unique variety using labor $\ell$ and intermediate $\nu_k$ inputs:

$$q = z^\delta \nu_k^{1-\delta}; \quad \nu_k = im_C^\lambda im_S^{1-\lambda}$$

- $im_C$ and $im_S$ are CES aggregates of tradable (C) and non-tradable (S) varieties.

- Intermediate inputs play a key role in transmitting changes in trade openness to the entire economy.

- Firm’s productivity follows a AR(1) process:

$$\ln z' = \rho_k \ln z + \epsilon_k^z, \quad k = C, S$$
Timing: Incumbents

- Period $t$ starts

  - Informal Firm
    - $V_{ki}(z, \ell)$
      - Stays Informal
      - Exits
  - Formal Firm
    - $V_{kf}(z, \ell)$
      - Stays Formal
      - Becomes Formal
      - Exits

- Period $t+1$ starts

  - Chooses $\ell'$
  - $\pi_{ki}(z, \ell, \ell')$
  - Draws $z'$
  - $V_{ki}(z', \ell')$
  - $\pi_{kf}(z, \ell, \ell')$
  - Draws $z'$
  - $V_{kf}(z', \ell')$

- Stage 1
- Stage 2
- Stage 3
Mass $M_k$ of entrants into sector $k$ pay an entry cost $c_{e,k}$, draw $z$ from the ergodic distribution of prod. + Free Entry.
Profit functions

▶ Formal firms:

\[ \pi_{kf} (z, \ell, \ell') = (1 - \tau_y) VA_k (z, \ell') - C_{kf} (z, \ell, \ell') - \bar{c}_k \]

▶ Variable costs:

\[ C_{kf} (z, \ell, \ell') = \begin{cases} 
(1 + \tau_w) \max \{w_{kf} (z, \ell'), w\} \ell' + H_{kf} (\ell, \ell') & \text{if } \ell' > \ell \\
(1 + \tau_w) \max \{w_{kf} (z, \ell'), w\} \ell' + \kappa (\ell - \ell') & \text{if } \ell' \leq \ell 
\end{cases} \]

▶ Wage bill is bounded below by the minimum wage
▶ Expanding firms pay hiring costs
▶ Contracting firms pay firing costs
Profit functions

- Informal firms:

\[ \pi_{ki} (z, \ell, \ell') = VA_k (z, \ell') - K_{inf}^{inf} (z, \ell') - C_{ki} (z, \ell, \ell') - \bar{c}_k, \]

\[ C_{ki} (z, \ell, \ell') = \begin{cases} 
  w_{ki} (z, \ell') \ell' + H_{ki} (\ell, \ell') & \text{if } \ell' > \ell \\
  w_{ki} (z, \ell') \ell' & \text{if } \ell' \leq \ell, 
\end{cases} \]

- No minimum wage, No firing costs and No taxes
Revenues and Value Added

- Monopolistic Competition + Intermediate Input Usage ⇒ Value Added of firm with productivity $z$ and employment $\ell$:

$$VA_k (z, \ell) = \Psi_k (z \ell \delta_k)^{\Lambda_k}$$

- Demand shifter $\Psi_k$ depends on both $P_C$ and $P_S$ (intermediates) and aggregate income.
Hiring costs

- Cost of expanding from $\ell$ to $\ell'$ workers

\[ H_{kj} (\ell, \ell') = (\mu_{kj})^{-\gamma_{k1}} \times \left( \frac{h_k}{\gamma_{k1}} \right) \times \left( \frac{\ell' - \ell}{\ell \gamma_{k2}} \right)^{\gamma_{k1}} \]

$\mu_{kj}$ = Prob. of filling a vacancy in $k$, $j$

- Nature of hiring costs is important to generate:
  - Firm-level turnover declines with firm size.
  - Wage dispersion across firms.
Search and Matching

- Workers are matched to firms/vacancies randomly (random matching).

- Wages are determined by Nash bargaining.

- Search frictions \(\Rightarrow\) informal/unproductive firms are able to keep workers at lower wages (as long as they are above the worker’s reservation wage).
Search and Matching

- To expand (in expectation) from $\ell$ to $\ell'$ firms post vacancies
- Firm vacancies and the number of unemployed workers determine the number of matches that will occur through the matching function.
  - Total number of matches in the economy:
    \[ m(v_{Cf}, v_{Ci}, v_{Sf}, v_{Si}, L_u) = \phi \tilde{\nu}^{\xi} L_u^{1-\xi} \]
    \[ \tilde{\nu} = v_{Cf} + v_{Ci} + v_{Sf} + v_{Si} \]
  - Matches in each sector are proportional to the relative number of vacancies they post
    \[ m_{kj} = \frac{v_{kj}}{\tilde{\nu}} m(v_{Cf}, v_{Ci}, v_{Sf}, v_{Si}, L_u) \]
Open Economy

- Small open economy model: aggregate conditions abroad are fixed + set of imported goods is fixed.

