

# Minimum Wages, Inequality, and the Informal Sector

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*IMF*

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

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- Informal inequality did not fall alongside the rapid expansion of the federal minimum wage
- Reduced-form evidence on the impact of the minimum wage
  - 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
  - Minimum wage **reduces monopsony power** in the formal sector, **reducing formal 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
  - **Some firms become informal**, readjust wages and employment, **increasing informal inequality**

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  - **85% increase in enforcement** of formal employment **to undo unintended consequence**



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  - Improvement in the skill composition of workers reduced informality by 40%...
  - ...and undoes the unintended consequences of minimum wage increase

# 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	<b>39.1</b>	69.1	<b>30.9</b>
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

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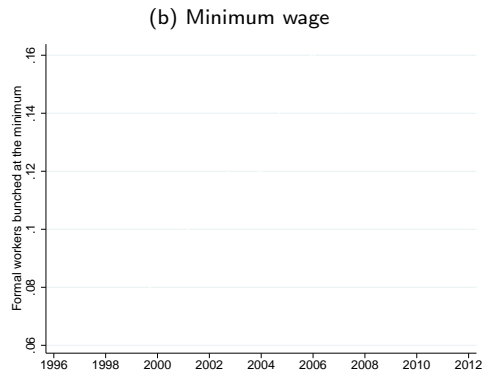
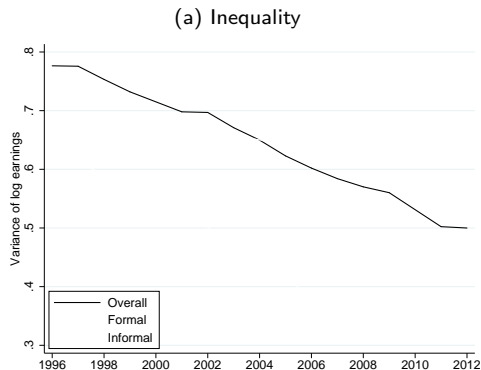
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# Earnings inequality and the minimum wage: aggregate time series

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



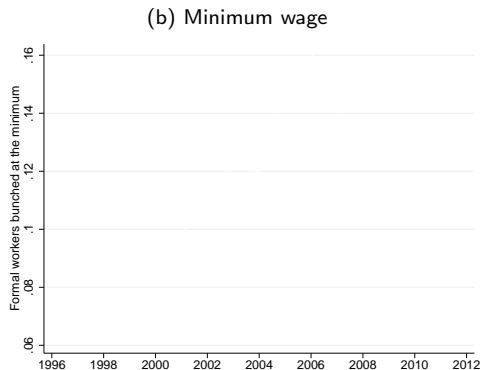
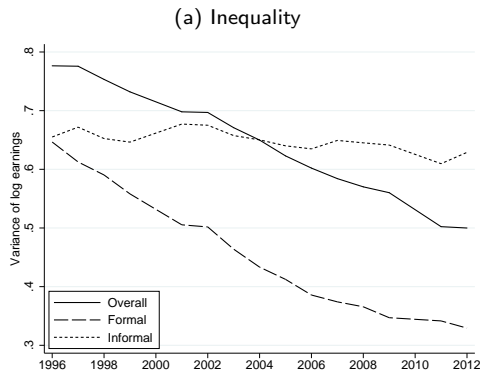
► W/B formality

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► Minimum wage

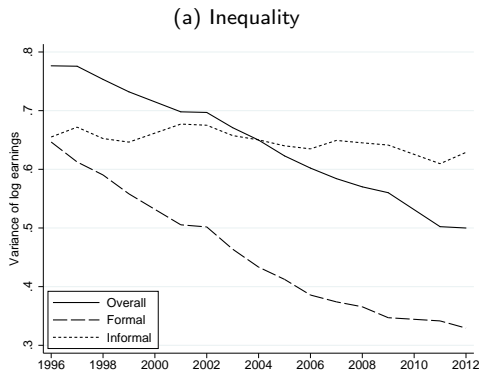
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- Substantial 36% decrease in aggregate inequality ( $\equiv$  variance of log earnings)
- Formal inequality fell by 50%; Informal inequality fluctuated around 0.65
- Sharp **increase in share of formal workers at min wage**, particularly after 1999 (7%  $\nearrow$  16%)



