

Payments Under the Table: Estimation and Optimal Tax Policy

Ana Franco

Federal Reserve Bank of Minneapolis

October 16, 2026

Disclaimer: The views expressed here are my own and do not necessarily reflect those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System

Motivation

- Standard view in development economics:
 - Income tax evasion is associated with *informal* work
(workers not registered on firm's payroll)
 - *Formal* employees are assumed to comply because employers report earnings
(third-party reporting)

Motivation

- Standard view in development economics:
 - Income tax evasion is associated with *informal* work (workers not registered on firm's payroll)
 - *Formal* employees are assumed to comply because employers report earnings (third-party reporting)
- Growing evidence shows that *formal employees* receive part of their wage off the books, even in the *presence of third-party reporting*
 - **Envelope wages / payments under the table (PUT)**

Motivation

- Standard view in development economics:
 - Income tax evasion is associated with *informal* work (workers not registered on firm's payroll)
 - *Formal* employees are assumed to comply because employers report earnings (third-party reporting)
- Growing evidence shows that *formal employees* receive part of their wage off the books, even in the *presence of third-party reporting*
 - **Envelope wages / payments under the table (PUT)**
- Yet we know little about what PUT implies for tax policy
 - Policy-relevant, as formal workers are not among the lowest earners (Fazio & Levy 2012, de Andrade et al. 2016)

1. Measuring PUT

- **Method:** Compare third-party reported (payroll) and self-reported (survey) wage distributions for comparable workers
- **Application (Peru):** PUT is prevalent among private formal employees
 - Extensive margin: at least 13% receive PUT
 - Intensive margin: those who do are paid at least 10% of their reported wage under the table

1. Measuring PUT

- **Method:** Compare third-party reported (payroll) and self-reported (survey) wage distributions for comparable workers
- **Application (Peru):** PUT is prevalent among private formal employees
 - Extensive margin: at least 13% receive PUT
 - Intensive margin: those who do are paid at least 10% of their reported wage under the table

2. Optimal Tax Policy with PUT

- **Theory:** Optimal PIT with firm-worker wage underreporting (PUT) & presence of CIT
 - **Key prediction:** corporate taxation reduces incentives of firms to pay under the table (b/c PUT cannot be deducted from taxable profits)
- **Empirics:** Use tax reforms to test model predictions

1. Measuring PUT

Measuring PUT: Data

- Existing studies: ask workers whether they receive PUT and how much
 - ▶ LAC Surveys : 17% of workers report receiving PUT. Among those, 23% of wages are off the books

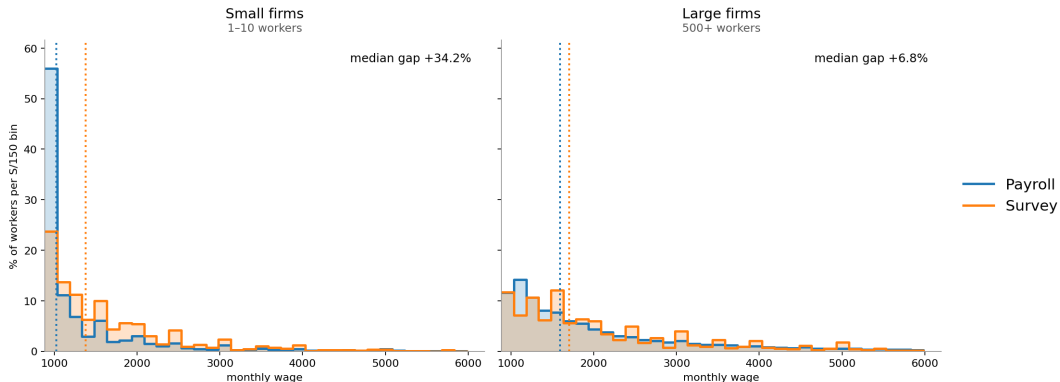
Measuring PUT: Data

- Existing studies: ask workers whether they receive PUT and how much
 - ▶ LAC Surveys : 17% of workers report receiving PUT. Among those, 23% of wages are off the books
- **This paper:** no PUT question; compare wage records governments already collect
- **Peru, 2020–2023:**
 1. Payroll records: third-party reported; all private formal employees (about 7M in 2022)
 2. Household survey (EPEN 2022–2023): self-reported; 23–24K obs/year.
ENAH0 2020–2023: as robustness
- Same population on both sides
 - Full-time private formal employees, main occupation, exclude top 4% on HH survey

Measuring PUT: Descriptive Stats

Third-party reported (payroll) vs. self-reported (survey) wages, 2022

Figure: Wage distributions, small and large firms, 2022

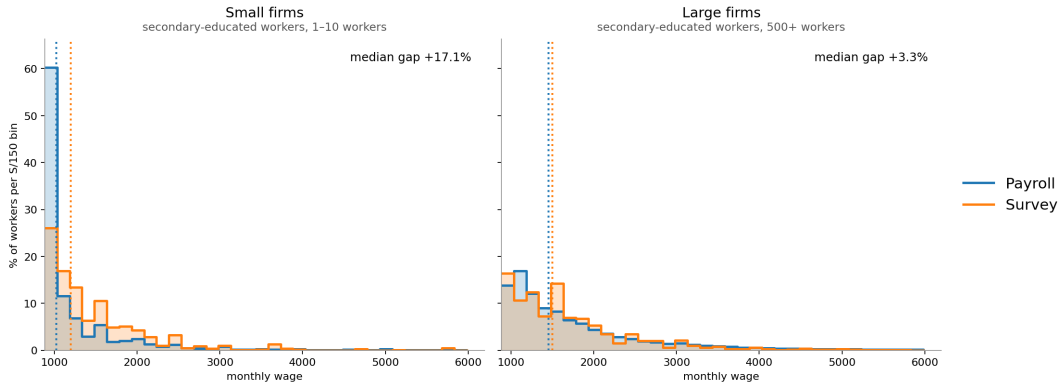


- Small firms: 53% of payroll records sit *exactly* at the minimum wage, against 15% in the survey
- Large firms: the two distributions are close. Same pattern within education groups →

