

# Trade and Informality in the Presence of Labor Market Frictions and Regulations

## Fisher-Schultz Lecture

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- ▶ This Lecture draws from material in the paper with the same title authored by

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# Introduction

- ▶ 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).
- ▶ Informal firms evade taxes and social contributions as well as labor market regulations, including minimum wages and firing restrictions
- ▶ Informal workers are either not covered by various benefits (health, UI, pension) or just get limited cover
  - ▶ Informal sector jobs widely considered as low quality.

# Introduction

- ▶ There are alternative views on informality
  - ▶ Some regard it as the mechanism by which an economy becomes more efficient undermining sclerotic regulations
  - ▶ Others view informality as undermining basic institutions designed to improve work standards and allow tax collection for the provision of public goods
- ▶ In a world with frictions informality will typically have both efficiency and distributional effects.
- ▶ Understanding the interaction with trade openness is of first order importance, given that many developing countries that opened up to trade also have large informal sectors.

# Introduction

- ▶ An important feature of informality is that it is pervasive: it does not concern just the least skilled
- ▶ We observe workers transiting between formal and informal jobs.
- ▶ In Meghir, Narita and Robin (2015) we show that reducing informality can release valuable labor resources, which get reallocated to more productive formal firms.
- ▶ This leads to improvements in welfare.
- ▶ The extent that this is true depends on the degree of frictions and the costs of informality.

## Introduction: Trade and Informality

- ▶ We now ask a broader question: how does the presence of informality affect the impact of trade openness?
- ▶ Shifts into/out of informality and unemployment are important margins of adjustment to trade (e.g. McCaig and Pavcnik, 2018; Dix-Carneiro and Kovak, 2019).
- ▶ Dix-Carneiro and Kovak (2019) show that the presence of a large informal sector acted as a buffer to trade-displaced workers.
- ▶ Labor market effects of trade depend on stringency of labor market regulations (Ponczek and Ulysea, 2021).
- ▶ We revisit important questions on the impact of trade liberalization on productivity, inequality and welfare.

# Introduction: Trade and Informality

- ▶ Reduced form empirical results based on Diff-in-Diffs, show evidence of interaction of trade and informality.
- ▶ Trade models typically abstract from informality, we fill this gap.
- ▶ A complete picture can only be obtained with an equilibrium framework.
- ▶ With our model we can quantify:
  - ▶ Aggregate effects
  - ▶ Distributional impacts
  - ▶ Counterfactual policy Analysis
  - ▶ Welfare analysis

## Literature

- ▶ The paper brings together and extends the literatures on informality and on trade with heterogeneous firms and frictional labor markets:
- ▶ **Informality:** Meghir, Narita and Robin (2015), Ulyssea (2018), LaPorta and Shleifer (2014)
- ▶ **Trade** Cosar, Guner and Tybout (2016), Melitz (2003), Helpman, Itskhoki and Redding (2010)
- ▶ **Trade and Informality** Goldberg and Pavcnic (2003), McGaig and Pavcnik (2018), Dix-Carneiro and Kovak (2017, 2019)



# Informality

## Definitions:

- (i) Informal firms: those that do not register with tax authorities, invisible to the government.
- (ii) Informal workers: no formal contract, verifiable by the fact that their labor card is not stamped.

## Potential Consequences:

- ▶ Tax evasion, hindering the provision of public goods.
- ▶ Misallocation of resources.
- ▶ Informal workers: no unemployment insurance, no employer social security contributions, no pension and no or limited healthcare.
- ▶ 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 the earlier results on informality (Meghir, Narita and Robin, 2015 and Ulyssea, 2018). It 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).

# Data

- ▶ We estimate the model using several data sources from Brazil
  - ▶ ECINF / Economia Informal Urbana – “Informality Survey” : Matched Employer/Employee data representing all urban firms with up to 5 employees.
  - ▶ RAIS / All **formal** sector firms and workers – Admin Data
  - ▶ SECEX – Customs data identifying exporters
  - ▶ PIA, PAS, PAC: Censuses of all firms above 20 employees (PAC and PAS) and 30 employees (PIA), and a random survey of firms below these thresholds. Information on revenues, inputs and investment at the firm level.
  - ▶ PME – Household Survey, worker level rotating panel similar to CPS
- ▶ Exclude Public and Primary sector. Use data from 2003/04
- ▶ Include self-employed as one person informal firms.

## Five Facts on Formal and Informal Firms in Brazil

- ▶ **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 1](#)
- ▶ **Fact 2:** The probability that a firm is informal declines sharply with its employment size. [▶ Fact 2](#)
- ▶ **Fact 3:** Informal firms are, on average, less productive than formal firms, but the distributions overlap. [▶ Fact 3](#)
- ▶ **Fact 4:** The average informal worker is paid lower wages than the average formal worker. [▶ Fact 4](#)
- ▶ **Fact 5:** Firm-level labor turnover tends to decline with firm-level employment size. However, conditional on size, exporters tend to have higher turnover.

[▶ Details](#)

## Fact 5: Turnover, Firm Size and Export Status

Table: Turnover, Firm Size and Export Status

	Dep. Variable: $Turnover_i$	
	Manufacturing (C) sector	Service (S) sector
Intercept	0.741 (0.008)	0.645 (0.003)
$\log(\ell_i)$	-0.126 (0.003)	-0.096 (0.002)
$Exporter_i$ (Dummy)	0.071 (0.019)	
Observations	20,342	147,936

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

## The Model

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

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

- ▶  $C_t$  and  $S_t$  are aggregates of varieties  $c_t(n)$  and  $s_t(n)$

$$C_t = \left( \int_0^{N_{C_t}} c_t(n)^{\frac{\sigma_C-1}{\sigma_C}} dn \right)^{\frac{\sigma_C}{\sigma_C-1}}$$

$$S_t = \left( \int_0^{N_{S_t}} s_t(n)^{\frac{\sigma_S-1}{\sigma_S}} dn \right)^{\frac{\sigma_S}{\sigma_S-1}}$$

