

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

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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 Pavcnik (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

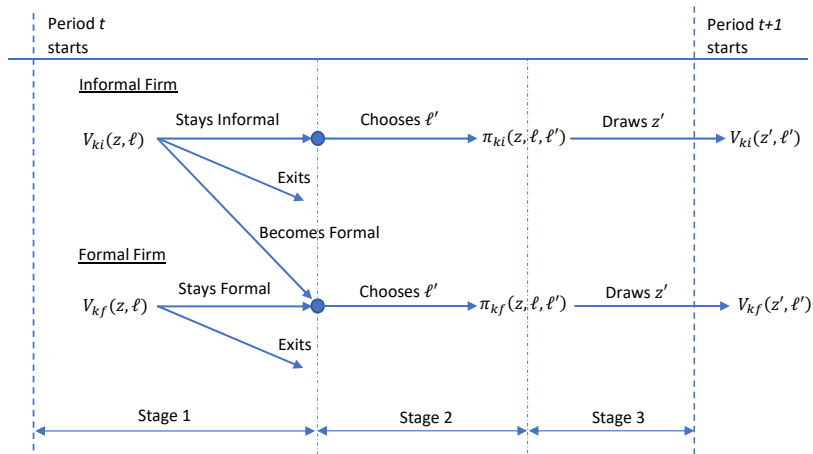
- ▶ Sector $k \in \{C, S\}$ goods are produced by heterogeneous firms, which produce a unique variety using labor ℓ and intermediate ι_k inputs:

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

- ▶ 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:

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

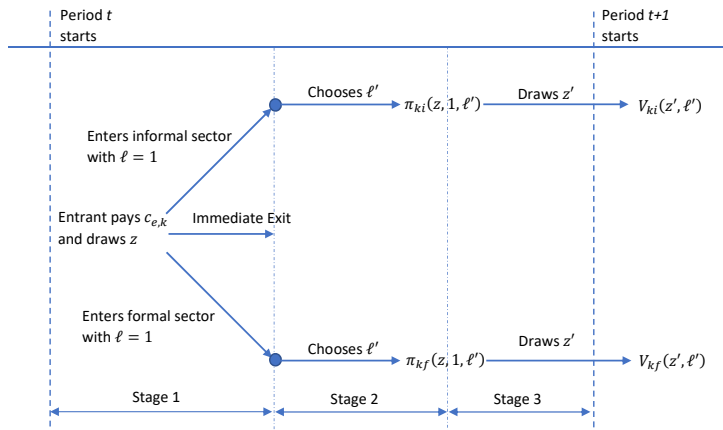
Timing: Incumbents



► 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:

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

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

- No minimum wage, No firing costs and No taxes
- $K^{inf}(z, \ell')$: 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 ℓ :

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

- ▶ Λ_k depends on the substitution elasticity in sector k
- ▶ Demand shifter Ψ_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 ℓ to ℓ' workers

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

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

- ▶ γ_{k1} controls convexity of hiring costs
- ▶ γ_{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 ℓ to ℓ' 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 Ψ_C (for formal and informal firms) and foreign demand d_F .
 - ▶ But also Ψ_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.

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

- ▶ β 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 ≥ 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
τ_C	Iceberg Trade Cost	Cosar et al. and EatonKortum2002	2.50
ζ	Share of final expend. on C	IBGE National Accounts (2000/2005)	0.283
λ_C	Prod. Function	IBGE National Accounts (2000/2005)	0.645
λ_S	Prod. Function	IBGE National Accounts (2000/2005)	0.291
r	Interest rate	Ulyssea	0.08
τ_y	Value Added Tax	Ulyssea	0.293
τ_w	Payroll Tax	Ulyssea	0.375
$\tau_a - 1$	Import Tariff	UNCTAD TRAINS	0.12
κ	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
ξ	Matching Function	Petrongolo and Pissarides	0.5
ϕ	Matching Function	Match unemployment to employment trans.	0.576
β	Workers' Bargaining Weight	Symmetric Bargaining	0.5