Measuring PUT: Descriptive Stats

It is not that these workers are worth the minimum

Figure: Secondary-educated workers, small and large firms, 2022

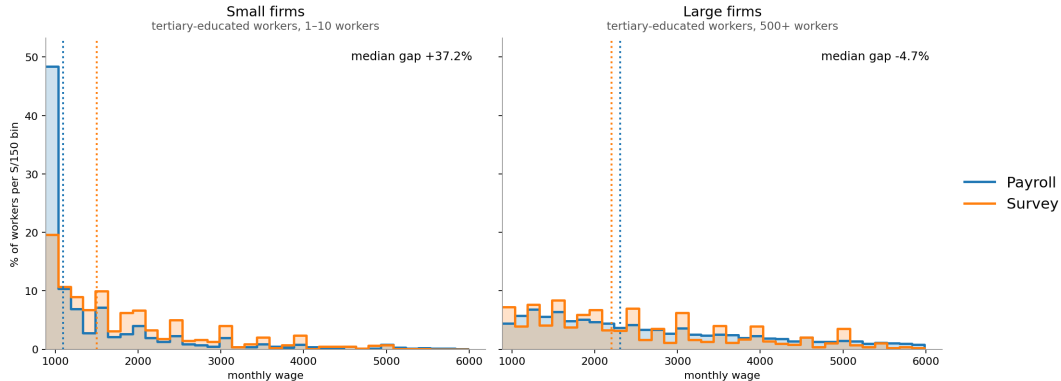


- Small firms: 57% of payroll records sit *exactly* at the minimum wage, against 16% in the survey
- Large firms: no payroll bunching at the minimum (5% vs. 10%)

Measuring PUT: Descriptive Stats

It is not that these workers are worth the minimum

Figure: Tertiary-educated workers, small and large firms, 2022



- Small firms: 45% of payroll records sit *exactly* at the minimum wage, against 13% in the survey
- Large firms: no payroll bunching at the minimum (2% vs. 4%)

Measuring PUT: Method

- Within a cell of comparable workers, we have two marginal distributions (firm size $\times$ sector; survey reweighted to payroll's age, sex, Lima)
 - Payroll: third-party reported wage $W \sim F_c$
 - Survey: self-reported wage $\sim G_c$. **Assumed** to be the true one (s.t. ME)
- **Goal:** $PUT = Y - W$
 - The two sources cannot be linked: we see F_c and G_c , never who is who

Measuring PUT: Method

- Within a cell of comparable workers, we have two marginal distributions (firm size $\times$ sector; survey reweighted to payroll's age, sex, Lima)
 - Payroll: third-party reported wage $W \sim F_c$
 - Survey: self-reported wage $\sim G_c$. **Assumed** to be the true one (s.t. ME)
- **Goal:** $PUT = Y - W$
 - The two sources cannot be linked: we see F_c and G_c , never who is who
- **Approach, in two steps:**
 1. Compare the two distributions within cells (mean, median) $\rightarrow$ needs *no* pairing
 2. Margins: the least PUT consistent with both, under *any* pairing
 - $\rightarrow$ lower bounds on extensive margin and intensive margin via Optimal Transport

Step 1: Within Cells

By firm size: same comparison, holding observables fixed

Table: Within-cell wage gap by firm size

	Mean gap (% payroll mean)		Median gap (% payroll median)	
	2022	2023	2022	2023
All	5.5***	5.3***	8.4***	10.3***
Micro, 1–10	22.5***	27.1***	31.2***	45.9***
11–100	1.1	–0.7	1.7	–1.6
101–500	–1.4	–5.5***	–0.9	–5.8***
500+	2.6**	1.7*	5.1**	4.7*

- Micro firms: about a quarter on means, a third or more on medians, in both years
- Larger firms: small (at most 5%); negative at 101–500 in 2023 (survey under-captures high salaries)

Step 2: Margins

By firm size, EPEN 2022–2023

Table: Lower bounds consistent with the two marginals (%)

	Extensive margin share receiving PUT		Intensive margin PUT per recipient, % own wage		Avg. PUT rate PUT/own wage, all workers	
	2022	2023	2022	2023	2022	2023
All	≥ 13.2	≥ 13.7	≥ 9.7	≥ 11.9	≥ 7.7	≥ 8.2
Micro, 1–10	≥ 33.5	≥ 38.0	≥ 25.7	≥ 33.8	≥ 22.0	≥ 27.1
11–100	≥ 6.3	≥ 4.8	≥ 5.2	≥ 5.3	≥ 3.7	≥ 2.4
101–500	≥ 4.7	≥ 3.1	≥ 4.1	≥ 3.0	≥ 2.4	≥ 1.0
500+	≥ 10.8	≥ 10.3	≥ 6.4	≥ 6.0	≥ 5.1	≥ 4.3