- ▶  $C$  = Manufacturing / tradable
- ▶  $S$  = Services / non-tradable

# The Model

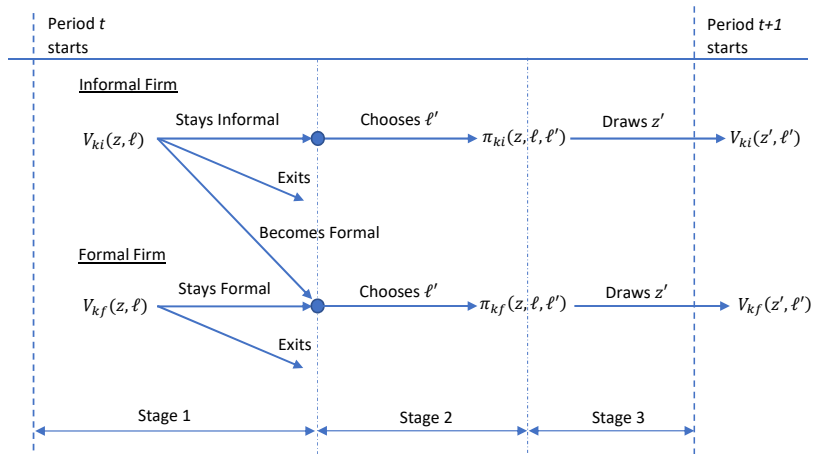
- ▶ Sector  $k \in \{C, S\}$  goods are produced by heterogeneous firms, which produce a unique variety using labor  $\ell$  and intermediate  $\iota_k$  inputs:

$$q = z \ell^{\delta_k} \iota_k^{1-\delta_k}; \quad \iota_k = im_C^{\lambda_k} im_S^{1-\lambda_k}$$

- ▶  $im_C$  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

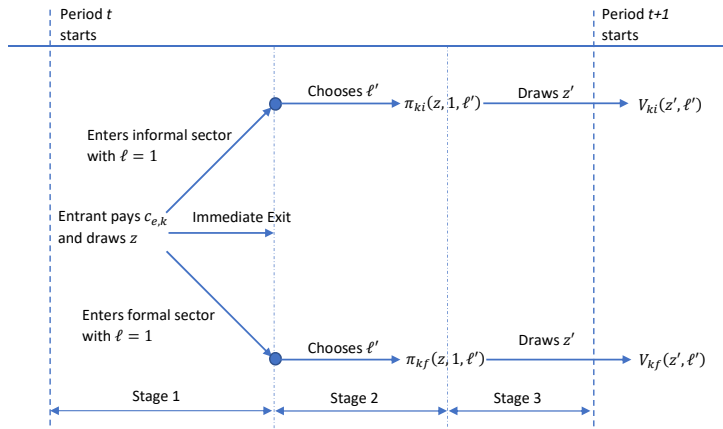


► ValueFunctions



# Entry

- ▶ 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:

$$\pi_{kf}(z, \ell, \ell') = (1 - \tau_y) VA_k(z, \ell') - C_{kf}(z, \ell, \ell') - \bar{c}_k, \quad k = C, S$$

- ▶ Variable costs:

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

- ▶ Wage bill is bounded below by the minimum wage
- ▶ Expanding firms pay hiring costs reflecting frictions
- ▶ Contracting firms pay firing costs reflecting regulations

# Profit functions

► Informal firms:

$$\pi_{ki}(z, l, l') = VA_k(z, l') - K^{inf}(z, l') - C_{ki}(z, l, l') - \bar{c}_k,$$

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

- No minimum wage, No firing costs and No taxes
- $K^{inf}(z, l')$ : Costs of informality (fines access, to finance and latest technology) proportional to revenue
- The costs of informality are convex in employment

## Revenues and Value Added

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

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

- ▶  $\Lambda_k$  depends on the substitution elasticity in sector  $k$
- ▶ Demand shifter  $\Psi_k$  depends on both  $P_C$  and  $P_S$  (pricing out intermediates) and on aggregate income.

▶ Details

## Hiring costs

- ▶ Hiring costs are an important friction in the labor market and reflects the cost of locating workers and firm adjustment costs.
- ▶ Cost of expanding from  $\ell$  to  $\ell'$  workers

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

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

- ▶  $\gamma_{k1}$  controls convexity of hiring costs
- ▶  $\gamma_{k2}$  controls scale economies of hiring costs
- ▶ Hiring costs are incurred in terms of purchases of non-tradable sector composite good.

# Hiring costs

- ▶ Nature of hiring costs is important to generate:
  - ▶ Fact 5: firm-level turnover declines with firm size.
  - ▶ Wage dispersion across firms.
- ▶ Wage dispersion and hiring costs: Firms set marginal value = to cost of additional worker.
- ▶ With convex hiring costs expanding firms pay higher wages.
- ▶ We return to wages shortly

# Search and Matching

- ▶ Workers are matched to firms/vacancies randomly (random matching).
- ▶ Wages are determined by Nash bargaining.
- ▶ Search frictions: 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:

$$m(\tilde{v}, L_u) = \phi \tilde{v}^\xi L_u^{1-\xi}$$

$$\tilde{v} = v_{Cf} + v_{Ci} + v_{Sf} + v_{Si}$$

- ▶ Matches in each sector are proportional to the relative number of vacancies they post

$$m_{kj} = \frac{v_{kj}}{\tilde{v}} m(\tilde{v}, L_u)$$



# 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

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

- ▶ Intermediate inputs: Transmission of trade shocks to the Service (S) and the informal sector (I) 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:

$$VA_C^x(z, \ell) = \underbrace{\left( \exp(d_F) \right)^{\frac{\sigma_C}{\sigma_C - 1} \Lambda_C}}_{> 1} \times VA_C^d(z, \ell)$$

- ▶ Trade costs / tariffs affect domestic demand shifters  $\Psi_C$  (for formal and informal firms) and foreign demand  $d_F$ .
  - ▶ But also  $\Psi_S$ .