► 1 Real = 0.3 US\$ in 2003

Estimated Parameters

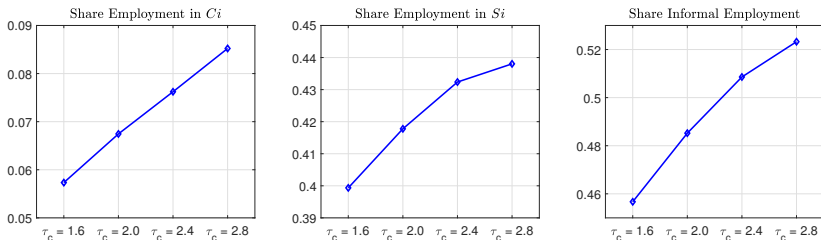
Table: Parameter Estimates

Parameter	Description	$k = C$	$k = S$
\tilde{a}_k	Cost of Informality, Intercept	0.183	0.379
\tilde{b}_k	Cost of Informality, Convexity	0.090	0.011
h_k	Hiring Cost, Level	471.3	2959.4
γ_k^1	Hiring Cost, Convexity	2.007	5.745
γ_k^2	Hiring Cost, Scale Economies	0.109	0.147
σ_k	Elasticity of Substitution	5.256	3.063
ρ_k	Productivity AR(1) Process, Pers. Coeff.	0.979	0.977
σ_k^z	Productivity AR(1) Process, SD of Shock	0.197	0.340
α_k	Exogenous Exit Probability	0.073	0.082
\bar{c}_k	Fixed Cost of Operation	174.404	29.383
δ_k	Labor Share in Production	0.264	0.525
c_k^e	Entry Cost	5004.2	3960.6
f_x	Fixed Cost of Exporting	56900.9	
b_0	Utility Flow of Unemployment	-0.764	
$(D_F^*)^{\frac{1}{\sigma_C}}$	Foreign Demand Shifter	1169.5	

Model Implications and Counterfactuals

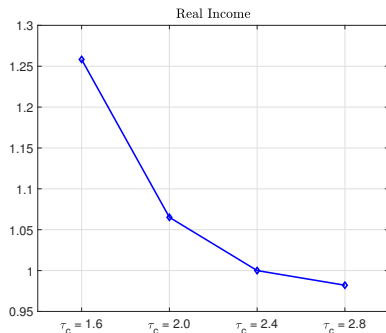
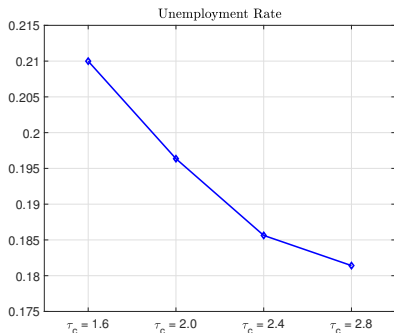
- ▶ We now turn to see what the model tells us about trade openness
- ▶ We use alternative iceberg costs ranging from $\tau_c = 1.6$ to $\tau_c = 6$ (*autarky*)
- ▶ Tariffs have a much smaller impact

Figure: Trade and Informality



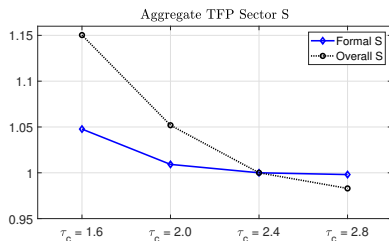
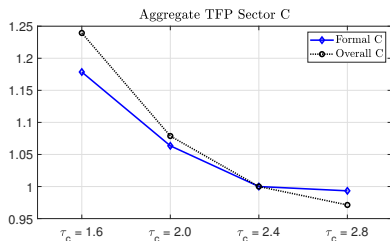
- ▶ In C : Wages increase across the board and reduction in demand for purely-domestic firms \Rightarrow low-productivity formal firms \rightarrow informality, but also low-productivity informal firms exit.
- ▶ Consistent with McGaig and Pavcnik - Vietnam formal manufacturing benefited from improved 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. On net decline in informality.