- By sector: agriculture (≥37%), mining (≥19%) and construction (≥18%) stand out
- PUT-LAC survey, Peru: 10% say they receive PUT (extensive), at 22% of their true wage (intensive)

► Extensive bound

► All years

► Intensive bound

► Sectors

2. Optimal Tax Policy with PUT

Model

PUT and the Tax System

Tax System in Peru

Tax System in Peru, MTR					
	PIT	Payroll Tax			Corporate Tax
		Pensions	Healthcare	UI	General Regime
Individual Income					
$[\bar{w}, 2.5\bar{w})$	0%	13%	9.7%	9%	
$[2.5\bar{w}, 4\bar{w})$	8%	13%	9.7%	9%	
$[4\bar{w}, 9\bar{w})$	14%	13%	9.7%	9%	
$[9\bar{w}, 14.5\bar{w})$	17%	13%	9.7%	9%	
$[14.5\bar{w}, 18\bar{w})$	20%	13%	9.7%	9%	
$18\bar{w}+$	30%	13%	9.7%	9%	
Firm Profits					
> 0					29.5%
Levied on:	Workers	Workers	Firms	Firms	Firms

- PUT is not subject to personal income tax, but cannot be deducted from corporate tax, so it increases the firm's taxable profit. Incentives for firm? Joint surplus

PUT and the Tax System

Tax System in Peru

Tax System in Peru, MTR					
	PIT	Payroll Tax			Corporate Tax
		Pensions	Healthcare	UI	General Regime
Individual Income					
$[\bar{w}, 2.5\bar{w})$	0%	13%	9.7%	9%	= 31.7%
$[2.5\bar{w}, 4\bar{w})$	8%	13%	9.7%	9%	
$[4\bar{w}, 9\bar{w})$	14%	13%	9.7%	9%	
$[9\bar{w}, 14.5\bar{w})$	17%	13%	9.7%	9%	
$[14.5\bar{w}, 18\bar{w})$	20%	13%	9.7%	9%	
$18\bar{w}+$	30%	13%	9.7%	9%	
Firm Profits					
> 0					29.5%
Levied on:	Workers	Workers	Firms	Firms	Firms

- PUT is not subject to personal income tax, but cannot be deducted from corporate tax, so it increases the firm's taxable profit. Incentives for firm? Joint surplus

Model Overview

- **Policy instruments:** PIT τ (incl. payroll tax), CIT t , transfer T
- **Workers:** wage subject to PIT ► Workers
 - Formal: true and reported wages are the same, w^F
 - PUT: true wage w^P , reported wage: $w^P - \text{PUT}$
(PUT not subject to PIT, but there is a cost of informality)
- **Firm:** profits subject to CIT ► Firms
 - **PUT not deductible** from taxable profits $\Rightarrow \uparrow$ effective hiring cost
- **Equilibrium:** labor demand = labor supply in each contract; wages $\{w^F, w^P\}$ adjust
- **Government:** chooses PIT that maximizes welfare, given CIT ► Planner

Optimal Income Tax

- $PUT = PUT(\tau, t)$ + fn. of PIT & - fn. of CIT
- Optimal PIT formula:

$$\tau^* = \frac{1 - \tilde{g} - t(1 - g_\pi) \frac{PUT}{\hat{Z}} e_{PUT}}{1 - \tilde{g} + \text{ETI}}$$

1. Numerator: + **fiscal externality**. PUT raises taxable profits and CIT revenue $\rightarrow$ higher τ^*
2. Denominator: $\downarrow$ **ETI than worker wage under-reporting**. Higher CIT, lower ETI $\rightarrow$ higher τ^*

$$\text{ETI} = \frac{d \log \hat{Z}}{d \log(1 - \tau)} = \underbrace{\text{labor supply + wage effects}}_{\text{standard}} - \underbrace{\frac{PUT}{\hat{Z}} \frac{d \log PUT}{d \log(1 - \tau)}}_{\text{PUT response}}^{e_{PUT}}$$

2. Optimal Tax Policy with PUT

Estimation

Empirics

Policy Change: Peru's Agricultural Regime

- **Agricultural Regime:** workers in agricultural firms in roles in the field → lower payroll tax & CIT
- Non-field/admin ag workers must be hired under the General Regime → standard tax rates
- **Changes:** 2020-2021: ↑ payroll tax & no change in CIT; 2022-2023: ↑ payroll tax & ↑ CIT

Table: Statutory rates, Agricultural vs. General Regime, 2020–2023

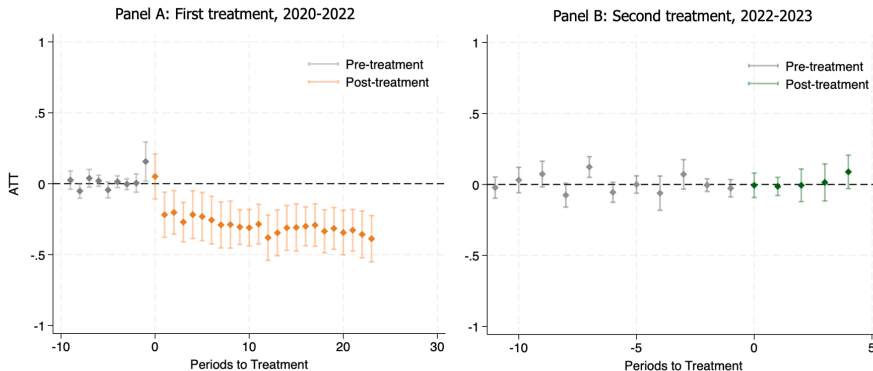
Year	Ag Regime (AgR) (treated)				General Regime (GR) (control)	
	Healthcare (payroll tax)		Corporate Tax		Healthcare	Corporate Tax
	Small	Large	Small	Large	All	All
2020	4%	4%	15%	15%	9%	29.5%
2021	6%	7%	15%	15%	9%	29.5%
2022	6%	7%	15%	15%	9%	29.5%
2023	6%	8%	15%	20%	9%	29.5%

Notes: Small firms have less than 100 workers. Large firms have 100 workers or more.

