Minimum Wages, Inequality, and the Informal Sector

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Most recent slides:

Introduction

- Long-standing debate on the economic **effects of the minimum wage**
- Minimum wage important driver in **reducing earnings inequality** in Brazil in the 2000s
- Large share of employment in developing world operates **informally**
  - Economic agents responding to incentives
- However... quantitative work on the minimum wage **disregards the informal sector**

How the minimum wage affects income inequality in countries with a large informal sector?

This paper

Empirics: 1996-2012 Brazil

- **Large informal sector**, which represents over 30% of the labor force

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- **Informal inequality did not fall** alongside the **rapid expansion of the federal minimum wage**

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  - States most exposed to minimum wage experienced relative increases in overall inequality
  - Driven by relative **increases in informal inequality and the informal share of labor**

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Theory: model where **monopsonists** compete under **a minimum wage and an informal sector**

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- Minimum wage can have the **unintended consequence of increasing overall inequality**

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- Minimum wage can have the unintended consequence of increasing overall inequality
  - Minimum wage **reduces monopsony power** in the formal sector, **reducing formal inequality**

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  - Minimum wage reduces monopsony power in the formal sector, reducing formal inequality
  - **Some firms become informal**, readjust wages and employment, **increasing informal inequality**

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Quantification: bring in **skill heterogeneity** and **skill bias in the production technology**

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  - **112% increase in enforcement** of formal employment **to undo unintended consequence**

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  - 112% increase in enforcement of formal employment to undo unintended consequence
  - Improvements in **skill composition of labor force reduced informality** by 40%

Literature

1. Informality

   Rauch (1991), La Porta and Shleifer (2008), Ulyssea (2010), La Porta and Shleifer (2014), Meghir, Narita, and Robin (2015), Ulyssea (2018), Ulyssea (2020), Gomes, Iachan, and Santos (2020)

2. Minimum wage effects on the formal sector

   Card and Krueger (1994), DiNardo, Fortin, and Lemieux (1996), Burdett and Mortensen (1998), Lee (1999), Flinn (2010), Autor, Manning, and Smith (2016), Harasztosi and Lindner (2019), Haanwinckel (2020), Engbom and Moser (2021)

3. Minimum wages and the informal sector

   Lemos (2009), Haanwinckel and Soares (2016), Jales (2018), Jales and Yu (2020), Derenoncourt et al. (2021)

Contributions:

1. **Reduced form evidence** on the impact of minimum wage on inequality and the informal sector
2. Develop **quantitative framework to assess the aggregate effects** of minimum wage

Outline

Data and stylized facts

Cross-state variation, minimum wage, inequality, and the informal sector

A benchmark model of the informal sector and minimum wages

Quantitative analysis

Conclusion

Data and stylized facts

Data and definitions

- Main data source: 1996-2012 PNAD ▸ RAIS ▸ ECINF
  - Labor market survey with socioeconomic info on representative sample of Brazilian workers
- Informal worker: employee without a signed working card ▸ Favela Census
  - Working card, when signed by the firm, guarantees access to formal labor legislation
- Sample of individuals highly attached to the labor force
  - All genders, 18-54 years old
- Earnings measure: real monthly earnings from main job ▸ Contract hours
  - $<5\%$ of workers declare to have more than one job ▸ Shares
  - Deflated by the CPI and expressed in 2012 Brazilian Reais
- Minimum wage in Brazil is a federal floor on monthly earnings of formal workers

The large informal sector in Brazil, 1996-2012

- Informality represents **large share of labor force**
- Informal workers are less paid, less educated, more female, and younger

	1996		2012	
	Formal	Informal	Formal	Informal
Share	60.9	**39.1**	69.1	**30.9**
Mean earnings	1,387	673	1,388	840
Share with HS	31.5	14.6	61.2	38.4
Male	63.8	55.2	58.6	50.0
Age	32.5	31.0	33.7	33.5

Notes: Earnings are deflated by CPI and expressed in 2012 values. *Sources:* PNAD.

▸ Across industries ▸ Shift share ind ▸ Shift share educ ▸ Unempl ▸ Mean/median earnings

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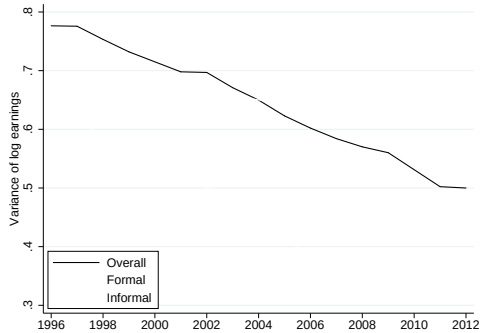
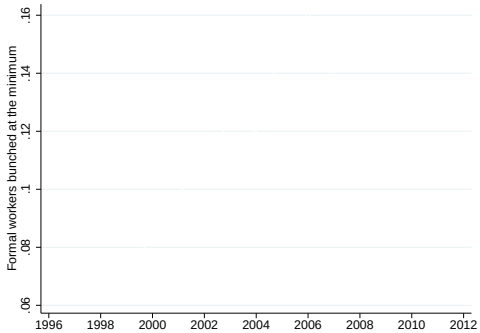
Earnings inequality and the minimum wage: aggregate time series

- Substantial **36% decrease in aggregate inequality** ($\equiv$ variance of log earnings)

(a) Inequality



(b) Minimum wage



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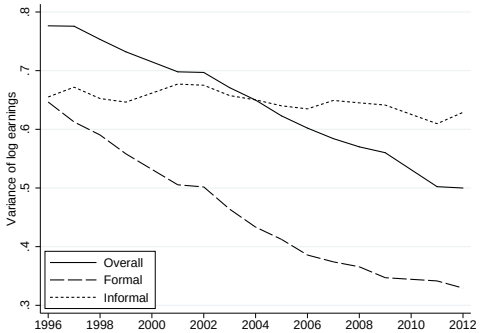

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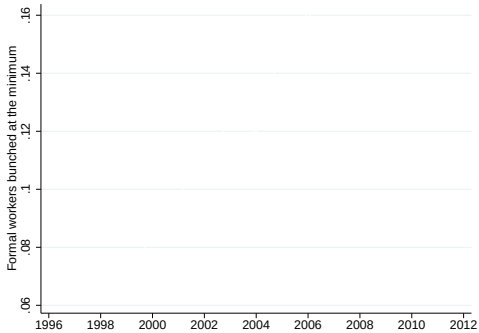

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- Formal inequality fell by 50%; Informal inequality fluctuated around 0.65
- Sharp **increase in share of formal workers at min wage**, particularly after 1999 (7% $\nearrow$ 16%)

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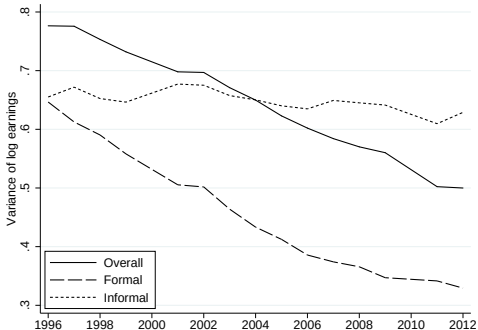

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Cross-state variation, minimum wage, inequality, and the informal sector

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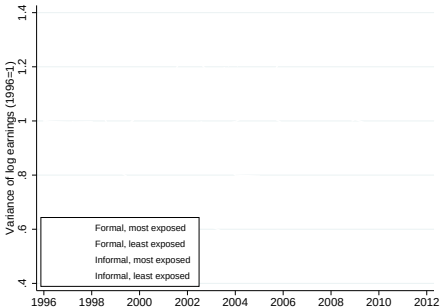
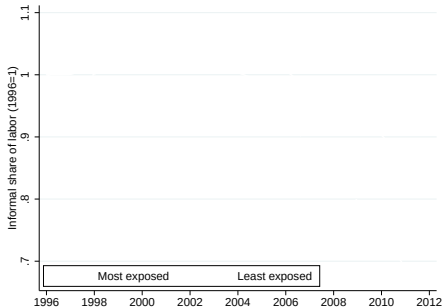


(b) Informality



Cross-state variation, inequality, and the informal sector

- Compare ineq/inf in 3 states with most/least share of min wage workers in 1999 ▸ Shares
- **States most exposed to the minimum wage** hike experienced...
  - Stronger **formal inequality decreases** (60% vs. 40% in least exposed)

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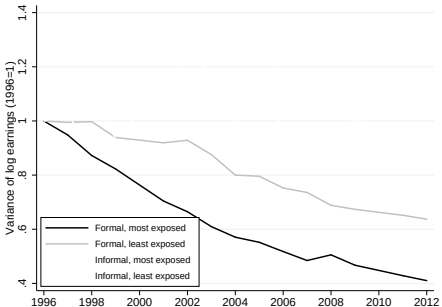

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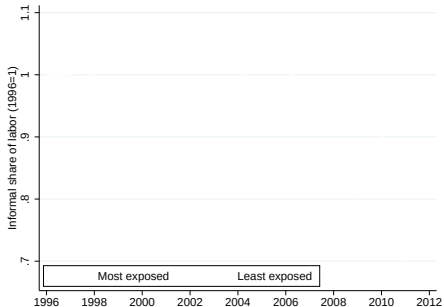

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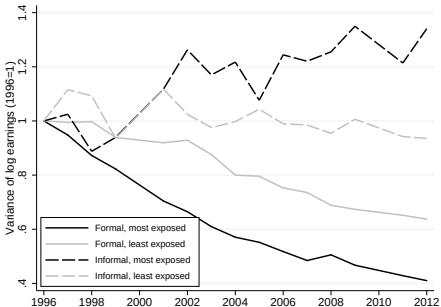

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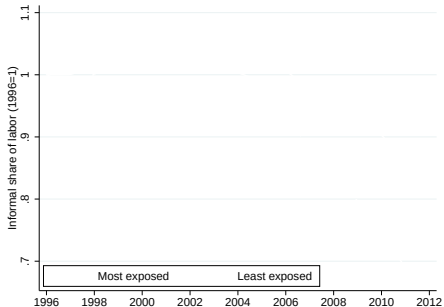

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- **States most exposed to the minimum wage** hike experienced...
  - Stronger formal inequality decreases (60% vs. 40% in least exposed)
  - 40% increase in informal inequality vs. mild decline in least exposed states
  - **Milder reductions in the informal share of labor** (13.6% vs. 33.6% in least exposed)

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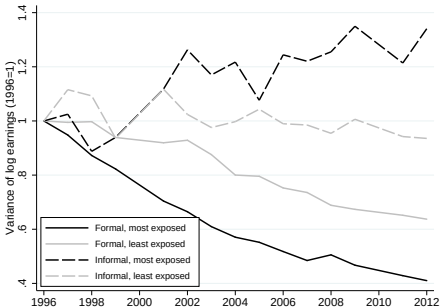

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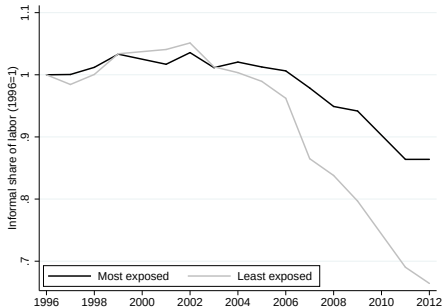
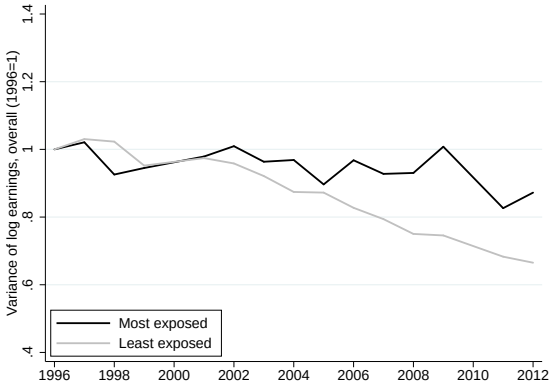


Cross-state variation, minimum wage, and aggregate inequality

- **States most exposed** to minimum wage experienced **milder reductions in overall inequality**
  - 10% vs. 30% in least exposed states



▸ Taking stock ▸ DiD ▸ Inf ineq ▸ Shares ▸ Hrly wages ▸ SE ▸ Min w vs. inf share ▸ Scatter plots ▸ Levels

Econometric analysis: controlling for state heterogeneity

- States differentially exposed to the minimum wage are **different in many other characteristics**

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  - **Compare outcomes** across treatment groups **before and after the minimum wage hike**
  - **Control for alternative drivers** by including fixed effects and state-level controls

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- Relative to the least treated states, the **states most treated experienced**
  - 25pp stronger **formal inequality reductions**
  - Relative **increases** in **informal inequality** (31pp) and the **informal share of labor** (7pp)
  - Together, these imply a 20pp larger **increase in overall inequality**

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- **Effects of the minimum wage vary widely** across treatment groups
  - Minimum wage **reduces formal inequality** in all states
  - The **more exposed** a state is, the stronger are the **responses in the informal sector**
  - Minimum wage **reduces overall inequality in Rio de Janeiro**, but **increases it in Ceará**!