Figure: Trade, Unemployment and Welfare



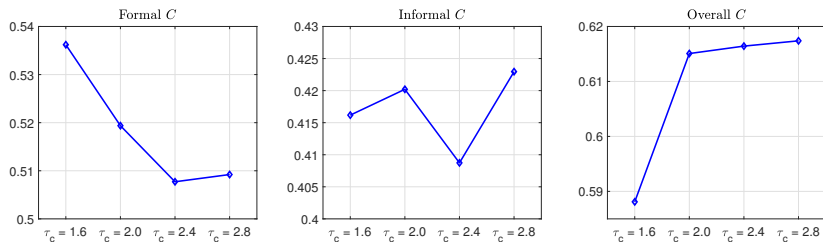
- ▶ $\tau_c \downarrow \Rightarrow$ resources reallocated toward larger firms (both in C and S)
 \Rightarrow less turnover as larger firms tend to be more stable.
- ▶ However, resources reallocated towards exporters, and $d_F \uparrow \Rightarrow$ more turnover.
- ▶ \uparrow turnover associated with \uparrow unemployment.

Figure: Trade and Aggregate TFP



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

Figure: Trade and the Std. Dev. of log-Wages Across Workers in the C sector



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

Figure: Various Scenarios of Stricter Enforcement



Figure: Trade and Welfare: Various Scenarios

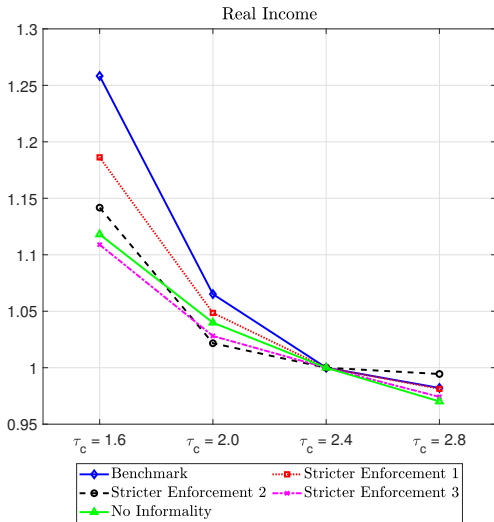


Figure: Iceberg Trade Costs and Aggregate TFP Relative to $\tau_c = 2.4$, Various Enforcement Scenarios

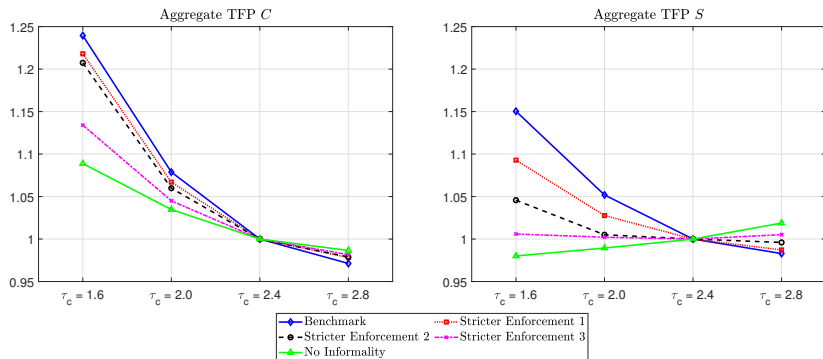
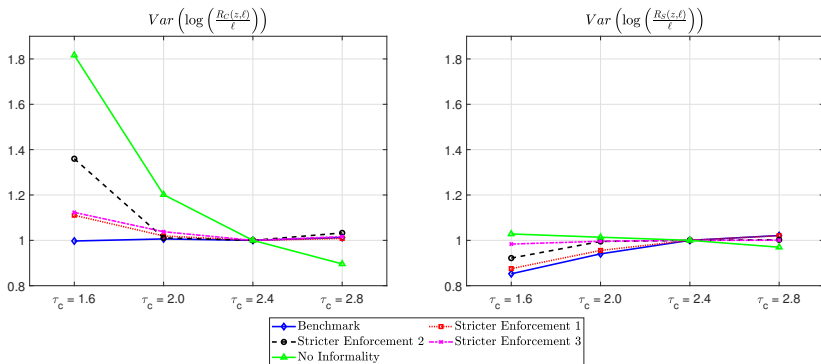