ETI Estimates

Parallel Trends

Figure: Event study, log reported income. A: AgR vs. GR (2021 reform). B: large vs. small AgR (2023)



- Panel A: sharp decrease in reported income in the first period
- Panel B: no change in the second period

Table: Elasticity of taxable income, continuous difference-in-differences

	Dep. Var.: $\log(\hat{Z}_{ijt})$			
	2020–2022 (CIT unchanged)			2022–2023 (CIT increased)
Treated firms:	All AR	Large AR	Small AR	Large AR
Control firms:	GR	GR	GR	Small AR
	(1)	(2)	(3)	(4)
$\log(1 - \tau_{jt})$	2.274*** (0.410)	2.614*** (0.684)	1.620*** (0.254)	0.748* (0.337)
Time FE (month–year)	Yes	Yes	Yes	Yes
Group FE (size $\times$ regime)	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Worker controls	Yes	Yes	Yes	Yes
Observations	10,003,142	8,774,570	1,228,572	4,051,641
R^2	0.223	0.216	0.230	0.116

Notes: Continuous DiD of log reported income on $\log(1 - \tau)$ across regime $\times$ size cells (Kleven & Schultz 2014). AR = Agricultural Regime; GR = General Regime. Standard errors (in parentheses) clustered at firm-size $\times$ regime. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

- ETI > 2 when CIT is unchanged, < 1 when CIT increases: consistent with the model ► Specification

Concluding Remarks

1. **Measuring PUT.** Comparing payroll and survey wage distributions for comparable workers: PUT is concentrated in micro firms, at the minimum wage. At least 1 in 3 micro-firm workers receive it, at least a quarter of their reported wage.
2. **Tax design with PUT.** Optimal income tax is a function of the corporate tax:

- FE: PUT is less costly than standard worker-side evasion:

$\$1 \text{ hidden} \neq \$1 \text{ lost}$ (CIT offsets part of it).

- ETI: The corporate tax rate t acts as a policy lever:

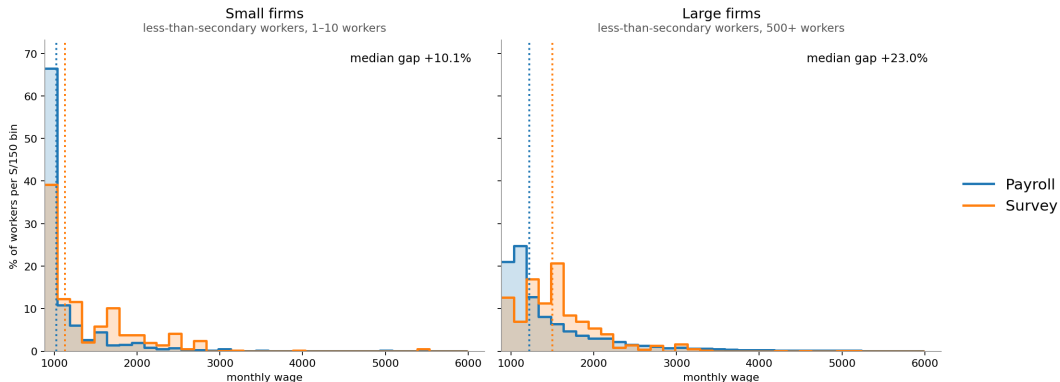
$\uparrow t \Rightarrow \uparrow \text{PUT cost for firms} \Rightarrow \downarrow \text{PUT incentives} \Rightarrow \downarrow \text{ETI}.$

Thank you!
apfranco@umich.edu

Measuring PUT: Descriptive Stats

It is not that these workers are worth the minimum

Figure: Workers without complete secondary, small and large firms, 2022



Small firms: 63% of payroll records sit *exactly* at the minimum wage, against 25% in the survey. At large firms, no payroll bunching at the minimum (7% vs. 8%).

[Back](#)

Firms and Equilibrium

Corporate tax wedge

Firm problem:

$$\max_{L^F, L^P} (1 - t) \left[\phi(L^F + L^P) - w^F L^F - w^P L^P \right] - \underbrace{t \text{ PUT } L^P}_{\text{non-deductible PUT payments}}$$

FOCs:

$$\phi'(L) = w^F, \quad \phi'(L) = w^P + \frac{t}{1 - t} \text{ PUT}$$

$$\Rightarrow \text{PUT raises the firm's effective labor cost by } \frac{t}{1 - t} \text{ PUT}$$

Equilibrium objects

- **Market clearing:** $L^S = L^D$ in each arrangement $\Rightarrow$ wages (w^F, w^P) and cutoff θ^*
- Reported labor income: $\hat{Z} = w^F L^F + (w^P - \text{PUT}) L^P$
- Aggregate PUT: $\text{PUT} = \int_0^{\theta^*} \text{PUT}(\theta) l^P(\theta) dQ(\theta) (= \bar{\text{PUT}} L^P)$