Taking stock

- 3 stylized facts on Brazil:
  - **Sizable informal sector**, represents over 30% of employment
  - Substantial **increase in the minimum wage**, particularly after 1999
  - Differently from formal sector, **informal inequality moved sideways**

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- Cross-state evidence that the minimum wage hike
  - **Reduced formal** inequality
  - **Increased informal** inequality and the informal share
  - As a consequence, **increased in overall** inequality!
  - Robustness: DiD analysis controlling for other drivers of inequality and informality

A benchmark model of the informal sector and minimum wages

Informal sector and the effects of the minimum wage

A bird's-eye view of the model

- Homogeneous workers consume final good and choose firm that offers highest utility

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- After observing productivity, firms choose formality status:
  - Formal firms subject to the minimum wage
  - Informal firms subject to random government inspections, in which case all revenue is lost
- Profits and gov't revenues owned by absentee households that consume final good
- Equilibrium: aggregate wage index that clears the labor market

▸ Detail inspec.

Labor supply

- Measure 1 of homogeneous workers

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- Worker i at firm $j \in \Omega$ has indirect utility (price of good normalized to one):

$$V_i(j) = w(j)A_i(j), \quad A_i(j) \sim \text{Frechet}(\eta), \text{ iid across workers and firms}$$

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- Upward-sloping labor supply curve for firm $j \in \Omega$:

$$l(j) = W^{-\eta} w(j)^{\eta}$$

with $W \equiv \left[\int_{j' \in \Omega} w(j')^{\eta}\right]^{1/\eta}$ denoting the aggregate wage index of the economy

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- Worker welfare proportional to the aggregate wage index ($U \propto W$)
  - Representative family bundles up labor across different firms in a CES fashion
  - Family welfare = total family earnings = $1 \times W$ (Berger, Herkenhoff, and Mongey, 2019)

Labor demand and equilibrium

- Measure 1 of heterogeneous producers with labor productivity $z \sim F[z_0, \infty)$, $F' > 0$

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Labor demand and equilibrium

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- Competitive in goods market and monopsonists in labor market
- Maximize profits choosing employment, wages, and **formality status**:

$$\pi^{form}(z) = \max_{l,w} \left\{ zl - wl \,|\, l = \left(\frac{w}{W}\right)^{\eta},\ w \geq \underline{w} \right\}, \quad \pi^{inf}(z) = \max_{l,w} \left\{ (1-\rho)zl - wl \,|\, l = \left(\frac{w}{W}\right)^{\eta} \right\}$$

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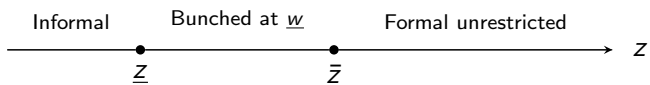

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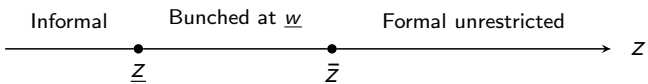

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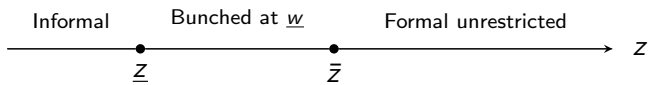

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- There exists a unique equilibrium where $L^D(W) = L^S = 1$

▸ Visualization

Minimum wages, earnings inequality, and the informal sector

Welfare

Proposition

Assume that the minimum wage ($\underline{w}$) is low enough, such that $\underline{w} \in (\underline{w}_0, \underline{w}_0 + \varepsilon)$, where $\underline{w}_0$: $\underline{z}(\underline{w}_0) = z_0$ and small ϵ. Then, the marginal effect of the minimum wage on the variance of log earnings (V) is:

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With informality, increasing $\underline{w}$ **increases** *inequality: $\frac{\partial V}{\partial \underline{w}} > 0$.*

Proof

Quantitative extensions

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- Heterogeneous workers with skill $h = 1, ..., H$ (fraction N_h of population)

  $\Rightarrow$ Skill-specific labor supply curve: $l_h(j) = N_h \left[w_h(j)/W_h\right]^{\eta}$, $W_h = \left[\int_{j\in\Omega} w_h(j)^{\eta} dj\right]^{1/\eta}$

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  - First component drawn: $\nu \sim F_\nu$
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- Equilibrium: aggregate wages indices W_h that clear labor markets for every $h = 1, ..., H$

Calibration and validation

Labor supply

- Map skills to educational levels, obtain shares directly from data:

		N_h	
Years of education	Degree	1996	2012
≤ 4	No degree	38.0	15.8
$(4, 8]$	Primary	30.3	22.9
$(8, 11]$	Secondary	22.6	42.7
> 11	Tertiary	9.1	18.7

Notes: Fraction of workers within each group of years of education. *Sources:* PNAD.

- Elasticity of labor supply η internally calibrated to match formal/informal mean wage ratio

▸ Wage distributions ▸ Relative wages

Labor demand

- Elasticity of substitution $\varepsilon = 1.875$ (Katz and Murphy, 1992 and Fernández and Messina, 2018)

- Demand shifters (Burstein and Vogel, 2017):

$$\xi_h(z) = \frac{z^{\phi_h}}{\sum_{h'} z^{\phi_{h'}}}, \quad \sum_h \phi_h = 0$$

  internally calibrated to match relative wages across skills

- Pareto-LogNormal distribution of productivities (Colombi, 1990):

$$z = \nu\theta, \quad \nu \sim \text{LogNormal}(0, \sigma^2), \quad \theta \sim \text{Pareto}(\kappa), \quad \nu \perp \theta$$

  internally calibrated to match formal and informal earnings inequality

Government

- Min wage and informality cost internally calibrated to match min wage and informal shares
- Allow a dollar of formal earnings to be worth more/less than a dollar of informal earnings
  - Valuation/costs of labor legislation (access to social security programs, payroll taxes)

$$w_h^{hh}(j) = (1 + \varsigma_h(j))w_h(j), \quad w_h^{firm}(j) = (1 + \tau(j))w_h(j), \quad \text{if } j \text{ is formal}$$

	Workers				Firms
	ς_1	ς_2	ς_3	ς_4	τ
1996	29.1	28.6	27.8	24.6	71.4
2012	29.4	29.2	28.7	24.3	

Notes: Methodology from Souza et al. (2012), taking into consideration direct and indirect firm-worker transfers such as retirement, unemployment and disabi benefits, severance payments, vacation stipends, and others. *Sources:* Labor legislation and PNAD.

Internal calibration

▸ Targeted moments ▸ Identification

Parameter	Description	1996	2012	Target
$\underline{w}$	Minimum wage	4.04	8.87	Share at min wage
ρ	Detection probability	0.258	0.321	Informal share
ϕ_4		0.079	0.115	Relative wages (tert/sec)
ϕ_3	Skill shifters	0.014	0.056	Relative wages (sec/prim)
ϕ_2		-0.028	-0.043	Relative wages (prim/no deg)
η	Labor supply elast.	4.52	4.22	Relative wages (form/inf)
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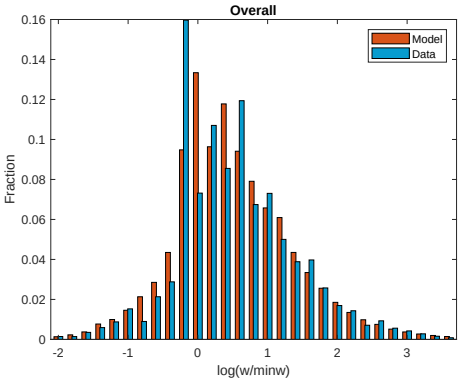
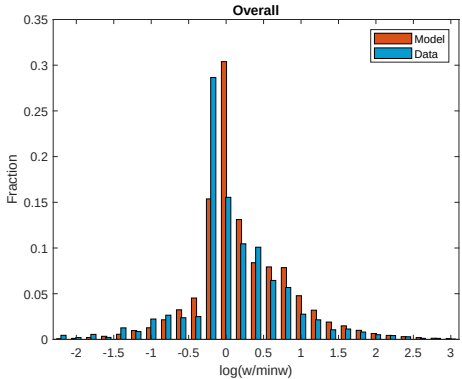
- **Labor supply elasticity** $\eta \approx 4$ in line with labor literature (Lamadon, Mogstad, and Setzler, 2019)

Model-implied overall earnings distribution

▸ By skills



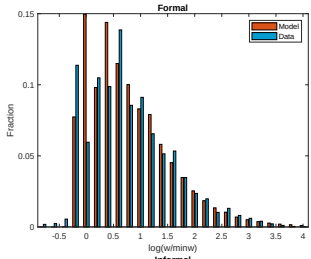
(a) 1996



(b) 2012

Distribution of earnings by formality status

▸ By skills



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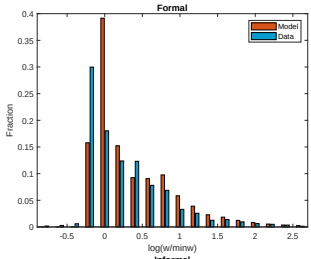

(b) 2012

Counterfactual exercises

Counterfactual exercises

- Minimum wage decreases formal inequality by 19% but increases agg inequality by 11.5%

		All parameters at 1996 values, except...			
		$\Delta \underline{w} = 120\%$	$\Delta \rho = 23\%$	ΔN_h	$\Delta \xi_h(z)$
	1996	(minimum wage)	(enforcement)	(skill comp)	(SBTC)
Mean earnings					
prim/no deg	**1.39**	**1.37**	1.39	1.03	1.76
sec/prim	**1.49**	**1.49**	1.49	0.92	2.07
terc/sec	**2.41**	**2.41**	2.41	2.35	2.31
V(log earnings)					
overall	**0.78**	**0.87**	0.78	0.79	0.98
formal	**0.58**	**0.47**	0.58	0.62	0.70
informal	**0.73**	**0.88**	0.72	0.67	0.94
Fraction at $\underline{w}$	**7.74**	**23.4**	8.33	3.66	14.0
Informal share	**39.1**	**86.9**	27.9	22.8	61.4

▸ All but $\underline{w}$ ▸ Educ. attainment ▸ Inf share 1996-2012

Counterfactual exercises

- Change in enforcement decreases informal share by 28% but does not affect inequality

		All parameters at 1996 values, except...			
		$\Delta \underline{w} = 120\%$	$\Delta \rho = 23\%$	ΔN_h	$\Delta \xi_h(z)$
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Counterfactual exercises

- Improvements in educational attainment of labor force decrease informality by 42%

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▸ All but $\underline{w}$ ▸ Educ. attainment ▸ Inf share 1996-2012

Counterfactual exercises

- Skill-biased technical change increases informality by 61% and aggregate inequality by 26%

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Counterfactual exercises: minimum wage and formalization policies

- Estimated increase in enforcement does little in preventing unintended consequences

		Joint counterfactuals		
	1996	$\Delta \underline{w} = 120\%$	$+\Delta\rho = 24\%$	$+\Delta\rho = 112\%$
V(log earnings)				
overall	0.78	0.87	**0.87**	0.78
formal	0.58	0.47	**0.48**	0.46
informal	0.73	0.88	**0.85**	0.82
Fraction at $\underline{w}$	7.74	23.4	**22.6**	21.7
Informal share	39.1	86.9	**74.1**	19.4

▸ Educ. attainment ▸ Model with unempl ▸ Parasites

Counterfactual exercises: minimum wage and formalization policies

- $\Delta\rho = 112\%$ offsets the unintended consequences of min wage on inequality

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Conclusion

- Long-standing debate on the effects of the minimum wage on inequality
- Middle/low income countries have substantial share of informal workers
  - Endogenous compositional changes between formal and informal economies potentially shape the impacts of the minimum wage
- New theory and evidence on the importance of the informal margin in understanding the effects of the minimum wage
  - Cross-state: min wage raises overall inequality, due to more informality and inf. inequality
  - Theoretical model highlights the *unintended consequences of the minimum wage*
  - Quantitative work: the minimum wage hike *increased aggregate inequality by 12%*
- Potential implications for other debates
  - Federal vs. regional minimum wages; non-conventional work arrangements (Uber, Lyft, etc.)