- Manufacturing \((C)\) sector firms choose how much to export given foreign demand. Need to pay fixed cost \(f_x\) to export.

- Export decision

\[
\mathcal{I}_C^x (z, \ell') = \begin{cases} 
1 & \text{if } VA_C^x (z, \ell') - f_x > VA_C^d (z, \ell') \\
0 & \text{otherwise}
\end{cases}
\]

- Intermediate inputs / IO linkages \(\Rightarrow\) Direct transmission of trade shocks to \(S\) and informal sector firms.
Open Economy

- **Value Added Domestic Producers:**
  \[ VA_C^d (z, \ell) = \Psi_C \left( z\ell^{\delta_C} \right)^{\Lambda_C} \]

- **Value Added Exporters:**
  \[ VA_C^x (z, \ell) = \left( \exp (d_F) \right)^{\frac{\sigma_C}{\sigma_C - 1} \Lambda_C} \times VA_C^d (z, \ell) \]

Trade costs / tariffs affect domestic demand shifters \( \Psi_C \) (for formal and informal firms) and foreign demand \( d_F \).

- But also \( \Psi_S \).
Equilibrium

- Firms act optimally and make entry, exit decisions and post vacancies.
- Free entry.
- Wages solve bargaining problem between workers and the firm.
- Labor markets clear.
- Goods markets clear.
- Steady state: distribution of firms, number of firms, number of workers in each sector are stable.
Mechanisms

▶ Several mechanisms, pushing effects of trade in different directions.

▶ Melitz-type effects / Productivity thresholds*
  ▶ $\tau_a, \tau_c \downarrow \Rightarrow$ demand for purely domestic firms ↓, but ↑ for exporters.
    ▶ Least productive *formal* firms exit, replaced by informal firms ⇒ ↑ informality.
    ▶ Least productive *informal* firms exit ⇒ ↓ informality.
  ▶ Cheaper intermediates ⇒ ↑ worker productivity
    ▶ Most productive informal firms grow and formalize ⇒ ↓ informality.
    ▶ Higher income and demand ⇒ ↑ entry low productivity informal firms ⇒ ↑ informality.

* Abuse of language to provide intuition: decisions depend on both prod. $z$ and size $\ell$. 
Channels linking trade to unemployment have implications for the relative size of the informal sector. Transitions $U \rightarrow I$ twice as likely as transitions $U \rightarrow F$.

- Turnover at exporters is larger, conditional on size.
- Lower trade barriers reallocate resources toward exporters, who also become more sensitive to idiosyncratic shocks ($d_F \uparrow$)
- $\uparrow$ Turnover in $C$, increasing unemployment.
Estimation Strategy

We use Indirect Inference to estimate 27 parameters using 84 data moments and auxiliary model coefficients.
Figure: Trade and Informality

- In C: reduction in demand for purely-domestic firms ⇒ low-productivity formal firms → informality, but also low-productivity informal firms exit.

- In S: increased income and demand propelled by C sector ⇒ entry of low-productivity informal firms, but also formalization of high-productivity informal firms.
Figure: Trade, Unemployment and Welfare

- $\tau_c \downarrow \Rightarrow$ resources reallocated toward larger firms (both in $C$ and $S$) \Rightarrow less turnover as larger firms tend to be more stable.

- However, resources reallocated towards exporters, and $d_F \uparrow \Rightarrow$ more turnover.

- $\uparrow$ turnover associated with $\uparrow$ unemployment.
Trade drives highly unproductive informal $C$ sector firms out of the market, freeing up resources to be reallocated to more productive formal ones.