Related Literature

1. **PUT/envelope wages.** Focused on measurement. Either with survey data or by exploiting reforms that affect reported—but not true—compensation
(Barth & Ognedal, 2018; Di Nola et al., 2019; Williams & Padmore, 2013; Feinmann et al., 2025; Bergolo & Cruces, 2014; Kumler et al., 2020; Biro et al., 2022; Bjørneby et al., 2021; Gavoille & Zasova, 2023)
This paper: first to introduce tax design to PUT literature
2. **Optimal income taxation.** Builds on Mirrlees and the sufficient-statistics tradition and links optimal tax to evasion/avoidance margins
(Saez 2001, Chetty 2009, Allingham & Sandmo 1972, Slemrod & Yitzhaki 2002, Best et al. 2015)
This paper: extends the models of optimal income taxation to allow for imperfect third-party reporting
3. **Data combination and partial identification.** Bounds on the joint distribution when two marginals are observed in separate samples
(Makarov 1981; Ridder & Moffitt 2007; Fan & Park 2010; Chernozhukov, Lee & Rosen 2013)
This paper: bounds on the prevalence and size of underreporting from unlinked administrative and survey data
4. **Informality in labor markets.** Large literature studying the prevalence and consequences of informality in developing countries
(Williams & Lansky 2013, Bitran 2014, La Porta & Shleifer 2014, Ulyssea 2020)

Step 2: Margins

By sector, EPEN 2022–2023

Table: Least values over all pairings, by sector (%)

	Extensive margin share receiving PUT		Intensive margin PUT per recipient, % own wage		Avg. PUT rate PUT/own wage, all workers	
	2022	2023	2022	2023	2022	2023
All	≥ 13.2	≥ 13.7	≥ 9.7	≥ 11.9	≥ 7.7	≥ 8.2
Agriculture	≥ 36.8	≥ 35.3	≥ 18.8	≥ 15.8	≥ 17.8	≥ 14.3
Construction	≥ 18.0	≥ 16.7	≥ 16.6	≥ 16.3	≥ 15.4	≥ 13.8
Mining	≥ 19.3	≥ 17.5	≥ 14.8	≥ 18.1	≥ 11.3	≥ 13.8
Commerce	≥ 12.1	≥ 15.5	≥ 11.1	≥ 13.5	≥ 7.9	≥ 8.6
Manufacturing	≥ 12.1	≥ 11.7	≥ 7.3	≥ 10.1	≥ 5.6	≥ 7.1
Services	≥ 8.9	≥ 10.5	≥ 6.8	≥ 10.4	≥ 5.1	≥ 6.8

Agriculture, construction and mining stand out on all three.

► Back

Workers

Formal vs PUT

- **Formal:**

$$\max_l (1 - \tau)w^F l + T - v(l) \quad \Rightarrow \quad v'(l^F) = (1 - \tau)w^F$$

- **PUT (choose l and underreporting PUT):**

$$\max_{l, \text{PUT}} (1 - \tau)w^P l + T - v(l) + \underbrace{\tau \text{PUT} l}_{\text{tax savings}} - \underbrace{g(\theta, \text{PUT} l)}_{\text{lost value of formal benefits}}$$

$$v'(l^P) = (1 - \tau)w^P + \tau \text{PUT} - g'(\theta, \text{PUT} l) \cdot \text{PUT}, \quad \tau = g'(\theta, \text{PUT} l)$$

g strictly increasing and convex in PUT

- **Choice:** choose PUT iff $V^P(\theta) \geq V^F \Rightarrow$ cutoff $\theta^* \Rightarrow$ labor supply

- Social Welfare Function:

$$SWF = \underbrace{s^N G(V^N)}_{\text{non-workers}} + \underbrace{G(V^\pi)}_{\text{firm}} + \underbrace{(1 - s^N) \left[\int_0^{\theta^*} G(V^{\text{PUT}}) dQ(\theta) + \int_{\theta^*}^{\infty} G(V^F) dQ(\theta) \right]}_{\text{workers}}$$

G increasing, concave

- Budget: $\tau \{\text{Taxable Income}\} + t \{\text{Taxable Profits}\} = T$
- **Goal:** choose the income tax τ that maximizes SWF, subject to balanced budget constraint

Empirics

ETI Regression

- I estimate a continuous DiD exploiting statutory changes in τ across *regime* $\times$ *firm-size* cells over time
- Specification (Kleven and Schultz 2014):

$$\log \hat{z}_{ijt} = \alpha + \underbrace{\varepsilon}_{\text{ETI}} \log(1 - \tau_{jt}) + X_{ijt}\gamma + \delta_j + \delta_t + \nu_{ijt}$$

- i : worker; j : regime $\times$ size cell; t : year
- τ : statutory income tax, $\hat{z}$: reported income
- Two samples:
 - 2020–2022: AgR with CIT constant treated vs. GR as controls (small + large)
 - 2022–2023: large AR treated (CIT 15% $\rightarrow$ 20%) vs. small AR as controls

We cover 6 of the 7 largest countries in Latin America and the Caribbean

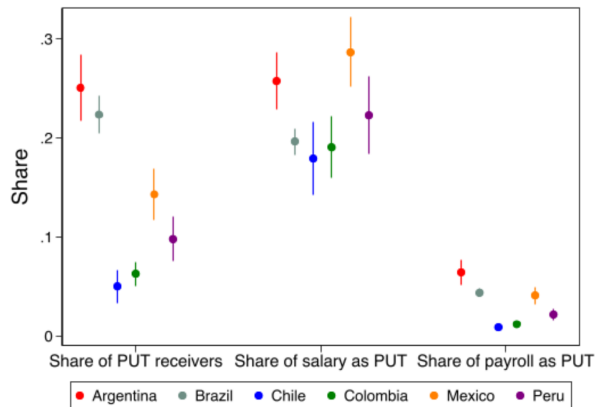
→ The countries in our survey represent 79% of the total labor force in the region