# Wage Setting

- ▶ Frictions imply a surplus to be shared between workers and firms
- ▶ Firm's Surplus

$$S_{kf}^e(z, \ell') = \underbrace{(1 - \tau_y) VA_k(z, \ell') - (1 + \tau_w) w_{kf}(z, \ell') \ell'}_{\text{Flow value}} + \underbrace{\beta E_{z'|z} V_{kf}(z', \ell')}_{\text{Future value}}$$

- ▶ Surplus of workers (union)

$$S_{kf}^u(z, \ell') = \ell' \times \left[ \underbrace{w_{kf}(z, \ell') + \beta J_{kf}^e(z, \ell')}_{\text{Job Value}} - \underbrace{\left( b + b^u + \frac{1}{1+r} J^u \right)}_{\text{Unemployment value}} \right],$$

## Wage Setting

- ▶ Wages are set to satisfy the Nash bargaining solution if the Surplus is positive.

$$S_{kf}^u(z, \ell') = \beta (S_{kf}^e(z, \ell') + S_{kf}^u(z, \ell')) .$$

- ▶  $\beta$  is the workers' bargaining power. We set this to 0.5 (symmetric bargaining)
- ▶ For formal firms the minimum wage constraint has to be satisfied and the firm will still want to hire.
- ▶ Wages must exceed reservation wages (Worker surplus  $\geq 0$ )

# Demand Functions

- ▶ The domestic demand for goods produced domestically:

$$Q_{H,C}(n) = D_{H,C} p(n)^{-\sigma_C}$$

- ▶ The domestic demand for foreign-produced goods is:

$$Q_{H,C}(n) = D_{H,C} (\epsilon \tau_a \tau_c p^*(n))^{-\sigma_C}$$

- ▶ Foreign demand for domestically produced goods

$$Q_{F,C}(n) = D_F^* (p_x^*(n))^{-\sigma_C}$$

- ▶  $p^*(n)$  is a price in foreign currency

# 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

- ▶ Reduction of trade barriers has a number of effects often in opposing directions
- ▶ First, domestic firms in the tradable sector face greater competition.
  1. Decline in demand for domestically produced goods: **low productivity formal firms replaced by informal.**
  2. **Closure of informal firms** because of decline in demand for domestic goods
  3. **Decline in formal employment**, leading to increases in unemployment and more workers directed to informal firms. **Transitions from unemployment to informal firms is much higher than to formal firms.**
  4. **Decline in prices of intermediates** (foreign competition): Growth of all firms and increases in formalizations. Also entry of lower productivity informal firms.

# Mechanisms

- ▶ External Balance: imports = exports
- ▶ This implies that the demand for exports will rise
- ▶ Lower costs of intermediaries can promote exports.
- ▶ Exporting firms will grow reallocating employment to larger more productive firms
- ▶ Lower trade barriers will increase the proportion of exporting firms
- ▶ This will have two implications:
  1. Larger firms have more **stable employment** (because of hiring and firing frictions).
  2. At the same time exporting firms are more **sensitive to productivity** shocks (because of  $d_F$ , which leads to more turnover and hence more unemployment).



# Estimation

- ▶ Some parameters are preset/ Estimation is conditional on these values.
- ▶ We use **Indirect Inference** to estimate 27 parameters using 84 data moments and auxiliary model coefficients (Gourieroux, Monfort, Renault, 1993).
- ▶ This matches the coefficients of auxiliary regressions obtained from simulating the model to those obtained by the data
- ▶ For example, an auxiliary regression can be the relationship between turnover and firm size.

▶ Estimates

▶ ModelFit

▶ FixedParameters

# Identifying Information

- ▶ In general all moments contribute to most parameters. To give some intuition we can say:
  - ▶ The **elasticity of substitution** is informed by the relationship between value added and firm size.
  - ▶ The **scaling of hiring cost** function is identified by average turnover rates and the unemployment rates.
  - ▶ The **scale economies for hiring** are identified by the auxiliary model relating turnover to employment levels and export status.

## Identifying information

- ▶ The relationship of log-wages to log-employment and an export status informs on the **convexity of hiring costs**, as it relates to wage dispersion across firms.
- ▶ The **fixed cost of production** is identified by the way the exit rate varies with firm size.
- ▶ The **cost of informality** is identified by the the informal sector firm-size distribution, share of employment, and the fraction of informal firms by size.
- ▶ The **fixed cost of exporting** is identified by the proportion of firms exporting

# Preset Parameters

Table: Fixed Parameters

Parameter	Description	Source	Value
$\tau_C$	Iceberg Trade Cost	Cosar et al. and EatonKortum2002	2.50
$\zeta$	Share of final expend. on C	IBGE National Accounts (2000/2005)	0.283
$\lambda_C$	Prod. Function	IBGE National Accounts (2000/2005)	0.645
$\lambda_S$	Prod. Function	IBGE National Accounts (2000/2005)	0.291
$r$	Interest rate	Ulyssea	0.08
$\tau_y$	Value Added Tax	Ulyssea	0.293
$\tau_w$	Payroll Tax	Ulyssea	0.375
$\tau_a - 1$	Import Tariff	UNCTAD TRAINS	0.12
$\kappa$	Firing Costs (in R\$)	Heckman and Pages	1,956.7
$\underline{w}$	Min. Wage (in R\$)	Annualized 2003 value	2,880
$b_u$	Unemployment Benefit	$1.37 \times 5 = 6.85$ monthly Min. Wage	1,644
$\xi$	Matching Function	Petrongolo and Pissarides	0.5
$\phi$	Matching Function	Match unemployment to employment trans.	0.576
$\beta$	Workers' Bargaining Weight	Symmetric Bargaining	0.5