Thank you!

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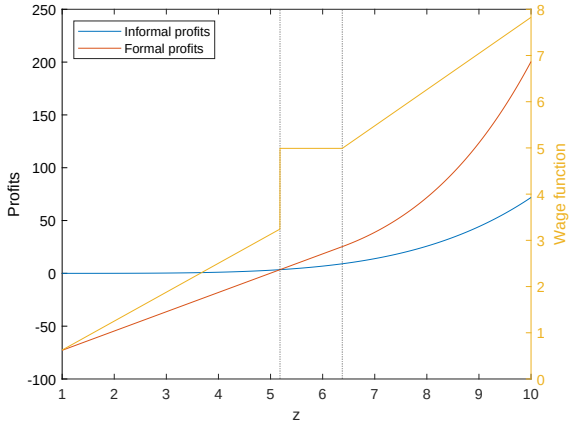
Appendix

The firm problem



Notes: Left axis: profit function of operating the informal (blue) and formal (red) technologies. Right axis: wage function (yellow). *Sources:* Model simulations.

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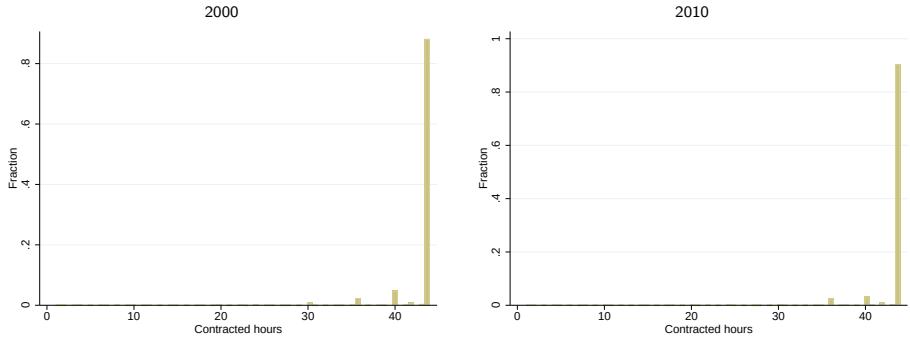
Distribution of hour on contract from RAIS



Notes: Histogram of contracted hours in the formal sector. I restrict analysis to male workers 25-55 not in the public sector. *Sources:* 2000 and 2010 RAIS.

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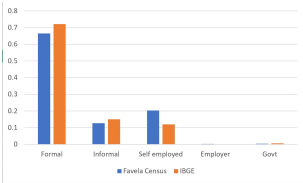
IBGE Census vs. Favela Census (RJ)

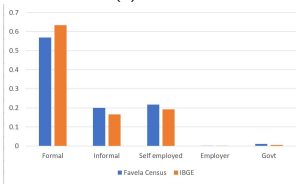
	2010 IBGE Census	Favela Census
Rocinha	69,356	73,410
Alemão	69,143	69,586
Manguinhos	36,160	27,073

Notes: Estimated population for 2010 IBGE Census (sample weights used) versus total number of respondents in 2010 Favela Census.

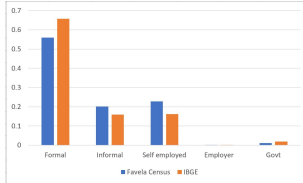
(a) Rocinha



(b) Alemão



(c) Manguinhos



Notes: Comparison of occupation distribution between IBGE Census and Favela Census.

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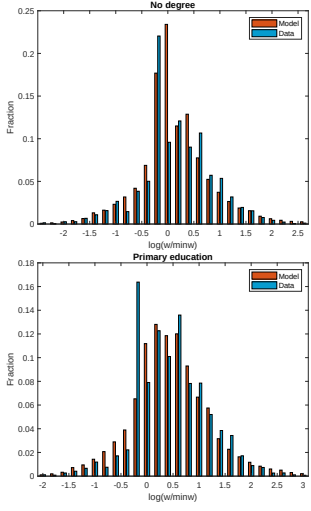
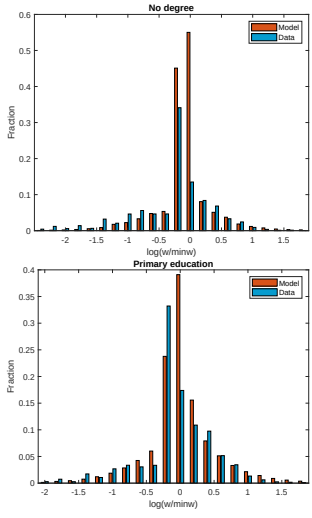
Validation exercise: distribution of earnings by skill (1/2)

Back



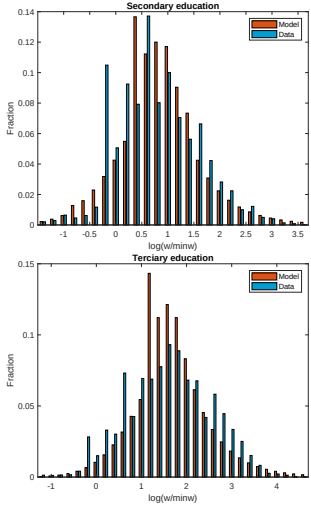
(a) 1996



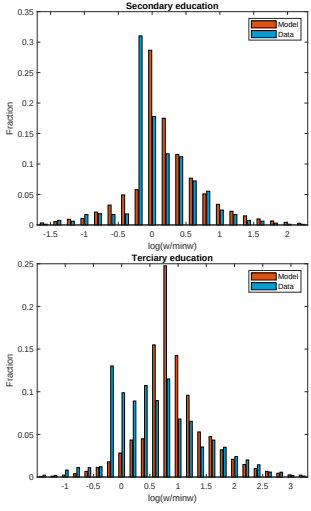
(b) 2012

Validation exercise: distribution of earnings by skill (2/2)

Back



(a) 1996

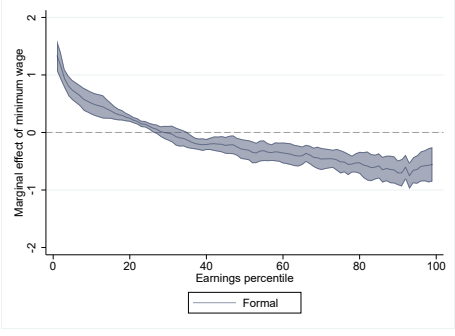


(b) 2012

Reduced form evidence across earnings distribution

- Min wage helps low-paid formal workers [Autor, Manning, and Smith, 2016, Engbom and Moser, 2021]

$$\log\left(\frac{w^p_{st}}{w^{50,Agg}_{st}}\right) = \beta_1 kaitz_{st} + \beta_2 kaitz^2_{st} + \alpha(s,t) + \varepsilon_{st}$$

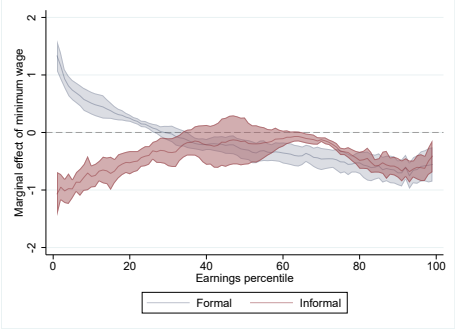


Back

Reduced form evidence across earnings distribution

- Min wage increases distance between low-paid informal workers and the rest

$$\log\left(\frac{w_{st}^{p}}{w_{st}^{50,Agg}}\right) = \beta_1 kaitz_{st} + \beta_2 kaitz_{st}^2 + \alpha(s,t) + \varepsilon_{st}$$



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Comparison with Engbom and Moser, 2021

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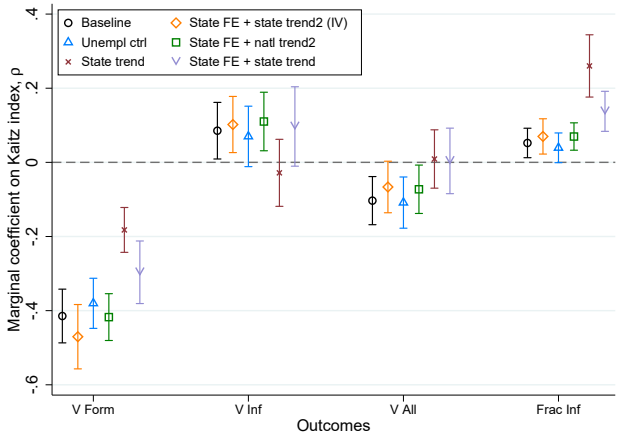
Robustness: regression specifications



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The informal sector across industries

	Share informal	Share of total employment
Manufacturing	16.5	18.1
Other activities	16.5	9.8
Transport, storage, and communic.	20.1	5.8
Commerce and repair	24.5	18.2
Undefined	30.4	0.0
Education, health, and social serv.	32.8	9.5
Restaurant and accommodation	38.8	5.6
Construction	43.5	6.5
Other services	46.4	3.5
Public admin	55.2	3.5
Agriculture	61.6	7.8
Domestic services	69.4	11.7

Notes: Table restricts data to 2001-2012 period, as industry definitions are consistent across surveys. The second column shows the share of employment that is informal in each industry. The third column shows the size of each industry in terms of total employment. *Sources:* PNAD.

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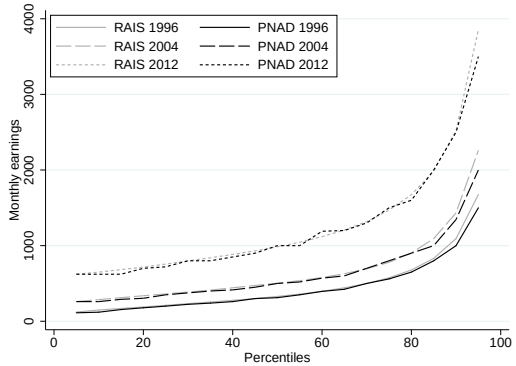
Comparison of earnings in RAIS and PNAD



Notes: Comparison between earnings distributions in PNAD (black) and RAIS (grey) across different years (patterns). *Sources:* PNAD and RAIS.