Economic and Informal Employment Statistics for Countries in our Sample in 2023

Country	GDP per capita	Informal / Employees	Informal / Labor Force	Population
Chile	US\$ 15,923	6.1 %	29.2 %	19.49 M
Argentina	US\$ 10,729	35.96 %	49.4 %	45.81 M
Mexico	US\$ 10,045	37.65 %	57.6 %	126.19 M
Brazil	US\$ 8,570	22.17 %	47.2 %	213.99 M
Colombia	US\$ 6,131	28.36 %	62.1 %	51.27 M
Peru	US\$ 5,358	34.30 %	68.4 %	33.36 M

Source: **World Bank Database**

Figure: PUT Prevalence by country



Extensive Margin

How many must receive PUT

$$\Pr(\text{PUT} > 0) \geq \underbrace{\sup_t [F_{\text{payroll}}(t) - F_{\text{survey}}(t)]}_{\text{lower bound}}$$

- At a wage t : share *reported* at or below t vs. share whose *true wage* is at or below t
- Every wage gives an “at least”; all hold at once $\Rightarrow$ keep the largest
- E.g. 60% reported $\leq S/1,000$, but only 40% with true wage $\leq S/1,000$
 $\Rightarrow$ at least 20% are reported below their true wage. Whoever they are, they receive PUT

Micro firms, 2022: at least **33.5%** receive PUT, under any pairing (all firms: 13.2%)

► Back

Extensive Margin, All Years

Table: Least share receiving PUT, $\Pr(\text{PUT} > 0)$, 2020–2023 (%)

	2020	2021	2022		2023	
	ENAH0	ENAH0	ENAH0	EPEN	ENAH0	EPEN
<i>By firm size</i>						
All	15.8	16.5	14.2	13.2	15.2	13.7
Micro, 1–10	40.2	44.3	35.9	33.5	43.5	38.0
11–100	9.5	10.6	7.4	6.3	7.1	4.8
101–500	8.0	5.1	6.7	4.7	4.3	3.1
500+	9.8	10.0	10.7	10.8	8.7	10.3
<i>By sector</i>						
Agriculture	18.9	31.1	34.4	36.8	36.9	35.3
Construction	26.0	17.1	31.2	18.0	20.3	16.7
Mining	22.2	20.1	17.0	19.3	15.6	17.5
Commerce	17.6	20.6	14.8	12.1	18.9	15.5
Manufacturing	13.8	14.6	9.5	12.1	11.8	11.7
Services	13.5	12.9	9.1	8.9	11.6	10.5

Least share over all pairings consistent with the two distributions within cells (firm size $\times$ sector; survey reweighted to the payroll's age, sex and Lima mix). One-sided 95% lower confidence bounds in the paper.

Agriculture rises from 19% to about a third after the 2021 reform.

► Back

Raw Gap

No cells

Table: Raw wage gap by firm size, no cells

	Mean gap (% payroll mean)				Median gap (% payroll median)			
	2020	2021	2022	2023	2020	2021	2022	2023
All	2.6	0.8	2.0	1.0	5.9	3.8	6.3	5.2
Micro, 1-10	16.4	16.0	17.6	16.9	29.2	31.6	31.3	36.1
11-50	3.0	0.8	1.4	4.2	7.9	-0.7	2.5	7.5
51-500	-4.1	-7.2	-4.3	-7.4	-3.4	-7.7	-4.8	-6.1
500+	0.0	0.8	0.6	-2.1	0.7	1.5	4.2	0.9

- The gap is at micro firms, in every year, on means and medians
- Economy-wide the mean gap is close to zero: large firms net out

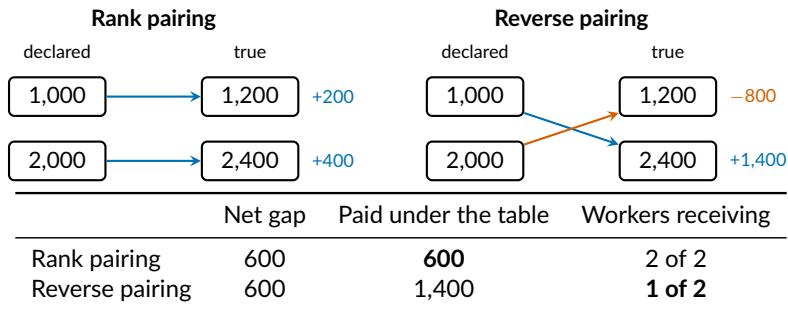
► Back

Private employers, window $[0.95 \times \text{lowest minimum wage, top-4\% cut}]$.

Who Receives and How Much

We never see who is who

Two workers in one cell. Payroll: 1,000 and 2,000. Survey: 1,200 and 2,400.



The net gap never depends on the pairing. Everything else does → report what **every** pairing must satisfy

► Back

Intensive Margin Without Assuming a Pairing

$$E\left[\frac{\text{PUT}}{w} \mid \text{PUT} > 0\right] = \frac{E[(\text{PUT}/w)^+]}{\Pr(\text{PUT} > 0)} \geq \frac{\overbrace{E_{\text{rank}}[(\text{PUT}/w)^+]}}^{\text{lower bound}}}{\underbrace{1 - \sup_t [F_{\text{survey}}(t) - F_{\text{payroll}}(t^-)]}_{\text{upper bound}}}$$

Numerator: the smallest it can be.