► W/B formality

► W/B firms

► Minimum wage

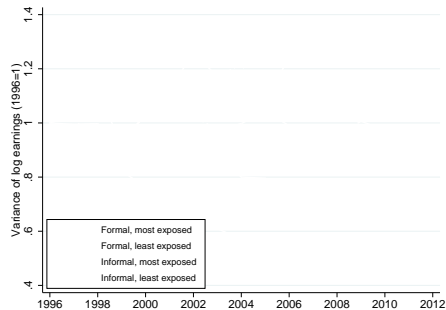
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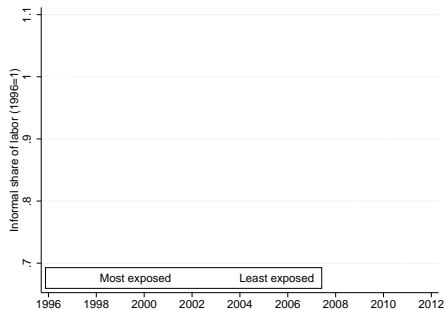
- Compare ineq/inf in **3 states with most/least share of min wage workers** in 1999

► Shares

(a) Inequality



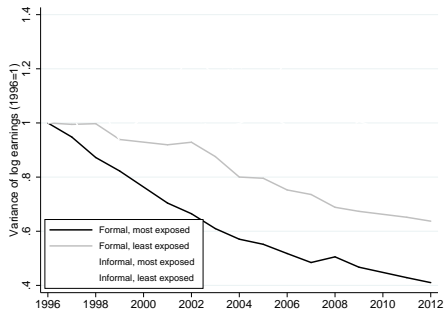
(b) Informality



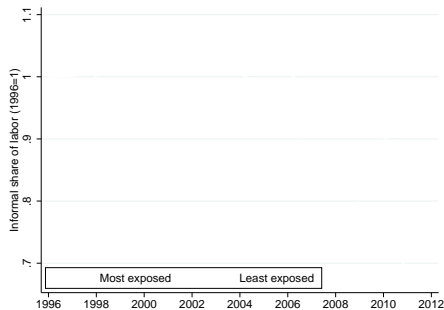
# Cross-state variation, inequality, and the informal sector

- 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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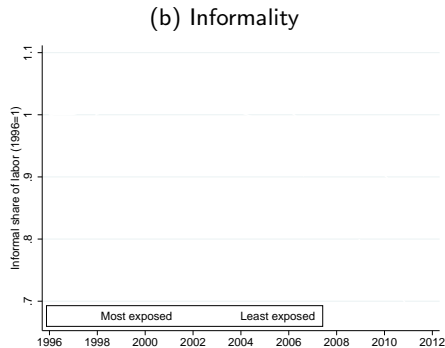
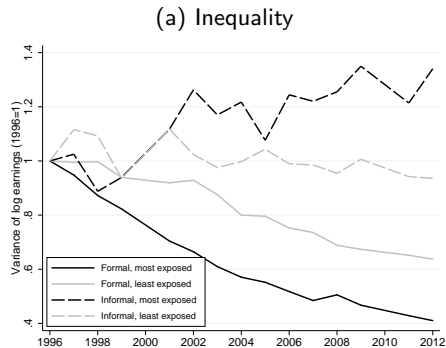


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  - 40% **increase in informal inequality** vs. mild decline in least exposed states

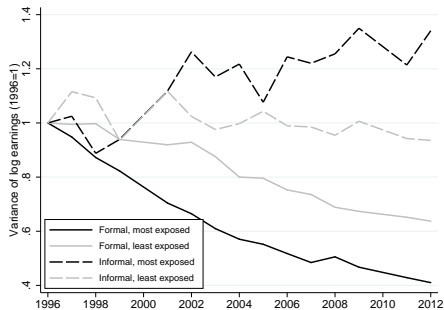




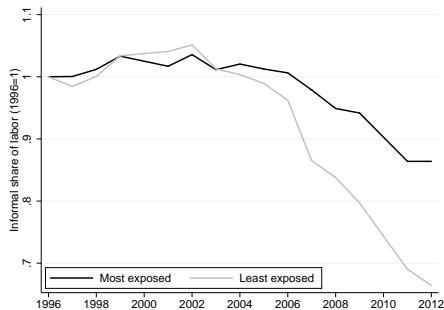
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- **States most exposed to the minimum wage hike experienced...**
  - Stronger formal inequality decreases (60% vs. 40% in least exposed)
  - 40% increase in informal inequality vs. mild decline in least exposed states
  - **Milder reductions in the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

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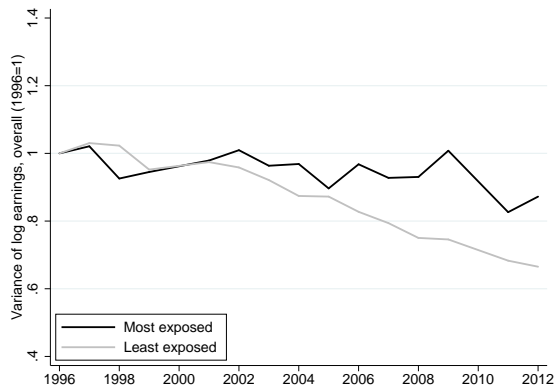