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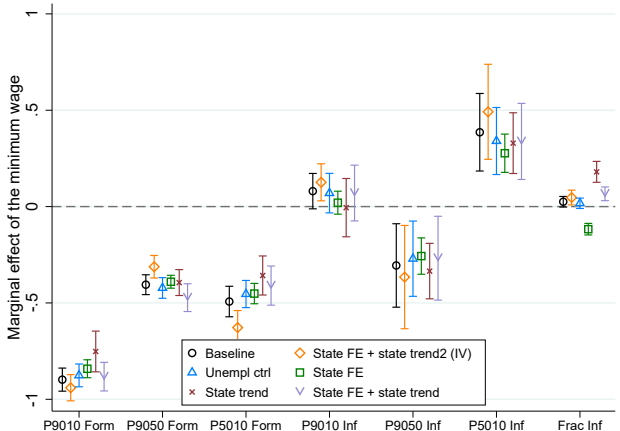
Minimum wage, inequality, and the informal sector

p90-Kaitz index



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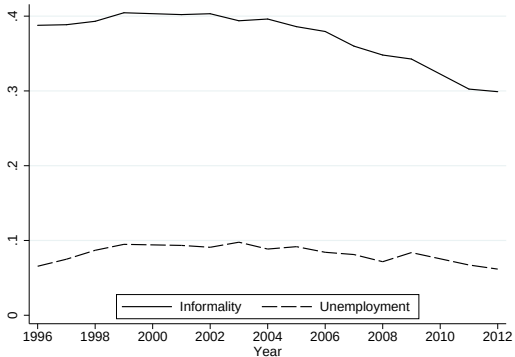
Unemployment versus informality, 1996-2012



Notes: Solid line shows the fraction of informal workers. Long dashes display the evolution of the unemployment rate. *Sources:* PNAD.

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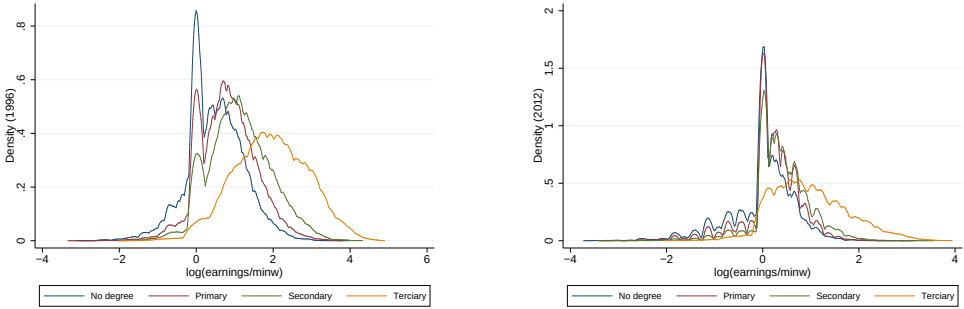
Distribution of earnings across skills, 1996-2012



Notes: Kernel density estimates for the distribution of log earnings relative to the minimum wage, by skill, for 1996 and 2012.

Sources: PNAD.

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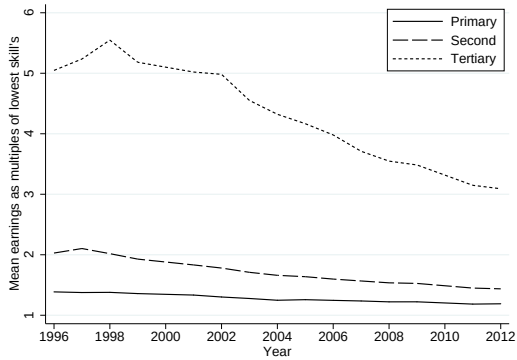
Relative wages by skill, 1996-2012



Notes: Mean earnings of different educational groups relative to mean earnings of no-degree workers. *Sources:* PNAD.

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Inequality between vs. within firms

- Variance decomposition: $Var(y_{ij}) = \underbrace{Var(\bar{y}_j)}_{\text{Between}} + \underbrace{\overline{Var(y_{ij}|i \in j)}}_{\text{Within}}$, worker i, firm j
- Both sectors, +50% of variance is accounted for by variance of wages between firms
- Changes in overall variance are accounted for by changes in between-firms inequality

	Formal (RAIS)		Informal (ECINF)	
	Total	Between	Total	Between
1997	0.624	0.364	0.535	0.460
		(58%)		(86%)
2003	0.484	0.272	0.545	0.485
		(56%)		(89%)
2012	0.373	0.183		
		(49%)		

Notes: Decomposition of total variance into the variance of mean earnings across firms (Between) and mean of variances within firms (Within): $Var(y_{ijt}) = Var(\bar{y}_{jt}) + \overline{Var(y_{ijt}|i \in j)}$. The numbers in parentheses represent the respective shares over total variance. *Sources:* 1997, 2003, and 2012 RAIS and 1997 and 2003 ECINF.

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Bunching at the minimum wage vs. inequality and informality

- Share of formal workers at the minimum wage as main explanatory variable

$$y_{st} = \beta \cdot \text{atminw}_{st} + \alpha_s + \alpha_t + \varepsilon_{st}$$

Outcomes	Formal	Informal	Aggregate
Variance	-0.521***	0.520***	0.302**
P90/P10	-1.647***	0.463*	1.447***
Informal share:		-.020	

Notes: Each cell represents a separate regression. All regressions control for state and time fixed effects, and the unemployment rate. All regressions are employment-weighted. Standard errors are clustered at the state level.

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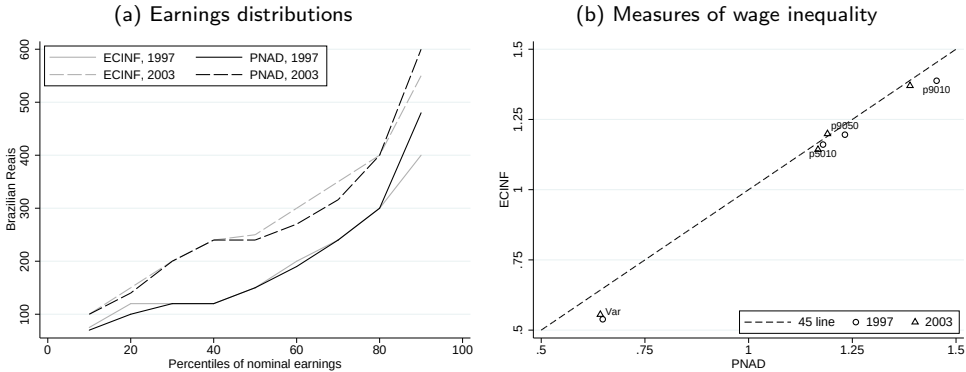
Comparison of wage distributions in PNAD and ECINF



Notes: Panel (a) displays the percentiles of earnings in the informal sector using PNAD (black) and ECINF (grey) data, for 1997 (solid) and 2003 (long dashes).
Sources: PNAD and ECINF.

▸ Back

Inspections and penalties of informal contracts

"When faced with violations of the labor code, inspectors must immediately notify the firm. The firm then has 10 days to present evidence in its defense. After that period, the process is re-examined by a different inspector from the one issuing the original fine, who deliberates on its fairness ... If firms do not contest the fine and pay it within 10 days of their notification, there is a 50 percent discount on the amount of the fine. Alternatively, if firms file an appeal, they must deposit the total value of the penalty until a second decision has been reached. ... For example, a **firm is fined R$446 for each worker that is found unregistered during an inspection.** Depending on its size and profitability, if a firm does not comply with the mandatory contributions to the FGTS, then it can be fined an amount between R$16 and R$160 per employee." (Almeida and Carneiro, 2012)

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Counterfactual - all parameters at 2012 except for the minimum wage

- Minimum wage explains 8.5% of the decrease in agg earnings inequality (vs. 23% of formal ineq)
- Why muted effects? Real increase in the minimum wage increases informal share by 23.8pp

	1996	all but $\underline{w}$	2012
Mean earnings			
prim/no deg	1.39	1.28	1.19
sec/prim	1.49	1.22	1.21
terc/sec	2.41	2.15	2.15
V(log earnings)			
overall	0.78	0.50	0.46
formal	0.58	0.43	0.33
informal	0.73	0.46	0.51
Fraction at $\underline{w}$	7.74	2.72	15.8
Informal share	39.1	7.1	30.9

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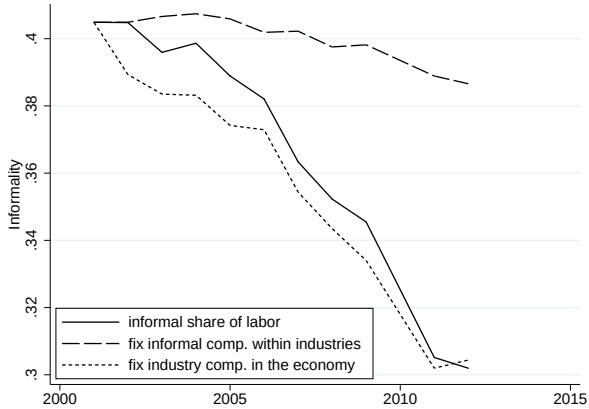
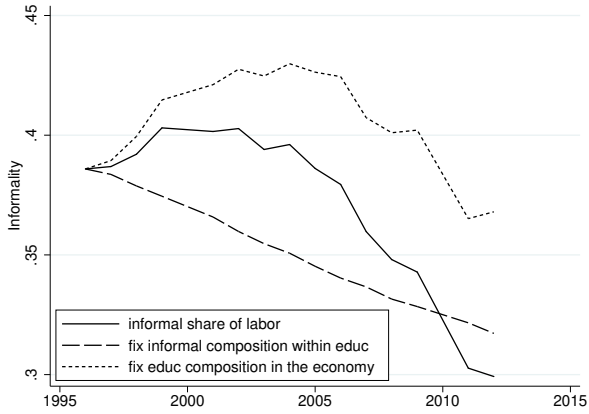
Shift-share analysis on the evolution of informality: by industry



Notes: Shift share decomposition of the informal share across industries: $(L_t^I/L_t) = \sum_j (L_{jt}/L_t) \cdot (L_{jt}^I/L_{jt})$ where j is industry, t is time and superscript I denotes informal. Solid curve is the informal share of labor. Long dash plots a counterfactual curve fixing the informal share within industries (L_{jt}^I/L_{jt}) in 2001. Short dash plots a counterfactual curve fixing industry composition of the labor force (L_{jt}/L_t) in 2001. *Sources:* PNAD. ▸ Back

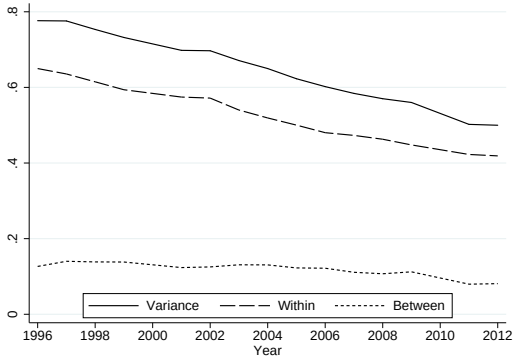
Shift-share analysis on the evolution of informality: by education



Notes: Shift share decomposition of the informal share across educational groups: $(L_t^I/L_t) = \sum_j (L_{jt}/L_t) \cdot (L_{jt}^I/L_{jt})$ where j is educational group, t is time and superscript I denotes informal. Solid curve is the informal share of labor. Long dash plots a counterfactual curve fixing the informal share within education (L_{jt}^I/L_{jt}) in 1996. Short dash plots a counterfactual curve fixing educational composition of the labor force (L_{jt}/L_t) in 1996. *Sources:* PNAD. Back

Inequality decomposition by formal-informal sectors

$$V_t = \underbrace{\sum_{j \in \{form, inf\}} s_{jt} V_{st}}_{\text{Within}} + \underbrace{\sum_{j \in \{form, inf\}} s_{jt} (E_{st} - E_t)^2}_{\text{Between}}$$