► 1 Real = 0.3 US\$ in 2003

# Estimated Parameters

Table: Parameter Estimates

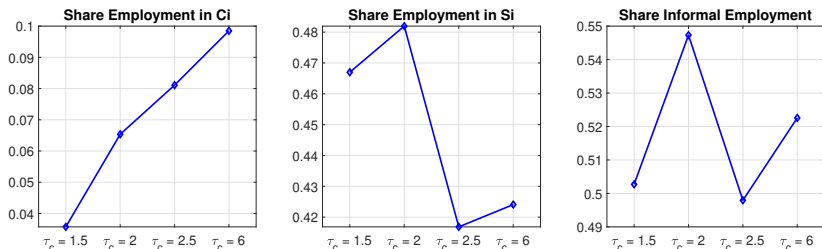
Parameter	Description	$k = C$	$k = S$
$\bar{a}_k$	Cost of Informality, Intercept	0.161	0.373
$\bar{b}_k$	Cost of Informality, Convexity	0.131	0.013
$h_k$	Hiring Cost, Level	559.7	2348.9
$\gamma_k^1$	Hiring Cost, Convexity	2.067	4.896
$\gamma_k^2$	Hiring Cost, Scale Economies	0.139	0.192
$\sigma_k$	Elasticity of Substitution	5.321	3.281
$\rho_k$	Productivity AR(1) Process, Persistence Coeff.	0.978	0.977
$\sigma_k^z$	Productivity AR(1) Process, Variance of Shock	0.199	0.296
$\alpha_k$	Exogenous Exit Probability	0.067	0.063
$\bar{c}_k$	Fixed Cost of Operation	23.071	27.047
$\delta_k$	Labor Share in Production	0.266	0.54
$c_k^e$	Entry Cost	5,332.2	2,067.1
$f_x$	Fixed Cost of Exporting		55,856.9
$b$	Utility Value of Unemployment		-8,662.5
$(D_F^*)^{\frac{1}{\sigma_C}}$	Foreign Demand Shifter		969.2

# Model Implications and Counterfactuals

- ▶ We now turn to see what the model tells us about trade openness
- ▶ We use alternative iceberg costs ranging from  $\tau_c = 1.5$  –  $\tau_c = 6$  (*autarky*)
- ▶ Tariffs have a much smaller impact

# Trade Costs and Informality

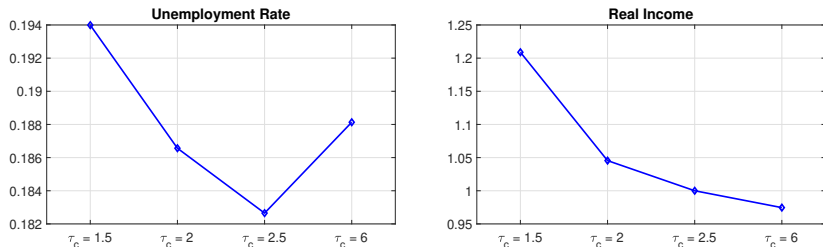
Figure: Trade and Informality - benchmark  $\tau_c = 2.5$



- ▶ In C: reduction in demand for purely-domestic firms  $\Rightarrow$  low-productivity formal firms  $\rightarrow$  informality, but also low-productivity informal firms exit.
- ▶ Consistent with McGaig and Pavcnik - Vietnam formal manufacturing benefited from improved exports to the US.
- ▶ In S: increased income and demand for intermediates driven by exporting C sector  $\Rightarrow$  entry of low-productivity informal firms, but also formalization of high-productivity informal firms.

# Trade Unemployment and Welfare

Figure: Trade, Unemployment and Welfare

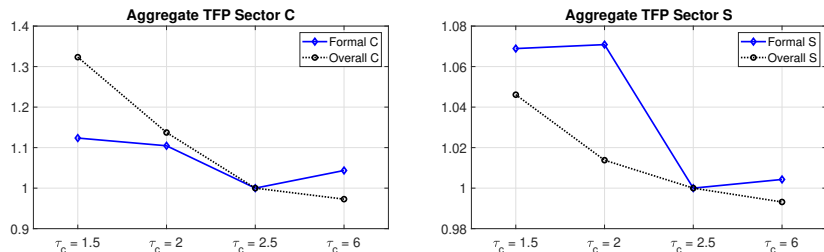


- ▶  $\tau_c \downarrow \Rightarrow$  resources reallocated toward larger firms (both in  $C$  and  $S$ )  
 $\Rightarrow$  less turnover as larger firms tend to be more stable (distribution effect).
- ▶ However, resources reallocated towards exporters, and  $d_F \uparrow \Rightarrow$  more turnover (sensitivity effect)
- ▶  $\uparrow$  turnover associated with  $\uparrow$  unemployment.
- ▶ The growth of firms in the  $S$  sector mitigates the increase in unemployment (distribution effect)



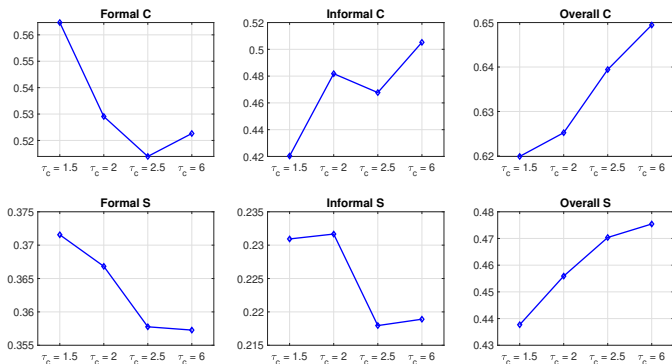
# Trade Costs and Productivity

Figure: Trade and Aggregate TFP



- ▶ Trade drives highly unproductive informal  $C$  sector firms out of the market, freeing up resources to be reallocated to more productive formal ones.
- ▶ It also closes down less productive formal firms.
- ▶ 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 and S sectors



- ▶  $\tau_c \downarrow \Rightarrow$  Wage inequality  $\uparrow$  in the formal C sector. Wage exporter premium  $\uparrow$ .
- ▶ Consistent with Cosar et al (2016), Helpman et al (2017).
- ▶ However, inequality within the informal sector  $\downarrow$  + between-sector differences  $\downarrow$