Figure: Variance of $\log\left(\frac{R_k(z,\ell)}{\ell}\right)$ Relative to $\tau_c = 2.4$, Various Enforcement Scenarios



► With small shocks

$$\Delta \text{Welfare} \approx \Delta \text{Mechanical Effect} + \Delta \text{Reallocation Effect}$$

Table: Small shock, τ_c declines from 2.4 to 2.3

	Bench	SE1	SE2	SE3	No Inf.
$100 \times \Delta \log(\text{Real Income})$	1.287	0.791	0.553	0.632	0.868
$100 \times \Delta \text{Mechanical Effect}$	0.228	0.239	0.253	0.262	0.286
$100 \times \Delta \text{Reallocation Effect}$	1.059	0.552	0.300	0.370	0.582
$100 \times \Delta \log(\text{Real Income}/\text{Employment})$	1.730	0.755	0.578	0.653	0.674
$100 \times \Delta \log(\text{Employment})$	-0.443	0.036	-0.025	-0.021	0.194

Figure: Negative Productivity Shocks, Informality, Unemployment and Welfare



Table: Small shock, Negative Productivity Shock of 0.5 pct

	Bench	SE1	SE2	SE3	No Inf.
$100 \times \Delta \log(\text{Real Income})$	-4.801	-2.488	-1.520	-1.831	-2.702
$100 \times \Delta \text{Mechanical Effect}$	-0.309	-0.308	-0.307	-0.306	-0.304
$100 \times \Delta \text{Reallocation Effect}$	-4.492	-2.180	-1.213	-1.524	-2.398
$100 \times \Delta \log(\text{Real Income}/\text{Employment})$	-5.122	-2.583	-1.256	-1.231	-1.155
$100 \times \Delta \log(\text{Employment})$	0.321	0.096	-0.264	-0.599	-1.547
$100 \times \Delta \log(\text{Agg } TFP_C)$	-1.721	-1.265	-0.809	-0.062	0.592
$100 \times \Delta \log(\text{Agg } TFP_S)$	-4.301	-2.048	-0.355	-0.018	1.599
$100 \times \Delta \text{Var}(\log(\frac{R_C(z, \ell)}{\ell}))$	1.016	1.295	1.869	-0.522	-5.971
$100 \times \Delta \text{Var}(\log(\frac{R_S(z, \ell)}{\ell}))$	4.224	2.046	0.087	0.145	-3.413

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:
 - ▶ Informal sector does not act as a “welfare buffer” in face of negative shocks.

Conclusions

- ▶ 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.
 - ▶ Gains from trade are larger in the presence of informality / domestic distortions.
 - ▶ Trade can partially “correct” for misallocation implied by these distortions.

Fact 1: Informality and Transitions

Table: Employment Shares and 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_i</i>	
	C sector	S sector
Intercept	1.135 (0.028)	1.130 (0.012)
ℓ_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 (0.013)	10.004 (0.005)	8.391 (0.037)	8.825 (0.015)	8.509 (0.006)	8.436 (0.002)	8.013 (0.033)	8.417 (0.014)
$\log(\ell_i)$	0.000 (0.005)	-0.128 (0.003)	0.342 (0.114)	0.321 (0.050)	0.117 (0.003)	0.105 (0.001)	0.292 (0.103)	0.231 (0.048)
<i>Exporter_i</i>	1.462 (0.021)				0.462 (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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Firms' value functions

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

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

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:

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

- ▶ 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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Value Added, Domestic Firms

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

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

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

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

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Fixed Parameters

Table: Fixed Parameters

Parameter	Description	Value
τ_c	Iceberg Trade Cost	2.50
ζ	Share of final expend. on C	0.283
λ_C	Prod. Function	0.645
λ_S	Prod. Function	0.291
r	Interest rate	0.08
τ_y	Value Added Tax	0.293
τ_w	Payroll Tax	0.375
$\tau_a - 1$	Import Tariff	0.12
κ	Firing Costs (in R\$)	1,956.7
\underline{w}	Min. Wage (in R\$)	2,880
b_u	Unemployment Benefit	1,644
ξ	Matching Function	0.5
ϕ	Matching Function	0.576
β	Workers' Bargaining Weight	0.5

Table: Effects of Increasing the Cost of Informality

	Bench.	Strict Enf. 1	Strict Enf. 2	Strict Enf. 3	No Inf.
Unemployment Rate	0.186	0.207	0.221	0.253	0.303
Share Emp. C_i	0.076	0.062	0.042	0.029	0.000
Share Emp. S_i	0.432	0.296	0.246	0.128	0.000
Share Informal Emp.	0.509	0.358	0.288	0.157	0.000
Imports/GDP	0.066	0.069	0.073	0.076	0.084
$N_C = N_{Cf} + N_{Ci}$	1.000	0.921	0.807	0.667	0.360
$N_S = N_{Sf} + N_{Si}$	1.000	1.011	0.992	0.803	0.561
Aggregate TFP C	1.000	1.037	1.075	1.104	1.208
Real Rev per worker C	1.000	0.969	0.946	0.890	0.860
Aggregate TFP S	1.000	1.052	1.091	1.211	1.439
Real Rev per worker S	1.000	0.996	0.975	1.006	1.055
P_C^m	1.000	1.009	1.029	1.032	1.046
P_S^m	1.000	1.004	1.013	1.014	1.020
Real Income	1.000	0.965	0.929	0.900	0.861
Real Income 2	1.000	0.940	0.885	0.824	0.734

Notes: Real Income refers to the real value of the sum of all wages and profits in the economy. Real Income 2 refers to the real value of the sum of all wages and profits in the economy including the disutility of unemployment $b_0 \times L_u$. Aggregate TFP is computed as the weighted average of the z s of all active firms—weights are given by firm-level employment. V.A. stands for value added. All variables below line 6 are normalized relative to Benchmark values.

Model Fit

Table: Employment Shares and Transition Rates from Unemployment

Moment	Dataset	Model	Data
Share of Employment C_i	PME	0.062	0.059
Share of Employment C_f	PME	0.097	0.106
Share of Employment S_i	PME	0.351	0.351
Share of Employment S_f	PME	0.303	0.334
Share Unemployment	PME	0.186	0.150
Share Informal Workers (Conditional on Working)	PME	0.508	0.482
Trans. Rate from Unemp. to C_i	PME	0.064	0.064
Trans. Rate from Unemp. to C_f	PME	0.060	0.050
Trans. Rate from Unemp. to S_i	PME	0.380	0.389
Trans. Rate from Unemp. to S_f	PME	0.161	0.161
Trans. Rate from Unemp. to Unemp.	PME	0.336	0.336
Ratio Trans. to Informal job / Trans. to Formal job	PME	2.013	2.146

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Model Fit

Table: Turnover-Related Moments and Auxiliary Models (Formal Sectors)