Notes: Within-between decomposition of aggregate inequality in Brazil. *Sources:* PNAD. Back

Kaitz analysis: minimum wage, inequality, and the informal sector

Closely follow minimum wage literature [Lee (1999) and Autor, Manning, and Smith (2016)]:

$$y_{st} = \beta_1 kaitz_{st} + \beta_2 kaitz_{st}^2 + \alpha(s,t) + \varepsilon_{st}, \quad kaitz_{st} \equiv \log\left(\frac{w_t}{w_{st}^{50,F}}\right)$$

Variation: across states (s) and over time (t)

- y_{st}: different measures of inequality
- $\alpha(s,t)$: control for state and national level changes in shape of wage dist unrelated to min wage [Engbom and Moser (2021); Haanwinckel (2020)]
- Additional control: unemployment rate
  - Proxy for heterogeneous shocks to a state's labor market

Marginal coefficient on the minimum wage: $\rho = \hat{\beta}_1 + 2\hat{\beta}_2\overline{kaitz}$

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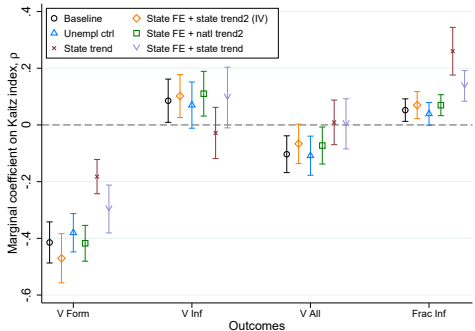
Minimum wage, inequality, and the informal sector

- Negative relationship between min wage and formal inequality
- Positive relationship between min wage and informal inequality (and informal share)
- (Weak) Negative relationship between min wage and aggregate inequality

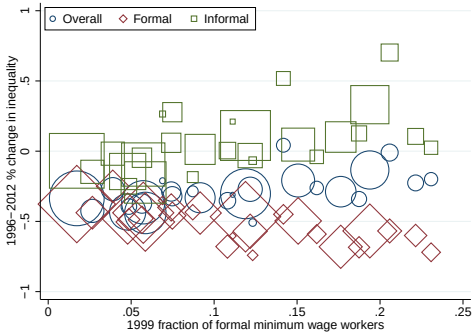


▸ Back ▸ atminw ▸ *kaitz*[90] ▸ Spillovers (formal) ▸ Spillovers (informal) ▸ Engbom and Moser (2021)

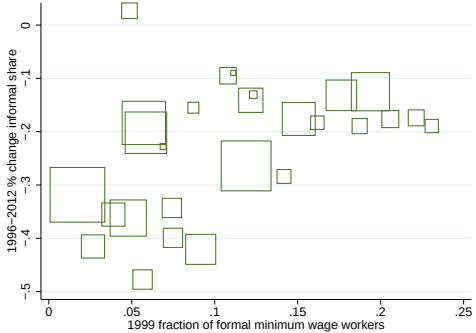
Scatter plots: inequality and informality vs. initial exposure to min wage

- Negative relationship between exposure and formal inequality (red diamonds)
- Positive relationship between exposure and informal share and informal inequality (green squares)
- Positive relationship between exposure and overall inequality (blue circles)

(a) Inequality



(b) Informal share



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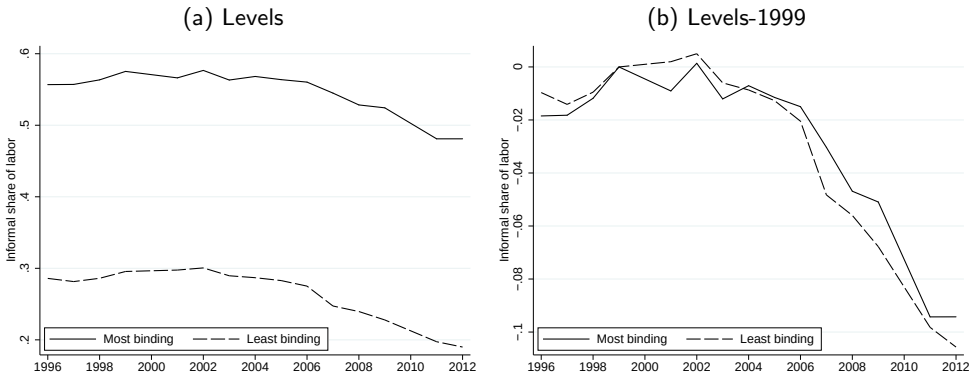
Evolution of informal share in levels across states



Notes: Panel (a) displays the evolution of the average informal share in states most and least exposed to the minimum wage. Panel (b) displays the evolution of the informal shares in excess to the share in 1999. *Sources:* PNAD.

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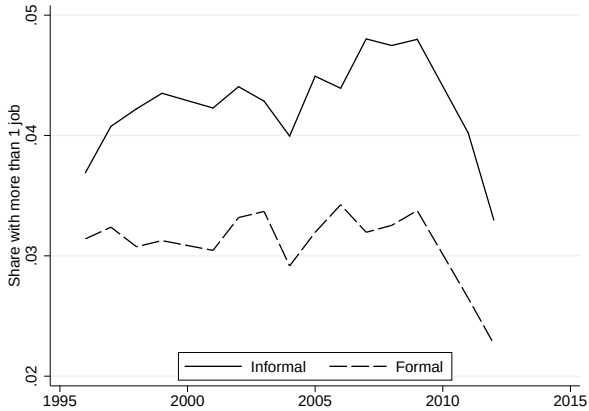
Share of formal/informal workers with more than one job, 1996-2012



Notes: Share of workers in the formal and informal sectors with more than one job in the reference week. *Sources:* PNAD.

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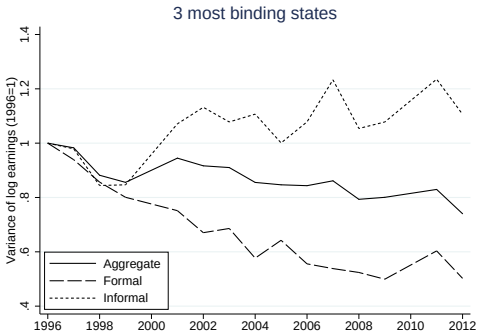
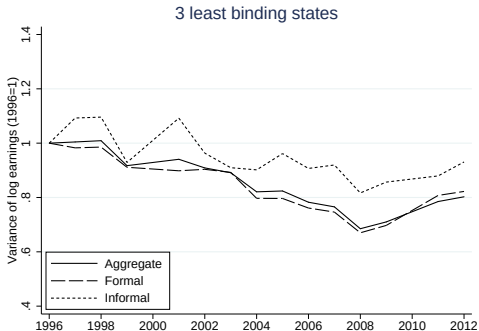
Cross-state variation and earnings inequality - hourly wages





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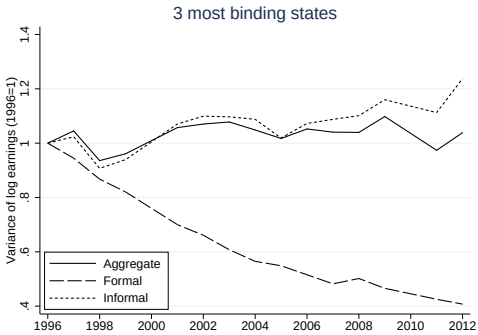
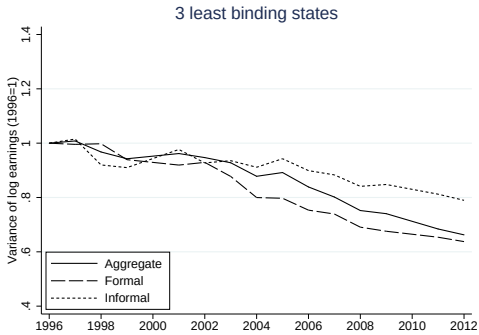
Cross-state variation and inequality - including self employed





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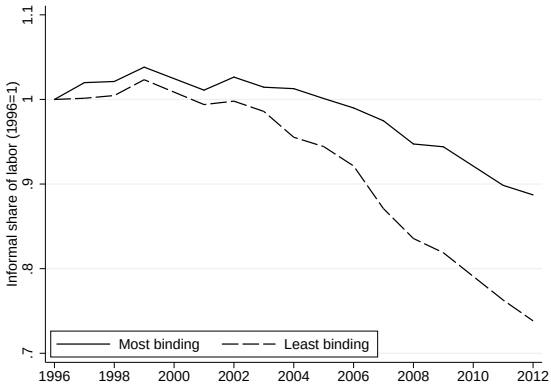
Cross-state variation and the informal sector - including self employed



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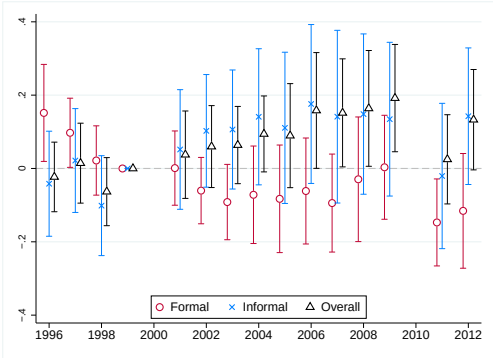
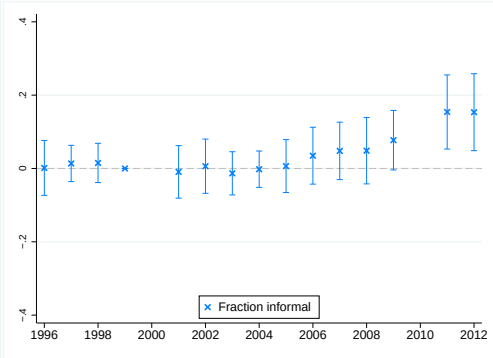
DiD results - median split of states

(a) log(Inequality)



(b) log(Informal share)



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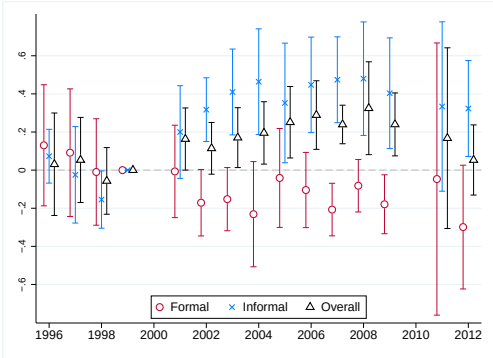
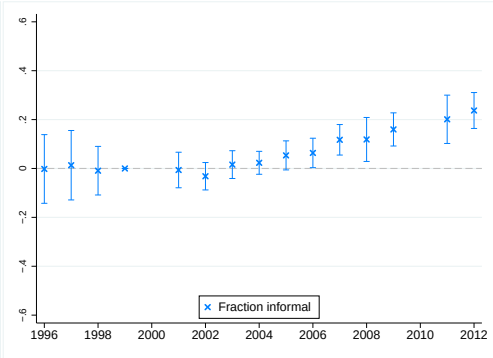
DiD results - hourly earnings

(a) log(Inequality)



(b) log(Informal share)



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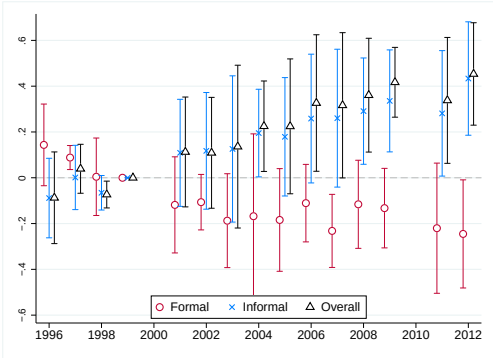
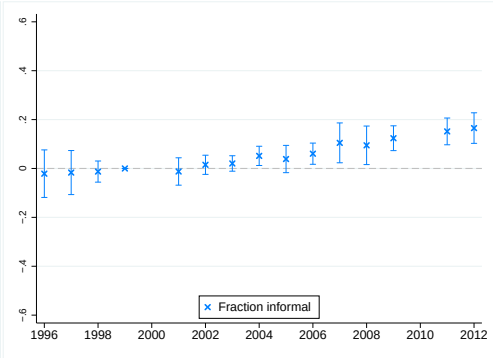
DiD results - including self employed