## Sources of the change in inequality

$$\text{Var}(\log w|k) = \sum_{j \in \{f,i\}} p_{kj} \text{Var}(\log w|kj) + \sum_{j \in \{f,i\}} p_{kj} (E[\log w|kj] - E[\log w|k])^2,$$

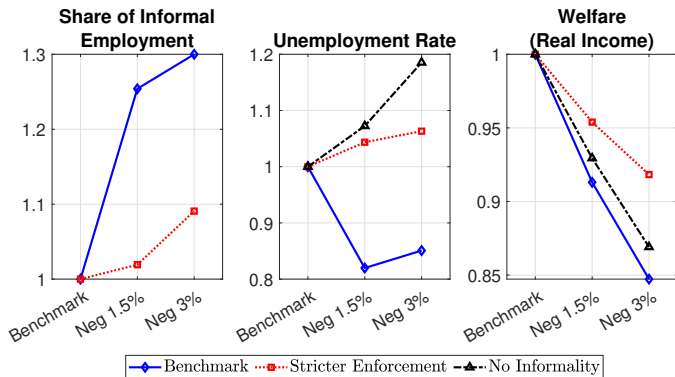
- ▶ The variance within the formal manufacturing sector ( $\text{Var}(\log w|cf)$ ) and its weight ( $p_{cf}$ ) increase.
- ▶ Both decline for the informal sector
- ▶ On net the **within term**  $\sum_{j \in \{f,i\}} p_{Cj} \text{Var}(\log w|Cj)$  increases
- ▶ But the **between variance** declines leading to an overall decline
- ▶ For the Services sector the overall decline comes from a large enough decline in the between group variance

Table: Effects of Increasing the Cost of Informality

	Benchmark	Stricter Enforcement	No Informality
Unemployment Rate	0.183	0.184	0.326
Share Emp. $C_i$	0.081	0.050	0
Share Emp. $C_f$	0.100	0.124	0.201
Share Emp. $S_i$	0.417	0.313	0
Share Emp. $S_f$	0.402	0.514	0.799
Share Informal Emp.	0.498	0.362	0
$N_C = N_{Cf} + N_{Ci}$	1	0.813	0.268
$N_S = N_{Sf} + N_{Si}$	1	1.137	0.574
Aggregate TFP $C$	1	1.085	1.317
Real V.A. per worker $C$	1	0.988	0.856
Aggregate TFP $S$	1	0.993	1.397
Real V.A. per worker $S$	1	0.940	0.987
$P_C^m$	1	1.030	1.061
$P_S^m$	1	1.013	1.027
Real Income	1	0.950	0.787
Real Income 2	1	0.938	0.541

Notes: **Real Income:** All wages and profits **Real Income 2** includes the disutility of unemployment.

Figure: Negative Productivity Shocks, Informality, Unemployment and Welfare



- ▶ Aggregate negative productivity shock:
  - ▶ Benchmark: Informality  $\uparrow$ , but unemployment does NOT increase.
  - ▶ Informality repressed: muted informality response, unemployment increases.
  - ▶ Informal sector: “unemployment buffer”, but not “welfare buffer”.

# Conclusions

- ▶ The Informal Economy is a major feature of developing and many developed countries.
- ▶ In many ways it obstructs the implementation of labor market policy, taxation and welfare assistance.
- ▶ However, the impacts of the informal sector can be more nuanced.
- ▶ We investigate how informality affects the impact of trade liberalization based on an equilibrium trade model incorporating an informal sector.

# Conclusions

- ▶ Our model is consistent with empirical patterns based on quasi-experimental studies:
  - ▶ 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)

## Conclusions

- ▶ We offer new insights implied by the model
  - ▶ Trade openness leads to **ambiguous** effects in aggregate informality.
  - ▶ Informal sector does not act as a “welfare buffer” in face of negative shocks.
- ▶ 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!

# Fact 1: Informality and Transitions

Table: Employment Shares and Quarterly Transition Rates

	Share of Workers	Transition Rates From Unemp.
Informal Tradable ( $C_i$ )	0.059	0.064
Formal Tradable ( $C_f$ )	0.106	0.050
Informal Non-Tradable ( $S_i$ )	0.351	0.389
Formal Non-Tradable ( $S_f$ )	0.334	0.161
Unemployment	0.150	0.336
Share of Informal Employment	0.482	
Transition Rate from Unemp.		
to Informal Employment	0.453	
to Formal Employment	0.211	
Ratio	2.146	

Data source: 2003 PME.

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## Fact 2: Informality Status by Firm Size

Table: Firm-Level Informality Status vs. Firm-Level Employment

	Dep. Variable: <i>Informal Status Indicator<sub>i</sub></i>	
	C sector	S sector
Intercept	1.135 (0.028)	1.130 (0.012)
$\ell_i$	-0.179 (0.025)	-0.204 (0.009)
Observations	1,194	7,273

Data source: 2003 ECINF. Standard errors in parentheses.