Average concealed share over *all* workers, non-recipients as 0. Rank matching offsets positive and negative gaps the most, so no pairing gives less. Used to compute the bound, not assumed.

Denominator: the largest it can be.

100% minus the workers whose true wage must be at or below their reported wage. The least PUT, spread over the most recipients, gives the least per recipient.

Micro firms, 2022 (EPEN): sharp minimum over all pairings (linear-fractional program):
25.7% of the reported wage

Figure: Share with PUT above δ of declared wage

What the marginal force (2022): share of workers whose PUT exceeds δ of their declared wage
size $\times$ industry cells, survey reweighted within cells; floor and ceiling hold under any pairing; blue line is one pairing



Share of workers with PUT above δ of the declared wage, 2022. Dark: floor under any pairing; blue: rank matching.

- With few survey workers per cell, noise alone makes two distributions look different
- Bounds use broad cells (firm size $\times$ sector, 24 cells), reweighted to the payroll's age, sex and Lima mix
- Largest-gap bounds: standard small-sample correction (Chernozhukov, Lee & Rosen 2013)
- Averages: benchmarked against a **placebo** that compares the payroll with itself (true answer: zero)
- Placebo, all firms 2022: extensive 1.6% (vs. 13.2%); average PUT rate 0.6% (vs. 7.7%)

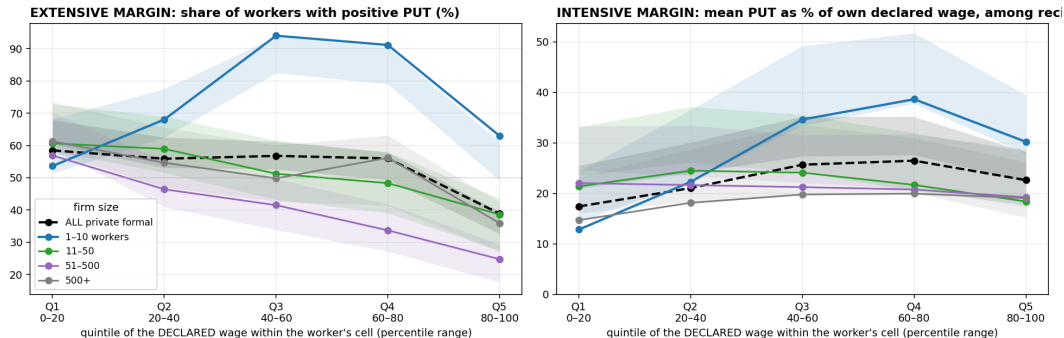
Why Is the Economy-Wide Gap Near Zero?

- The net gap is positives minus negatives. The negatives sit at 51–500 firms and among tertiary-educated workers at large firms (raw gap -9 to -11%)
- Reading: the survey under-captures high salaries in each cell, not over-declaration in payroll
- State-owned enterprises, where workers are verifiably in both sources: gap ≈ 0
- Positive block alone, under any pairing: at least 3.6% of the wage bill economy-wide, 17% at micro firms (2022)

Rank Invariance by Declared-Wage Quintile

Figure: Extensive and intensive margins by declared-wage quintile within cell, rank invariance, 2022

Extensive and intensive margins by rank within the worker's cell
2022, rank invariance, scope-matched, imputation within cells; shaded = 95% design-bootstrap CI



Under rank invariance. The micro-firm hump at Q2 is the assumption: it hands the workers declared at the minimum the lowest true wages in their cell.

The Bounds

Within a cell, payroll gives F (declared W), the survey gives G (true Y); no dataset links them.

Share receiving (sharp over all pairings; Makarov 1981):

$$\max \left\{ \sup_t [F(t) - G(t)], 0 \right\} \leq \Pr(Y > W) \leq 1 - \max \left\{ \sup_t [G(t) - F(t^-)], 0 \right\}$$

At threshold δ : replace $G(t)$ by $G((1 + \delta)t)$ for $\Pr(Y - W > \delta W)$.

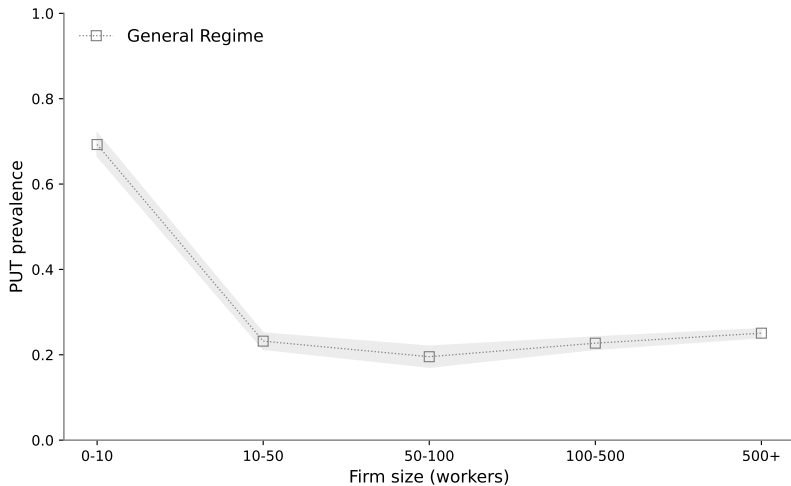
Positive block: $(y - w)^+$ is convex in $y - w$, so rank matching *minimizes* $E[(Y - W)^+]$ over all pairings.