(a) log(Inequality)



(b) log(Informal share)



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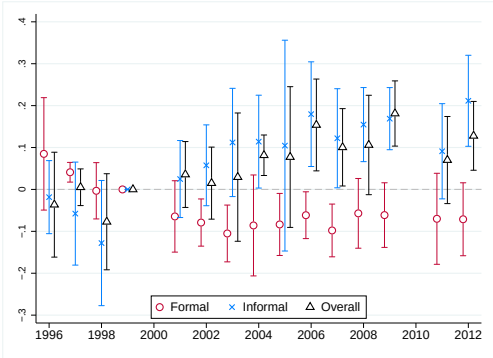
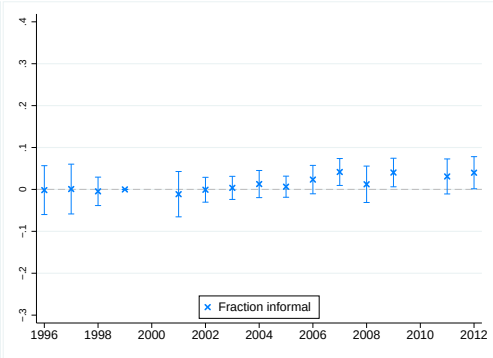
DiD results in levels

(a) Inequality



(b) Informal share



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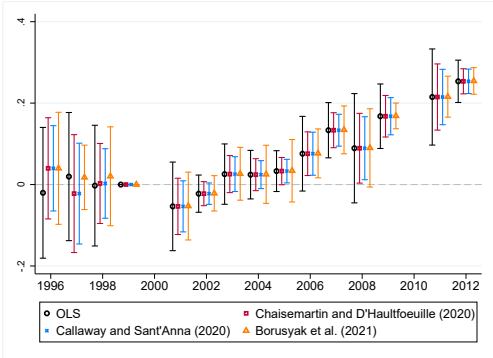
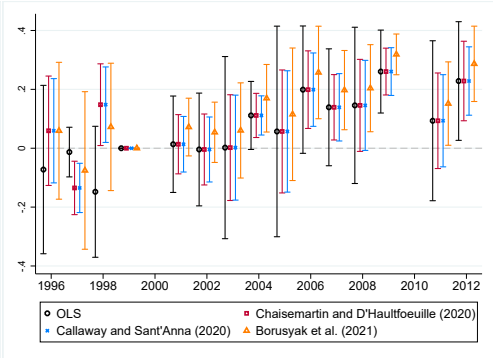
DiD results - robustness to different estimators

(a) log(Overall inequality)



(b) log(Informal share)



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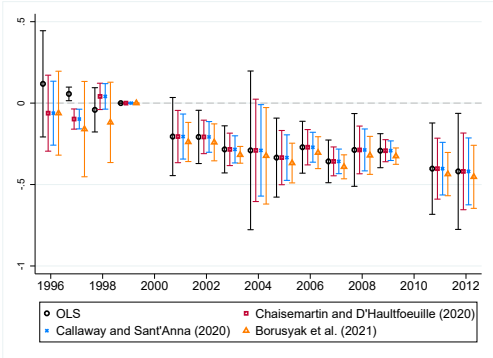
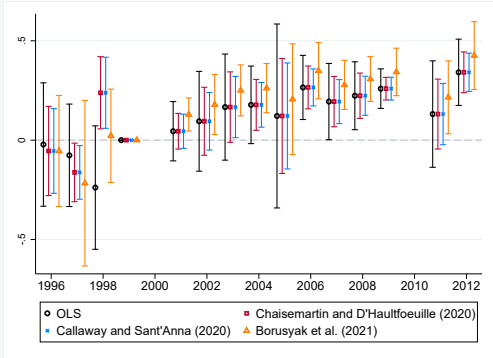
DiD results - robustness to different estimators

(a) log(Formal inequality)



(b) log(Informal inequality)



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DiD results

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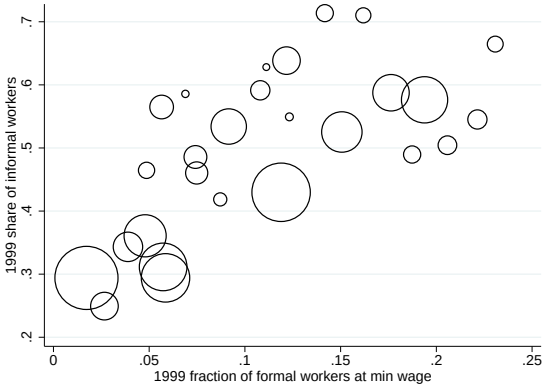
- Effects are stronger in most binding groups

	$\log(V^{agg})$	$\log(V^{form})$	$\log(V^{inf})$	$\log(InfShare)$
$\beta_6 \times$ Post	-0.008	-0.222	-0.020	0.013
	(0.063)	(0.091)**	(0.091)	(0.033)
$\beta_7 \times$ Post	0.085	-0.265	0.173	0.043
	(0.065)	(0.110)**	(0.075)**	(0.043)
$\beta_8 \times$ Post	0.213	-0.261	0.297	0.055
	(0.052)***	(0.075)***	(0.093)***	(0.021)**
$\beta_9 \times$ Post	0.200	-0.253	0.316	0.073
	(0.077)**	(0.063)***	(0.078)***	(0.032)**
High skill	0.485	0.447	0.582	-0.466
	(0.177)**	(0.373)	(0.254)**	(0.106)***
Young	-0.561	-0.511	-0.742	0.219
	(0.165)***	(0.320)	(0.198)***	(0.143)
White	-0.083	-0.233	-0.200	0.052
	(0.165)	(0.204)	(0.172)	(0.064)
Female	0.218	0.446	0.558	-0.059
	(0.147)	(0.269)	(0.220)**	(0.226)
Observations	405	405	405	405
R^2	0.854	0.891	0.642	0.966

1996 min wage vs. informal workers



Notes: Each circle represents a state in Brazil, where circle area is proportional to total employment in 1999. Y-axis plots the informal share and X-axis plots the formal share bunched at the minimum wage. *Sources:* PNAD.

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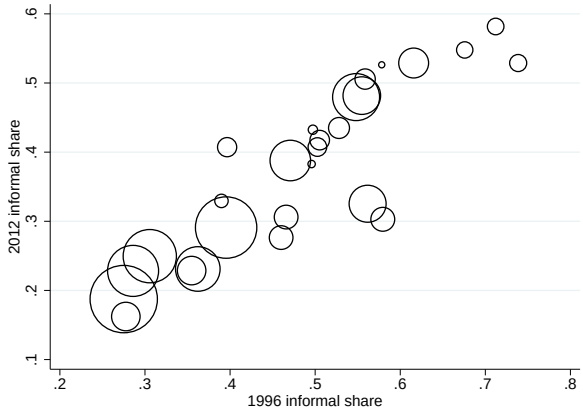
Informal share over time



Notes: Each circle represents a state in Brazil, where circle area is proportional to total employment in 1996. Y-axis plots the informal share in 2012, and X-axis plots the informal share in 1996. *Sources:* PNAD.

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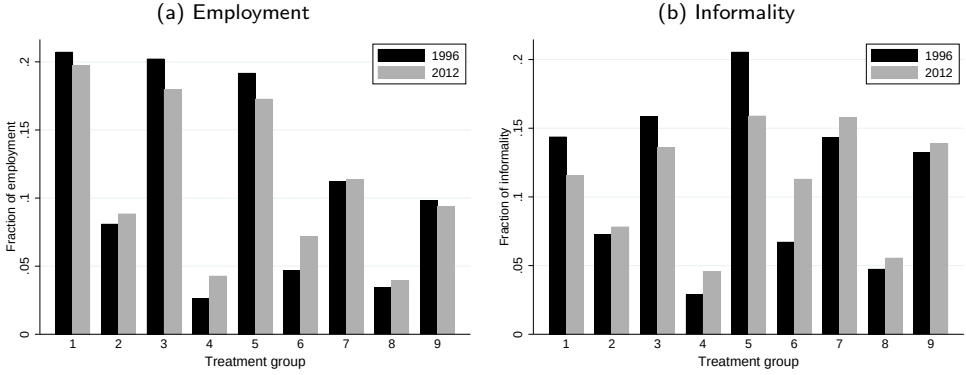
Fraction of employment/informality in each group

1=least binding



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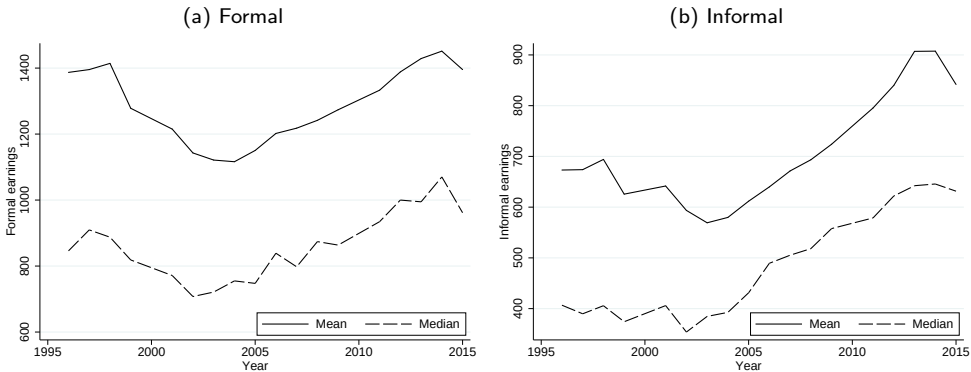
Evolution of mean/median earnings across sectors



Notes: Evolution of mean and median earnings in the formal and informal sectors. *Sources:* PNAD.

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Proof of inequality proposition (first half)

I first prove the first half of the proposition.

Write aggregate variance as:

$$V = L^I V^I + (1 - L^I) V^F + L^I (1 - L^I)(\mathbb{E}^I - \mathbb{E}^F)^2 \tag{2}$$

Differentiate completely and evaluate at $\underline{w}_0$ such that $L^I = 0$ to find:

$$\frac{\partial V}{\partial \underline{w}} = \frac{\partial V^F}{\partial \underline{w}} + \frac{\partial L^I}{\partial \underline{w}} \left[(\mathbb{E}^I - \mathbb{E}^F)^2 + V^I - V^F \right] \tag{3}$$

which establishes the decomposition of the minimum wage effects.

I now turn to the second half of the proposition...

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Proof of inequality proposition (second half)

To show part 1. of the second half, I calculate the variance of log earnings in an economy without the informal sector. I then show that increasing the minimum wage reduces inequality necessarily.

To show part 2. of the second half of the proposition, I proceed in three steps.

- First, I show that when the informal sector is present, the relative share of minimum wage workers within the formal sector workers does not change with the minimum wage, and this implies that the variance of log earnings in the formal sector is constant.
- Second, I show that the share of informal workers increases with the minimum wage.
- Third, I prove that the term inside brackets, which reflects first and second moment distances in formal and informal earnings, is positive.