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## Facts 3 and 4: Productivity and Wages

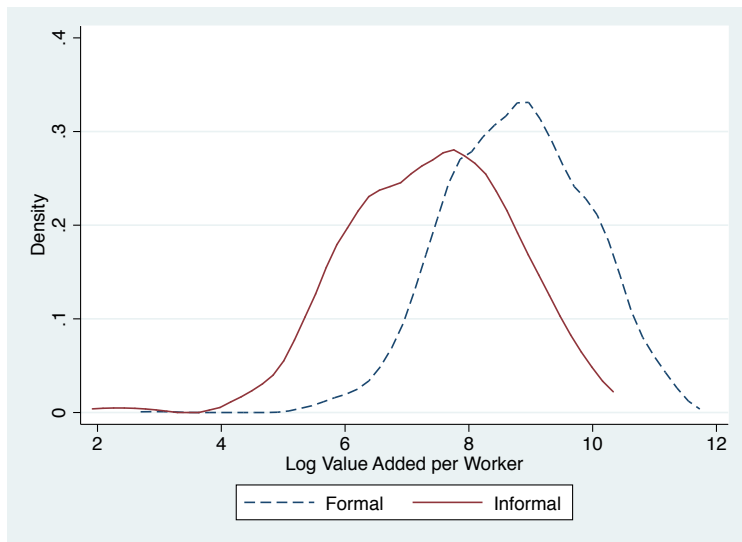
Table: Firm-Level log-Revenue per Worker and log-Wages vs. log-Employment

Sector / Firm Type	A. Dep. Variable: $\log(\text{Revenue}_i / \ell_i)$				B. Dep. Variable: $\log(\text{wage}_i)$			
	<i>Cf</i>	<i>Sf</i>	<i>Ci</i>	<i>Si</i>	<i>Cf</i>	<i>Sf</i>	<i>Ci</i>	<i>Si</i>
Intercept	10.118	10.004	8.391	8.825	8.509	8.436	8.013	8.417
	(0.013)	(0.005)	(0.037)	(0.015)	(0.006)	(0.002)	(0.033)	(0.014)
$\log(\ell_i)$	0.000	-0.128	0.342	0.321	0.117	0.105	0.292	0.231
	(0.005)	(0.003)	(0.114)	(0.050)	(0.003)	(0.001)	(0.103)	(0.048)
<i>Exporter<sub>i</sub></i>	1.462				0.462			
	(0.021)				(0.014)			
Observations	16,986	43,861	1,070	6,202	20,075	145,981	1,071	6,205
Dataset	PIA + SECEX	PAS + PAC	ECINF	ECINF	RAIS + SECEX	RAIS	ECINF	ECINF

Standard errors in parentheses.

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# Productivity Overlap



Source: Meghir, Narita and Robin (2015)

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# Firms' value functions

## ► Formal Firms

$$V_{kf}(z, \ell) = (1 - \alpha_{kf}) \max \left\{ 0, \max_{\ell'} \left\{ \pi_{kf}(z, \ell, \ell') + \frac{1}{1+r} E_{z'|z} V_{kf}(z', \ell') \right\} \right\}$$

## ► Informal Firms - Extra option because they can formalise

$$V_{ki}(z, \ell) = (1 - \alpha_{ki}) \max \left\{ \begin{array}{l} 0, \max_{\ell'} \left\{ \pi_{ki}(z, \ell, \ell') + \frac{1}{1+r} E_{z'|z} V_{ki}(z', \ell') \right\}, \\ \max_{\ell'} \left\{ \pi_{kf}(z, \ell, \ell') + \frac{1}{1+r} E_{z'|z} V_{kf}(z', \ell') \right\} \end{array} \right\}$$

## Entry value functions

Value of entry into sector  $k$  / formal status  $j$ :

$$V_{kj}^e(z) = \max_{\ell'} \left\{ \pi_{kj}(z, 1, \ell') + \frac{1}{1+r} E_{z'|z} V_{kj}(z', \ell') \right\}$$

Expected value of entry into sector  $k$ , before drawing  $z$  is given by:

$$V_k^e = E_z \max \{ V_{ki}^e(z), V_{kf}^e(z), 0 \}$$

Free entry leads to:

$$V_k^e = c_{e,k}.$$

## Revenues and Value Added

- ▶ Revenues under Monopolistic Competition for output  $q$  :

$$R_k(q) = \left( \frac{X_k}{P_k^{1-\sigma_k}} \right)^{\frac{1}{\sigma_k}} q^{\frac{\sigma_k-1}{\sigma_k}}$$

- ▶ Expenditure on tradables:  $X_C = \zeta I + X_C^{int}$ , and
- ▶ Expenditure on non-tradables:  $X_S = (1 - \zeta) I + X_S^{int} + E_S$ .
- ▶  $X_k^{int}$  is expenditure on intermediates and  $E_S$  expenditures on nontradables to cover entry, hiring and export costs.
- ▶ Value added:  $VA_k(z, \ell) = \Psi_k (z\ell^{\delta_k})^{\Lambda_k}$



# Search and Matching

- ▶ Probability of filling a vacancy in  $k$ [sector]- $j$ [formal status]:

$$\mu_{kj}^v \equiv \frac{m_{kj}}{v_{kj}} = \phi \left( \frac{L_u}{\tilde{v}} \right)^{1-\xi} = \mu^v$$

- ▶ Probability of unemployed worker find a job in  $k$ [sector]- $j$ [formal status]:

$$\mu_{kj}^e \equiv \frac{m_{kj}}{L_u} = \frac{v_{kj}}{\tilde{v}} \left( \frac{\phi}{(\mu^v)^\xi} \right)^{\frac{1}{1-\xi}}$$

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# Wage Determination

- ▶ Wages are driven by a Nash bargain between workers and firms (collective bargaining) –  $\beta$  is the bargaining power of the union/workers

$$S_{kf}^u(z, l') = \beta (S_{kf}^e(z, l') + S_{kf}^u(z, l'))$$

- ▶ The total surplus of the match accounts for the option value of employment: the surplus depends both on the flow of wages and profits today and on the value of preserving an employment relationship.
- ▶ Similar problem for informal firms.