Per recipient: $(y/w - 1)^+$ is submodular in (w, y) , so rank matching also minimizes $E[(Y/W)^+]$; divide by the upper bound on $\Pr(Y > W)$.

Small cells: largest-gap estimators are biased toward finding a gap; corrected with Chernozhukov, Lee & Rosen (2013); averages benchmarked against a payroll-vs-payroll placebo.

PUT and the Tax System

Special Regime



PUT and the Tax System

Tax System in Peru

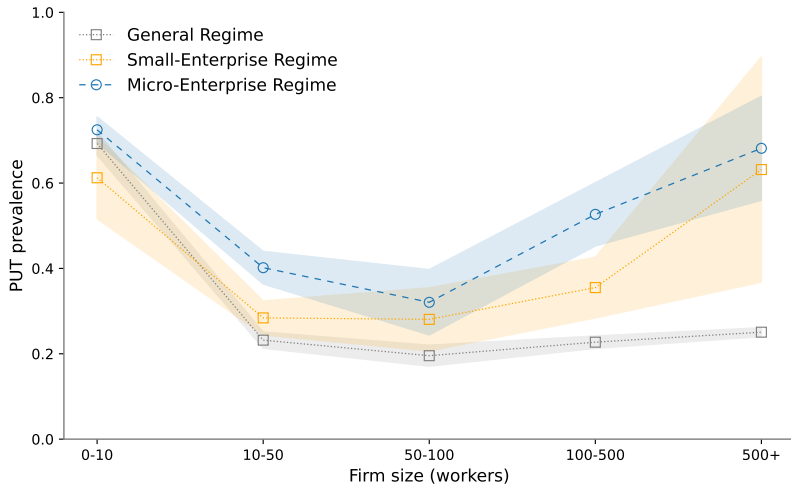
General Regime (GR) vs. Special Regime for Small Firms (SR), MTR

	PIT	Payroll Tax			Corporate Tax	
		Pensions	Healthcare	UI	GR	SR
Individual Income						
$[\bar{w}, 2.5\bar{w})$	0%	13%	9.7%	9%		
$[2.5\bar{w}, 4\bar{w})$	8%	13%	9.7%	9%		
$[4\bar{w}, 9\bar{w})$	14%	13%	9.7%	9%		
$[9\bar{w}, 14.5\bar{w})$	17%	13%	9.7%	9%		
$[14.5\bar{w}, 18\bar{w})$	20%	13%	9.7%	9%		
$18\bar{w}+$	30%	13%	9.7%	9%		
Firm Profits						
> 0					29.5%	10-25%%
Levied on:	Workers	Workers	Firms	Firms	Firms	Firms

- **Special Regime for Small Firms:** lower CIT. More incentives for PUT.

PUT and the Tax System

Special Regime for Small Firms



PUT and the Tax System

Tax System in Peru

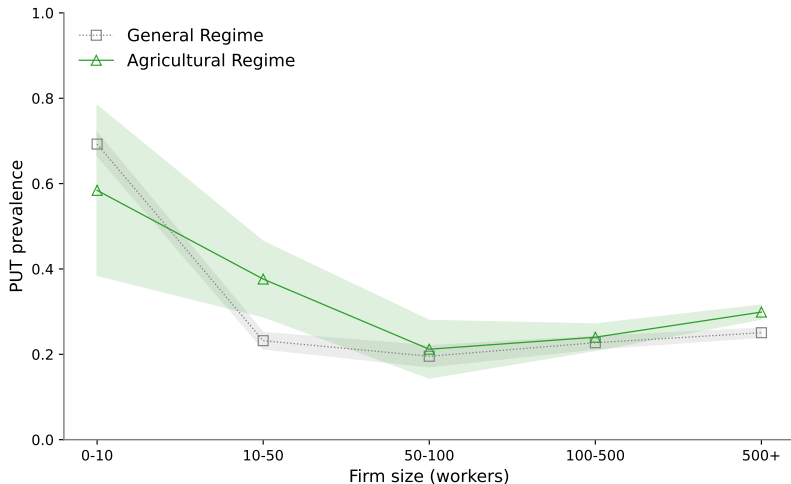
General Regime (GR) vs. Agricultural Regime (AR) , MTR

	PIT	Payroll Tax				Corporate Tax	
		Pensions	Healthcare		UI	GR	AR
			GR	AR			
Individual Income							
$[\bar{w}, 2.5\bar{w})$	0%	13%	9%	4-8%	9%		
$[2.5\bar{w}, 4\bar{w})$	8%	13%	9%	4-8%	9%		
$[4\bar{w}, 9\bar{w})$	14%	13%	9%	4-8%	9%		
$[9\bar{w}, 14.5\bar{w})$	17%	13%	9%	4-8%	9%		
$[14.5\bar{w}, 18\bar{w})$	20%	13%	9%	4-8%	9%		
$18\bar{w}+$	30%	13%	9%	4-8%	9%		
Firm Profits							
> 0						29.5%	15%
Levied on:	Workers	Workers	Firms	Firms	Firms	Firms	Firms

- **Agricultural Regime:** lower CIT but also lower healthcare payroll tax.

PUT and the Tax System

Agricultural Regime



⇒ There is an interaction in incentives to do PUT between the income tax and corporate tax