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Counterfactual exercises: minimum wage and educational attainment

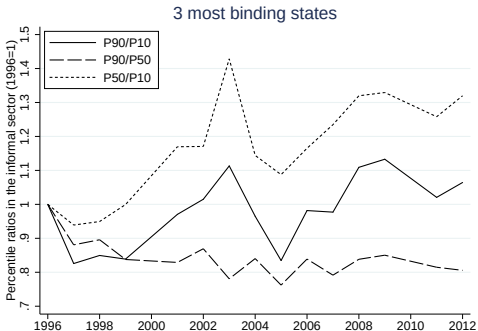
- Educational attainment **undoes the unintended consequences of the minimum wage**

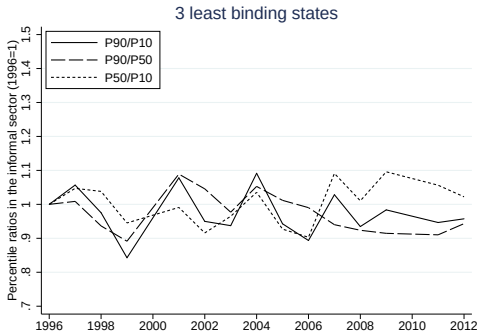
	1996	Joint counterfactuals $\Delta \underline{w} = 120\%$	$+\Delta N_h$
V(log earnings)			
overall	0.78	0.87	0.78
formal	0.58	0.47	0.51
informal	0.73	0.88	0.78
Fraction at $\underline{w}$	7.74	23.4	10.9
Informal share	39.1	86.9	60.0

▸ Back (N_h) ▸ Back (formalization)

Breaking down informal inequality

- Increase in informal inequality in most exposed states driven by median earnings
  - P5010 increased sharply, P9050 decreased mildly





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Calibration results: model vs. data on targeted moments

	1996		2012	
	Data	Model	Data	Model
Mean earnings				
Formal/Informal	**2.06**	**2.11**	**1.65**	**1.67**
Primary/No degree	**1.39**	**1.39**	**1.19**	**1.19**
Secondary/Primary	**1.46**	**1.49**	**1.21**	**1.21**
Tertiary/Secondary	**2.49**	**2.41**	**2.15**	**2.15**
Variance of log-earnings				
Overall	0.78	0.78	0.50	0.46
Formal	**0.65**	**0.58**	**0.33**	**0.33**
Informal	**0.66**	**0.73**	**0.62**	**0.51**
Formal bunching at min wage	**7.74**	**7.74**	**15.8**	**15.8**
$\frac{\text{Min wage}}{\text{Mean wage}}$	0.22	0.26	0.45	0.47
Informal share of labor	**0.39**	**0.39**	**0.31**	**0.31**

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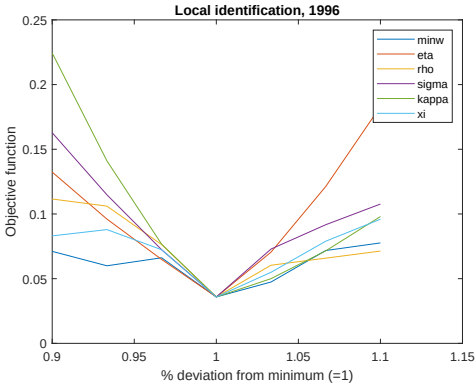
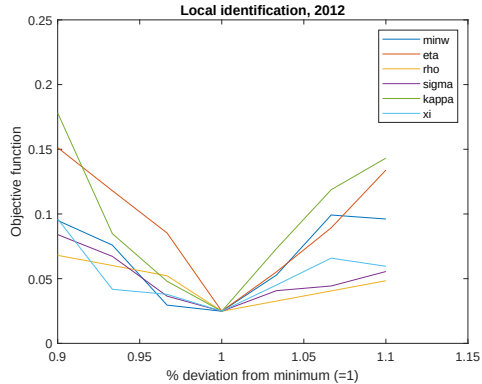
Identification of parameters

- For all parameters, the objective function varies substantially at minimum





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Unemployment and monopsonistic competition

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The model

- Unemployment sector that gives utility $b \cdot A_i(b)$ to household i
  - Unemployment benefits b; independent unemployment amenity shock $A_i(b) \sim \text{Frechet}(\eta)$
- Unemployment sector "competes" with firms for workers in the economy
- Share of households out of labor force:

$$U = \sum_h U_h, \quad U_h = N_h \left(\frac{b}{W_h} \right)^{\eta}, \quad W_h = \left[b^{\eta} + \int_{j \in \Omega} [(1 + \varsigma(j)) w_h(j)]^{\eta} dj \right]^{1/\eta} \tag{4}$$

Unemployment and monopsonistic competition

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Calibration: parameters

- Calibrate b to match unemployment rate; other parameters calibrated the same way

Parameter	Description	1996	2012	Target
$\underline{w}$	Minimum wage	3.985	8.623	Share at min wage
ρ	Probability of detection	0.269	0.327	Informal share
b	Unemployment benefits	0.620	1.237	Unemployment rate
ϕ_4		0.089	0.118	Relative wages (terc/sec)
ϕ_3	Demand shifter parameters	0.014	0.044	Relative wages (sec/prim)
ϕ_2		-0.027	-0.046	Relative wages (prim/no deg)
η	Labor supply elast.	4.856	4.121	Formal wage premium
σ	Standard deviation	0.957	1.324	Formal inequality
κ	Pareto tail	6.523	6.236	Informal inequality

Unemployment and monopsonistic competition

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Calibration: moments

	1996		2012	
	Data	Model	Data	Model
Mean earnings				
Formal/Informal	**2.06**	**2.13**	**1.65**	**1.68**
Primary/No degree	**1.39**	**1.39**	**1.19**	**1.20**
Secondary/Primary	**1.46**	**1.45**	**1.21**	**1.21**
Tertiary/Secondary	**2.49**	**2.49**	**2.15**	**2.15**
Variance of log-earnings				
Overall	0.78	0.73	0.50	0.46
Formal	**0.65**	**0.52**	**0.33**	**0.33**
Informal	**0.66**	**0.66**	**0.62**	**0.51**
Formal bunching at min wage	**0.077**	**0.077**	**0.158**	**0.159**
Informal share of labor	**0.390**	**0.386**	**0.299**	**0.299**
Unemployment share	**0.065**	**0.065**	**0.062**	**0.062**

Unemployment and monopsonistic competition

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The effects of the minimum wage hike

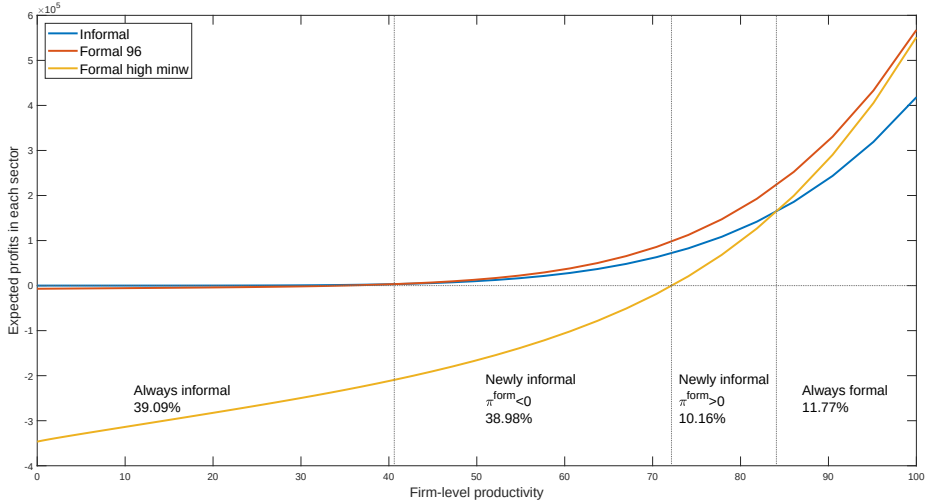
- Unintended consequences of the minimum wage increase persist
- Minimum wage hike increases unemployment by 9%
  - Firms becoming informal generates a surplus of workers to be reallocated in the economy
  - Some of them are hired by operating firms, but some end up unemployed!
  - Low levels of unemployment means only a small fraction of workers lose their jobs

		All parameters at 1996 values, except...		
		$\Delta \underline{w} = 120\%$	$\Delta \rho = 23\%$	N_h
	1996	(minimum wage)	(enforcement)	(skill comp)
V(log earnings)				
overall	**0.73**	0.81	0.72	0.71
formal	**0.52**	0.43	0.52	0.56
informal	**0.66**	0.81	0.65	0.58
Fraction at $\underline{w}$	**0.077**	0.211	0.072	0.045
Informal share	**0.390**	0.871	0.275	0.205
Unemployment rate	**0.065**	0.071	0.073	0.016

Informality response to minimum wage: a break down

Back

- 21% of labor force thrown into informality work at firms that are profitable in the formal sector



List of states in each group

Group	State	Group	State
1	São Paulo	6	Pará
1	Santa Catarina	6	Paraíba
1	Distrito Federal	6	Acre
2	Amapá	7	Maranhão
2	Paraná	7	Pernambuco
2	Amazonas	7	Ceará
3	Mato Grosso	8	Alagoas
3	Rio de Janeiro	8	Tocantins
3	Rio Grande do Sul	8	Rio Grande do Norte
4	Rondônia	9	Bahia
4	Mato Grosso do Sul	9	Sergipe
4	Roraima	9	Piauí
5	Goiás		
5	Espírito Santo		
5	Minas Gerais		

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Difference-in-differences analysis

- Construct 9 treatment groups according to share of formal min wage workers in 1999

Difference-in-differences analysis

- Construct 9 treatment groups according to share of formal min wage workers in 1999
- Event study specification (state s, treatment group g, time t):

$$y_{sgt} = \alpha + \sum_{k \neq 1999} \sum_{g \neq 1} \beta_{kg} \cdot \delta_g \cdot \delta_{t+k} + X'_{st}\Gamma + \delta_s + \delta_t + \varepsilon_{st} \tag{5}$$

β_{kg} tracks evolution of outcomes in group g before and after 1999 relative to group 1

Difference-in-differences analysis

- Construct 9 treatment groups according to share of formal min wage workers in 1999
- Event study specification (state s, treatment group g, time t):

$$y_{sgt} = \alpha + \sum_{k \neq 1999} \sum_{g \neq 1} \beta_{kg} \cdot \delta_g \cdot \delta_{t+k} + X'_{st}\Gamma + \delta_s + \delta_t + \varepsilon_{st} \quad (5)$$

  β_{kg} tracks evolution of outcomes in group g before and after 1999 relative to group 1

- Control for other drivers of inequality:
  - δ: fixed effects over state and time
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- Control for other drivers of inequality:
  - δ: fixed effects over state and time
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- Identification: absent increase in federal min wage, outcomes would follow parallel trends

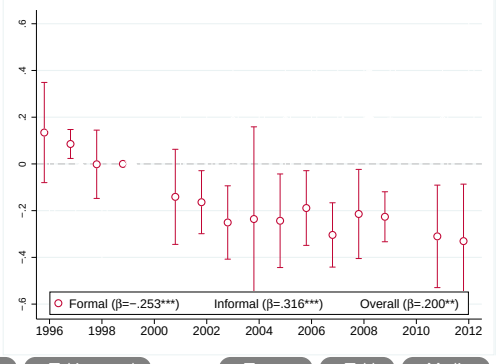
▸ Summary ▸ Taking stock ▸ List of states

DiD results: most vs. least exposed states (β_{k9})

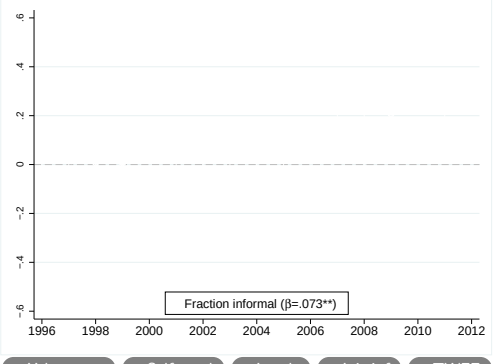
Most exposed states experienced...