▶ Surplus

▶ Wages

# Surplus Functions

$$S_{kf}^e(z, \ell') = (1 - \tau_y) VA_k(z, \ell') - (1 + \tau_w) w_{kf}(z, \ell') \ell' + \frac{1}{1+r} E_{z'|z} V_{kf}(z', \ell')$$

$$S_{kf}^u(z, \ell') = \left[ w_{kf}(z, \ell') + \frac{1}{1+r} J_{kf}^e(z, \ell') - \left( b + b^u + \frac{1}{1+r} J^u \right) \right] \ell'$$

▶ Back

## Wage functions

- ▶ The solution to union wages in the formal sector take the form

$$\begin{aligned}w_{kf}^u(z, \ell') &= \frac{1 - \beta}{1 + \beta\tau_w} \left( b + b^u + \frac{1}{1 + r} J^u \right) \\ &+ \frac{\beta(1 - \tau_y)}{1 + \beta\tau_w} \frac{VA_k(z, \ell')}{\ell'} \\ &+ \frac{1}{1 + r} \left( \frac{\beta}{1 + \beta\tau_w} E_{z'|z} \frac{V_{kf}(z', \ell')}{\ell'} - \frac{(1 - \beta)}{1 + \beta\tau_w} J_{kf}^e(z, \ell') \right).\end{aligned}$$

- ▶ Formal firms will not offer below reservation wage or below the minimum wage:

$$w_{kf}(z, \ell') = \max \{ w_{kf}^u(z, \ell'), w_{kf}^{res}(z, \ell'), \underline{w} \}$$

- ▶ There is an analogous bargaining solution for the informal sector, but minimum wages play no direct role

$$w_{ki}(z, \ell') = \max \{ w_{ki}^u(z, \ell'), w_{ki}^{res}(z, \ell') \}$$

## Value Added, Domestic Firms

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

$$\Psi_k \equiv \Theta_k (P_k^m)^{-(1-\delta_k)\Lambda_k} (\exp(d_{H,k}))^{\frac{\sigma_k}{\sigma_k-1}\Lambda_k}.$$

$$P_k^m \equiv \frac{P_C^{\lambda_k} P_S^{1-\lambda_k}}{\lambda_k^{\lambda_k} (1-\lambda_k)^{1-\lambda_k}},$$

$$d_{H,k} = \ln \left( \left( \frac{X_k}{P_k} \right)^{\frac{1}{\sigma_k}} \right)$$

$$d_F(\eta) = \ln \left( (1-\eta)^{\frac{\sigma_C-1}{\sigma_C}} + \epsilon \left( \frac{D_F^*}{D_{H,C}} \right)^{\frac{1}{\sigma_C}} \left( \frac{\eta}{\tau_C} \right)^{\frac{\sigma_C-1}{\sigma_C}} \right)$$

$\eta$ : proportion of output exported;  $\tau_C$ : iceberg costs

# Fixed Parameters

Table: Fixed Parameters

Parameter	Description	Value
$\tau_c$	Iceberg Trade Cost	2.50
$\zeta$	Share of final expend. on C	0.283
$\lambda_C$	Prod. Function	0.645
$\lambda_S$	Prod. Function	0.291
$r$	Interest rate	0.08
$\tau_y$	Value Added Tax	0.293
$\tau_w$	Payroll Tax	0.375
$\tau_a - 1$	Import Tariff	0.12
$\kappa$	Firing Costs (in R\$)	1,956.7
$\underline{w}$	Min. Wage (in R\$)	2,880
$b_u$	Unemployment Benefit	1,644
$\xi$	Matching Function	0.5
$\phi$	Matching Function	0.576
$\beta$	Workers' Bargaining Weight	0.5

# Estimates

Table: Parameter Estimates

Parameter	Description	$k = C$	$k = S$
$\tilde{a}_k$	Cost of Informality, Intercept	0.161	0.373
$\tilde{b}_k$	Cost of Informality, Convexity	0.131	0.013
$h_k$	Hiring Cost, Level	559.7	2,348.9
$\gamma_k^1$	Hiring Cost, Convexity	2.067	4.896
$\gamma_k^2$	Hiring Cost, Scale Economies	0.139	0.192
$\sigma_k$	Elasticity of Substitution	5.321	3.281
$\rho_k$	Productivity AR(1) Process, Pers. Coeff.	0.978	0.977
$\sigma_k^z$	Productivity AR(1) Process, Var. of Shock	0.199	0.296
$\alpha_k$	Exogenous Exit Probability	0.067	0.063
$\bar{c}_k$	Fixed Cost of Operation	23.071	27.047
$\delta_k$	Labor Share in Production	0.266	0.54
$c_k^e$	Entry Cost	5,332.2	2,067.1
$f_x$	Fixed Cost of Exporting	55,856.9	
$b$	Utility Value of Unemployment	-8,662.5	
$(D_F^*)^{\frac{1}{\sigma_C}}$	Foreign Demand Shifter	969.2	

Table: Effects of Increasing the Cost of Informality

	Benchmark	Stricter Enforcement	No Informality
Unemployment Rate	0.183	0.184	0.326
Share Emp. $C_i$	0.081	0.050	0
Share Emp. $C_f$	0.100	0.124	0.201
Share Emp. $S_i$	0.417	0.313	0
Share Emp. $S_f$	0.402	0.514	0.799
Share Informal Emp.	0.498	0.362	0
$N_C = N_{Cf} + N_{Ci}$	1	0.813	0.268
$N_S = N_{Sf} + N_{Si}$	1	1.137	0.574
Aggregate TFP $C$	1	1.085	1.317
Real V.A. per worker $C$	1	0.988	0.856
Aggregate TFP $S$	1	0.993	1.397
Real V.A. per worker $S$	1	0.940	0.987
$P_C^m$	1	1.030	1.061
$P_S^m$	1	1.013	1.027
Real Income	1	0.950	0.787
Real Income 2	1	0.938	0.541



# Model Fit

Table: Employment Shares and Transition Rates from Unemployment

Moment	Dataset	Model	Data
Share of Employment $C_i$	PME	0.067	0.059
Share of Employment $C_f$	PME	0.083	0.106
Share of Employment $S_i$	PME	0.360	0.351
Share of Employment $S_f$	PME	0.315	0.334
Share Unemployment	PME	0.176	0.150
Share Informal Workers (Conditional on Working)	PME	0.518	0.482
Trans. Rate from Unemp. to $C_i$	PME	0.062	0.064
Trans. Rate from Unemp. to $C_f$	PME	0.051	0.050
Trans. Rate from Unemp. to $S_i$	PME	0.383	0.389
Trans. Rate from Unemp. to $S_f$	PME	0.167	0.161
Trans. Rate from Unemp. to Unemp	PME	0.336	0.336
Ratio Trans. to Informal job / Trans. To Formal job	PME	2.042	2.146