	Dataset	C sector		S sector	
		Model	Data	Model	Data
Exit Rate	RAIS	0.098	0.103	0.100	0.125
Average Firm-level Turnover	RAIS	0.231	0.505	0.190	0.525
$Corr(\log \ell_{i,t+1}, \log \ell_{i,t})$	RAIS	0.951	0.929	0.938	0.914
<hr/>					
$Exit_i = \alpha + \beta \log(\ell_i)$					
Intercept	RAIS	0.153	0.188	0.145	0.185
$\log(\ell_i)$	RAIS	-0.024	-0.045	-0.035	-0.049
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$Turnover_i = \alpha + \beta \log(\ell_i) + \gamma Exporter_i$					
Intercept	RAIS+SECEX	0.426	0.741	0.326	0.645
$\log(\ell_i)$	RAIS+SECEX	-0.089	-0.126	-0.106	-0.096
$Exporter_i$	RAIS+SECEX	0.072	0.071		
<hr/>					
$Turnover_i = \alpha + \beta \log(\ell_i) + \gamma Exporter_i$, Conditional on Expansions					
Intercept	RAIS+SECEX	0.379	0.692	0.278	0.690
$\log(\ell_i)$	RAIS+SECEX	-0.094	-0.138	-0.100	-0.150
$Exporter_i$	RAIS+SECEX	0.118	0.116		
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$Turnover_i = \alpha + \beta \log(\ell_i) + \gamma Exporter_i$, Conditional on Contractions					
Intercept	RAIS+SECEX	0.466	0.744	0.368	0.624
$\log(\ell_i)$	RAIS+SECEX	-0.072	-0.101	-0.067	-0.064
$Exporter_i$	RAIS+SECEX	0.056	0.056		

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Table: Firm-Size Distribution (Formal Sectors)

	Dataset	C sector		S sector	
		Model	Data	Model	Data
Avg. Firm-Level log-Employment	RAIS	2.286	1.918	1.287	1.237
Std Dev. Firm-Level log-Employment	RAIS	0.889	1.416	0.667	1.175
Avg. Exporter log-Employment	RAIS + SECEX	3.621	4.014		

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Table: Trade-Related Moments

	Dataset	Model	Data
Fraction of Exporters (among formal C-sector firms)	RAIS + SECEX	0.124	0.073
Total Exports / (Total Formal Manufacturing Revenue)	SECEX + IBGE	0.134	0.134

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Model Fit

Table: Formal-Sector Wages

	Dataset	C sector		S sector	
		Model	Data	Model	Data
Avg. log-Wages	RAIS	8.630	8.769	8.568	8.567
$\log(w_i) = \alpha + \beta \log(\ell_i) + \gamma \text{Exporter}_i$					
Intercept	RAIS+SECEX	8.298	8.509	8.433	8.436
$\log(\ell_i)$	RAIS+SECEX	0.116	0.117	0.105	0.105
Exporter_i	RAIS+SECEX	0.549	0.462		

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Table: Formal-Sector Revenues

	Dataset	C sector		S sector	
		Model	Data	Model	Data
Avg. log-Revenues	IBGE	12.682	12.726	11.151	10.814
Std. Dev. log-Revenues	IBGE	1.241	1.874	0.966	1.440
$Corr(\log Rev_{i,t+1}, \log Rev_{i,t})$	IBGE	0.777	0.929	0.756	0.845
$\log(Rev_i) = \alpha + \beta \log(\ell_i) + \gamma Exporter_i$					
Intercept	IBGE+SECEX	9.997	10.118	9.671	10.004
$\log(\ell_i)$	IBGE+SECEX	1.144	1.000	1.150	0.872
$Exporter_i$	IBGE+SECEX	0.564	1.462		

Notes: The serial correlation of $\log(Rev)$ is conditional on the employment cutoffs the PIA (30 employees) and PAS (20 employees) panels.

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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	0.249	0.105	0.275	0.097
Std. Dev. log-Employment	ECINF	0.361	0.303	0.373	0.274
Avg. log-Revenue	ECINF	9.827	8.531	9.254	8.953
Avg. log-Wages	ECINF	7.819	8.043	7.603	8.440
<i>Informal_i = $\alpha + \beta \ell_i$</i>					
Intercept	ECINF	1.328	1.135	1.244	1.130
ℓ_i	ECINF	-0.179	-0.179	-0.204	-0.204

Notes: All statistics are computed conditional on firms with five employees or less, both in the data and in the model.

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