- 25pp stronger **decrease in formal inequality**

(a) log(Inequality)



(b) log(Informal share)



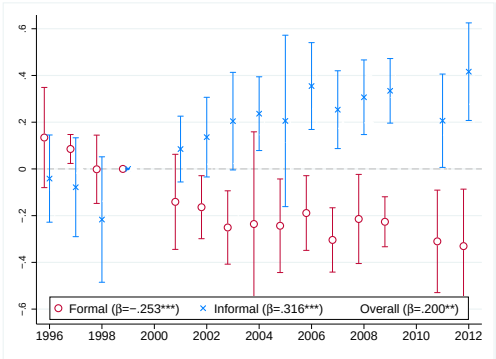
Summary | Taking stock | Trt grps | Table | Median | Hrly wages | Self empl | Levels | Init inf | TWFE | Kaitz

DiD results: most vs. least exposed states (β_{k9})

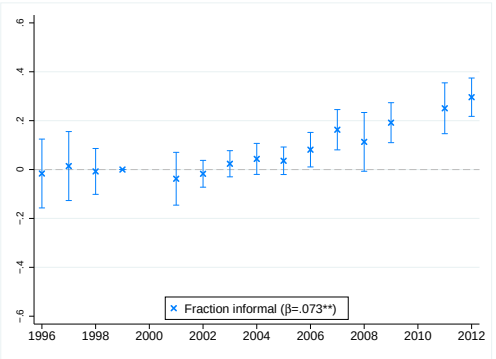
Most exposed states experienced...

- 25pp stronger **decrease in formal inequality**
- 31pp larger **increase in informal inequality** and 7pp relative **increase in informal share**

(a) log(Inequality)



(b) log(Informal share)



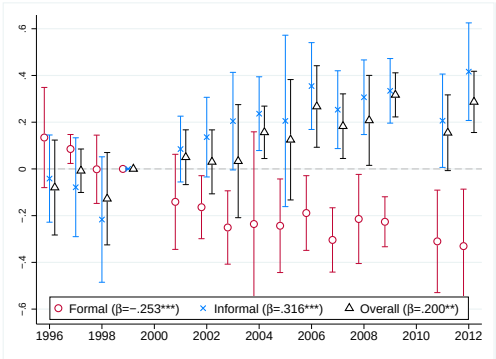
▸ Summary ▸ Taking stock ▸ Trt grps ▸ Table ▸ Median ▸ Hrly wages ▸ Self empl ▸ Levels ▸ Init inf ▸ TWFE ▸ Kaitz

DiD results: most vs. least exposed states (β_{k9})

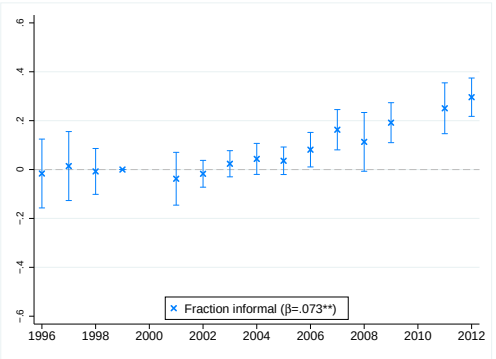
Most exposed states experienced...

- 25pp stronger **decrease in formal inequality**
- 31pp larger **increase in informal inequality** and 7pp relative **increase in informal share**
- 20pp relative **increase in overall inequality**

(a) log(Inequality)



(b) log(Informal share)

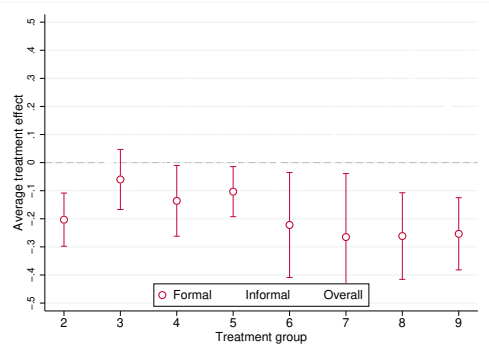


▸ Summary ▸ Taking stock ▸ Trt grps ▸ Table ▸ Median ▸ Hrly wages ▸ Self empl ▸ Levels ▸ Init inf ▸ TWFE ▸ Kaitz

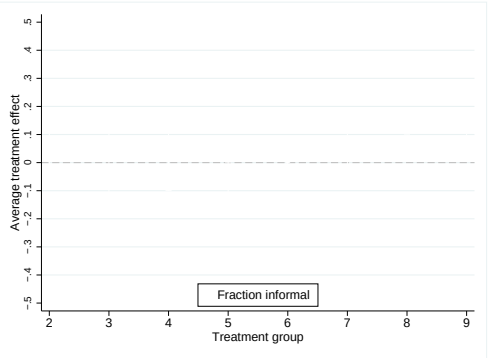
DiD results: average treatment effects across treatment groups

- Minimum wage **reduces formal inequality** in all treatment groups (relative to group 1)

(a) log(Inequality)



(b) log(Informal share)

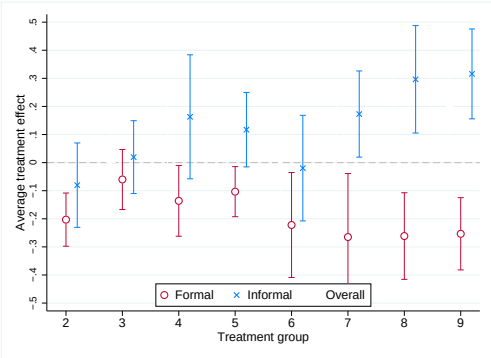


▸ Summary ▸ Taking stock

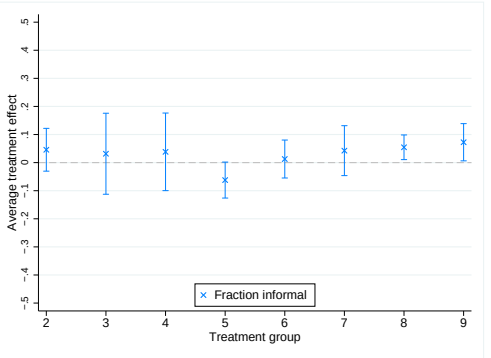
DiD results: average treatment effects across treatment groups

- Minimum wage **reduces formal inequality** in all treatment groups (relative to group 1)
- Stronger **informal margins of adjustment** in states that are more exposed

(a) log(Inequality)



(b) log(Informal share)

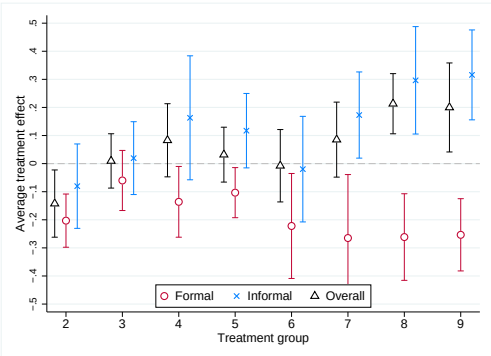


▸ Summary ▸ Taking stock

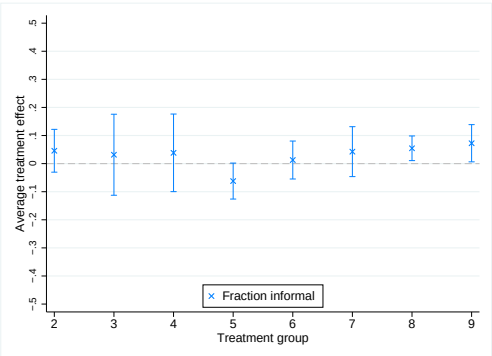
DiD results: average treatment effects across treatment groups

- Minimum wage **reduces formal inequality** in all treatment groups (relative to group 1)
- Stronger **informal margins of adjustment** in states that are more exposed
- **Effects of min wage** on overall inequality ranges from **negative (grp 2) to positive (grps 7-8)**

(a) log(Inequality)



(b) log(Informal share)

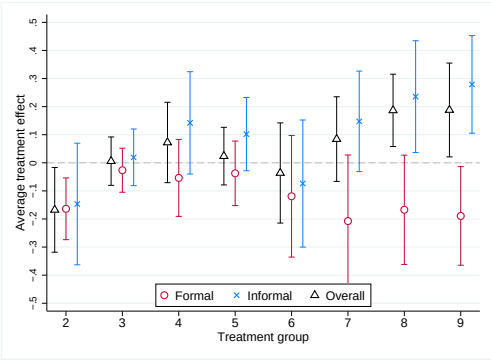


▸ Summary ▸ Taking stock

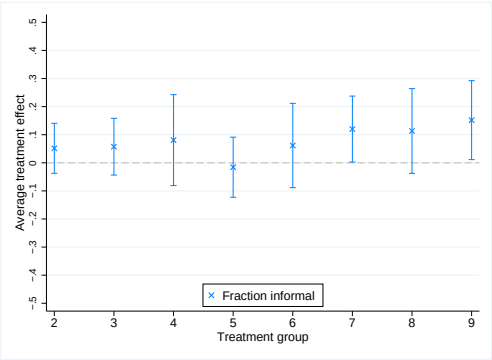
DiD results: controlling for evolution of informality

$$y_{sgt} = \alpha + \sum_{g \neq 1} \beta_g \cdot \delta_g \cdot \delta_{t>1999} + X'_{st}\Gamma + \mathit{InfShare}_{1999} \times \delta_t + \delta_s + \delta_t + \varepsilon_{st} \quad (6)$$

(a) log(Inequality)

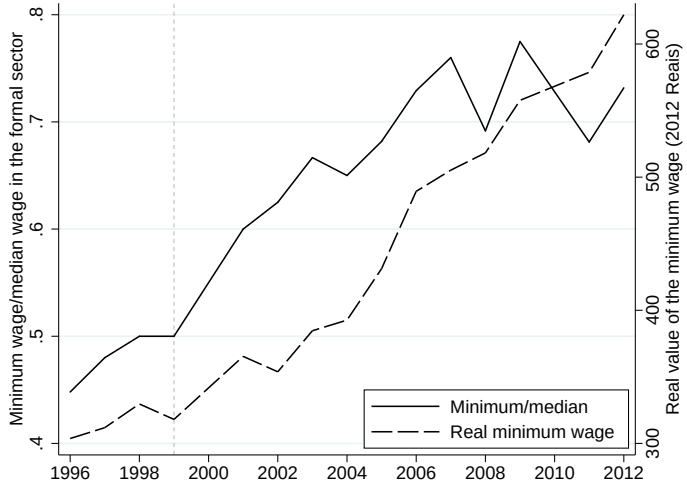


(b) log(Informal share)



Back

Other measures for the minimum wage



Back

Worker welfare and the minimum wage

Back

Proposition

Let $l^{inf}(z)$ and $l^{\underline{w}}$ denote labor allocation at informal and minimum-wage firms. Assume that the minimum wage ($\underline{w}$) is such that $\underline{w} < z_0 < \underline{z} < \bar{z}$. Then, the marginal effect of the minimum wage on labor demand (L^D) is:

$$\frac{\partial L^D}{\partial \underline{w}} =$$

Worker welfare and the minimum wage

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$$\frac{\partial L^D}{\partial \underline{w}} = \underbrace{\underbrace{[F(\bar{z}) - F(\underline{z})]}_{\text{Firms at MW}} \underbrace{\frac{\partial l^{\underline{w}}}{\partial \underline{w}}}_{L^D \text{ increase}}}_{\text{formal sector response (FR}\geq 0)}$$

Worker welfare and the minimum wage

Back

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Worker welfare and the minimum wage

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Proposition

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If $z \sim$ Pareto($\nu > \eta$),

Without informality, IR $= 0$, and increasing $\underline{w}$ **increases** *worker welfare: $\frac{\partial L^D}{\partial \underline{w}} > 0$.*

With informality, increasing $\underline{w}$ **reduces** *worker welfare: $\frac{\partial L^D}{\partial \underline{w}} < 0$.*

Proof