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# Model Fit

Table: Turnover-Related Moments and Auxiliary Models

	Dataset	C sector		S sector	
		Model	Data	Model	Data
Exit Rate	RAIS	0.091	0.103	0.089	0.125
Average Firm-level Turnover	RAIS	0.231	0.505	0.198	0.525
$Corr(\ell_{t+1}, \ell_t)$	RAIS	0.947	0.929	0.942	0.914
<i>Exit</i> <sub><i>i</i></sub> = $\alpha + \beta \log(\ell_i)$					
Intercept	RAIS	0.154	0.188	0.137	0.185
$\log(\ell_i)$	RAIS	-0.028	-0.045	-0.040	-0.049
<i>Turnover</i> <sub><i>i</i></sub> = $\alpha + \beta \log(\ell_i) + \gamma \text{Exporter}_i$					
Intercept	RAIS	0.435	0.741	0.315	0.645
$\log(\ell_i)$	RAIS	-0.095	-0.126	-0.097	-0.096
<i>Exporter</i> <sub><i>i</i></sub>	RAIS	0.071	0.071		
<i>Turnover</i> <sub><i>i</i></sub> = $\alpha + \beta \log(\ell_i) + \gamma \text{Exporter}_i$ , Conditional on Expansions					
Intercept	RAIS	0.410	0.692	0.278	0.690
$\log(\ell_i)$	RAIS	-0.105	-0.138	-0.098	-0.150
<i>Exporter</i> <sub><i>i</i></sub>	RAIS	0.119	0.116		
<i>Turnover</i> <sub><i>i</i></sub> = $\alpha + \beta \log(\ell_i) + \gamma \text{Exporter}_i$ , Conditional on Contractions					
Intercept	RAIS	0.456	0.744	0.335	0.624
$\log(\ell_i)$	RAIS	-0.077	-0.101	-0.064	-0.064
<i>Exporter</i> <sub><i>i</i></sub>	RAIS	0.056	0.056		

# Model Fit

Table: Firm-Size Distribution

	Dataset	C sector		S sector	
		Model	Data	Model	Data
Avg. Firm-Level log-Emp.	RAIS	2.249	1.918	1.213	1.237
Std Dev log-Emp	RAIS	0.915	1.416	0.685	1.175
Avg. Exporter log-Emp.	RAIS+SECEX	3.555	4.014		

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# Model Fit

Table: Trade-Related Moments

	Dataset	Model	Data
Fraction of Exporters	RAIS + SECEX	0.129	0.073
Total Exports / (Total Manuf. Rev.)	SECEX + IBGE	0.133	0.134

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# Model Fit

Table: Formal-Sector Wages

		C sector		S sector	
	Dataset	Model	Data	Model	Data
Avg. log-Wages	RAIS	8.635	8.769	8.413	8.567
$\log(w_i) = \alpha + \beta \log(\ell_i) + \gamma \text{Exporter}_i$					
Intercept	RAIS	8.301	8.509	8.288	8.436
$\log(\ell_i)$	RAIS	0.117	0.117	0.103	0.105
$\text{Exporter}_i$	RAIS	0.542	0.462		

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# Model Fit

Table: Formal-Sector Revenues

	Dataset	C sector		S sector	
		Model	Data	Model	Data
Avg. log-Revenues	IBGE	12.652	12.726	10.898	10.814
Std. Dev. log-Revenues	IBGE	1.278	1.874	0.916	1.440
$Corr(Rev_t, Rev_{t+1})$	IBGE	0.727	0.929	0.630	0.845
$Rev_i = \alpha + \beta \log(\ell_i) + Exporter_i$					
Intercept	IBGE	9.995	10.118	9.500	10.004
$\log(\ell_i)$	IBGE	1.149	1.000	1.152	0.872
$Exporter_i$	IBGE	0.561	1.462		

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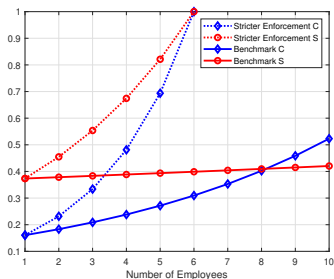
# Model Fit

Table: Informal Sector Moments and Auxiliary Moments

	Dataset	C sector		S sector	
		Model	Data	Model	Data
Average log-Employment	ECINF	0.189	0.105	0.244	0.097
Std. Dev. log-Employment	ECINF	0.316	0.303	0.355	0.274
Avg. log-Revenue	ECINF	9.596	8.531	9.253	8.953
Avg. log-Wages	ECINF	7.825	8.043	7.660	8.440
<i>Informal<sub>i</sub> = <math>\alpha + \beta\ell_i</math></i>					
Intercept	ECINF	1.308	1.135	1.212	1.130
$\ell_i$	ECINF	-0.179	-0.179	-0.202	-0.204

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Figure: Costs of Informality: Benchmark and Stricter Enforcement

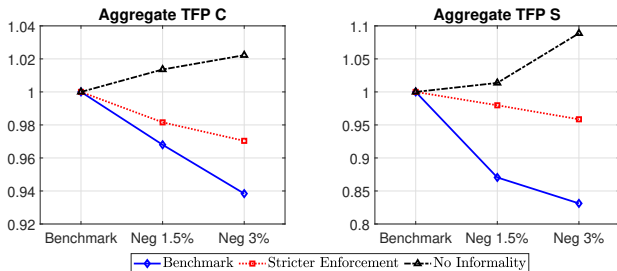


Notes:  $p_{Ci}(\ell)$  and  $p_{Si}(\ell)$  are plotted against  $\ell$  under the benchmark case and under the stricter enforcement policy.

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Figure: Negative Productivity Shocks and Aggregate TFP



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