In $S$: $\tau_c \downarrow \Rightarrow$ unproductive informal firms enter. Mitigates productivity gain in the formal $S$. 
Figure: Trade and the Std. Dev. of log-Wages Across Workers in the $C$ sector

\[ \tau_c \downarrow \Rightarrow \text{Wage inequality} \uparrow \text{ in the formal } C \text{ sector. Wage exporter premium} \uparrow. \]

\[ \text{Consistent with Cosar et al (2016), Helpman et al (2017).} \]

\[ \text{However, inequality within the informal sector} \downarrow + \text{ between-sector differences} \downarrow. \]
Figure: Costs of Informality: Benchmark and Stricter Enforcement

Notes: $p_{Ci}(\ell)$ and $p_{Si}(\ell)$ are plotted against $\ell$ under the benchmark case and under the stricter enforcement policy.
### Table: Effects of Increasing the Cost of Informality

<table>
<thead>
<tr>
<th></th>
<th>Benchmark</th>
<th>Stricter Enforcement</th>
<th>No Informality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment Rate</td>
<td>0.183</td>
<td>0.184</td>
<td>0.326</td>
</tr>
<tr>
<td>Share Emp. $Ci$</td>
<td>0.081</td>
<td>0.050</td>
<td>0</td>
</tr>
<tr>
<td>Share Emp. $Cf$</td>
<td>0.100</td>
<td>0.124</td>
<td>0.201</td>
</tr>
<tr>
<td>Share Emp. $Si$</td>
<td>0.417</td>
<td>0.313</td>
<td>0</td>
</tr>
<tr>
<td>Share Emp. $Sf$</td>
<td>0.402</td>
<td>0.514</td>
<td>0.799</td>
</tr>
<tr>
<td>Share Informal Emp.</td>
<td>0.498</td>
<td>0.362</td>
<td>0</td>
</tr>
<tr>
<td>$N_C = N_{Cf} + N_{Ci}$</td>
<td>1</td>
<td>0.813</td>
<td>0.268</td>
</tr>
<tr>
<td>$N_S = N_{Sf} + N_{Si}$</td>
<td>1</td>
<td>1.137</td>
<td>0.574</td>
</tr>
<tr>
<td>Aggregate TFP $C$</td>
<td>1</td>
<td>1.085</td>
<td><strong>1.317</strong></td>
</tr>
<tr>
<td>Real V.A. per worker $C$</td>
<td>1</td>
<td>0.988</td>
<td>0.856</td>
</tr>
<tr>
<td>Aggregate TFP $S$</td>
<td>1</td>
<td>0.993</td>
<td><strong>1.397</strong></td>
</tr>
<tr>
<td>Real V.A. per worker $S$</td>
<td>1</td>
<td>0.940</td>
<td>0.987</td>
</tr>
<tr>
<td>$P_C^m$</td>
<td>1</td>
<td>1.030</td>
<td>1.061</td>
</tr>
<tr>
<td>$P_S^m$</td>
<td>1</td>
<td>1.013</td>
<td>1.027</td>
</tr>
<tr>
<td>Real Income</td>
<td>1</td>
<td>0.950</td>
<td><strong>0.787</strong></td>
</tr>
<tr>
<td>Real Income 2</td>
<td>1</td>
<td>0.938</td>
<td><strong>0.541</strong></td>
</tr>
</tbody>
</table>
Figure: Negative Productivity Shocks, Informality, Unemployment and Welfare

- **Aggregate negative productivity shock:**
  - **Benchmark:** Informality ↑, but unemployment does NOT increase.
  - Informality repressed: muted informality response, unemployment increases.
  - Informal sector: “unemployment buffer”, but not “welfare buffer”.
Figure: Negative Productivity Shocks and Aggregate TFP
Conclusions

▶ Important to carefully model both the informal sector and the non-tradable sector to obtain an accurate and comprehensive picture of the effects of trade in developing countries.

▶ Our model is consistent with empirical patterns in the literature, based on Diff-in-Diff’s:
  ▶ Trade openness leads to declines in informality in the tradable sector (McCaig and Pavcnik, 2018)
  ▶ Informal sector acts an “employment buffer” in face of negative shocks (Dix-Carneiro and Kovak, 2019)

▶ But new insights that cannot be obtained with Diff-in-Diff’s:
  ▶ Trade openness leads to ambiguous effects in aggregate informality.
  ▶ Informal sector does not act as a “welfare buffer” in face of negative shocks.
Conclusions

▶ Repressing informality increases productivity at the expense of welfare, whereas trade leads to the same productivity gains and also increases welfare.

▶ Trade increases wage inequality in the formal tradable sector, but this effect is reversed when we include the informal sector in the analysis.

▶ The effect of trade on productivity is understated if the informal sector is left out.

▶ Large welfare gains from trade, robust to different scenarios in which informality is either completely or partially repressed.
THANK YOU!