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# Cross-state variation, minimum wage, and aggregate inequality


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




## Econometric analysis: controlling for state heterogeneity

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



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  - **9 treatment groups:** share of formal workers bunching at the minimum wage in 1999
  - **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**

# Taking stock

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  - Differently from formal sector, **informal inequality moved sideways**
- 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

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- After observing productivity, firms choose formality status:
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  - 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

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

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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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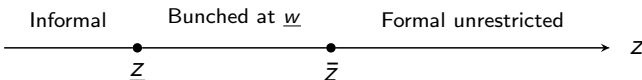
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- Maximize profits choosing employment, wages, and **formality status**:

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

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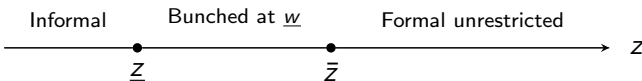
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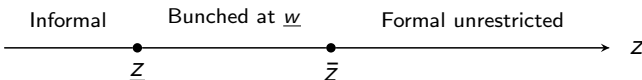
- Threshold solution: 
- Selection of low paying jobs to informal sector and bunching at the minimum wage
- Informality cutoff  $\underline{z}$  increases with  $\underline{w}$  and decreases with  $\rho$ .



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

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

- Threshold solution: 

Informal      Bunched at  $\underline{w}$       Formal unrestricted

$\underline{z}$        $\bar{z}$        $z$

  - Selection of low paying jobs to informal sector and bunching at the minimum wage
  - Informality cutoff  $\underline{z}$  increases with  $\underline{w}$  and decreases with  $\rho$ .
- There exists a unique equilibrium where  $L^D(W) = L^S = 1$

## Proposition

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

$$\frac{\partial V}{\partial \underline{w}} =$$

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$$\frac{\partial V}{\partial \underline{w}} = \underbrace{\frac{\partial V^{form}}{\partial \underline{w}}}_{\text{formal sector response (FR)}} + \underbrace{\frac{\partial L^{inf}}{\partial \underline{w}} \underbrace{\left[ \left( E^{inf} - E^{form} \right)^2 + V^{inf} - V^{form} \right]}_{\text{formal-informal differences}}}_{\text{workers become informal} \quad \text{informal sector response (IR)}} \quad (1)$$

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

Without informality, increasing  $\underline{w}$  **reduces** inequality:  $\frac{\partial V}{\partial \underline{w}} = \frac{\partial V^{form}}{\partial \underline{w}} < 0$ .

# Minimum wages, earnings inequality, and the informal sector

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

## Quantitative extensions

# Quantitative extensions

- Heterogeneous workers with skill  $h = 1, \dots, H$  (fraction  $N_h$  of population)  
 $\Rightarrow$  Skill-specific labor supply curve:  $l_h(j) = N_h [w_h(j)/W_h]^\eta$ ,  $W_h = \left[ \int_{j \in \Omega} w_h(j)^\eta dj \right]^{1/\eta}$



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- Two-component labor productivity:  $z = \nu\theta$  (Ulyssea, 2018)
  - First component drawn:  $\nu \sim F_\nu$
  - Formality decision before realization of second term:  $\mathbb{E}_z[\pi^{form}(z)|\nu] \gtrless \mathbb{E}_z[\pi^{inf}(z)|\nu]$
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  - Second component  $\theta \sim F_\theta$  and productivity  $z = \nu\theta$  are realized
- Equilibrium: aggregate wages indices  $W_h$  that clear labor markets for every  $h = 1, \dots, H$

# Calibration and validation

# Labor supply

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

Years of education	Degree	$N_h$	
		1996	2012
$\leq 4$	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  $\eta$  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)

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

	<u>Workers</u>				<u>Firms</u>
	$\varsigma_1$	$\varsigma_2$	$\varsigma_3$	$\varsigma_4$	$\tau$
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 disability benefits, severance payments, vacation stipends, and others. *Sources:* Labor legislation and PNAD.



Parameter	Description	1996	2012	Target
$\underline{w}$	Minimum wage	4.04	8.87	Share at min wage
$\rho$	Detection probability	0.258	0.321	Informal share
$\phi_4$	Skill shifters	0.079	0.115	Relative wages (tert/sec)
$\phi_3$		0.014	0.056	Relative wages (sec/prim)
$\phi_2$		-0.028	-0.043	Relative wages (prim/no deg)
$\eta$		4.52	4.22	Relative wages (form/inf)
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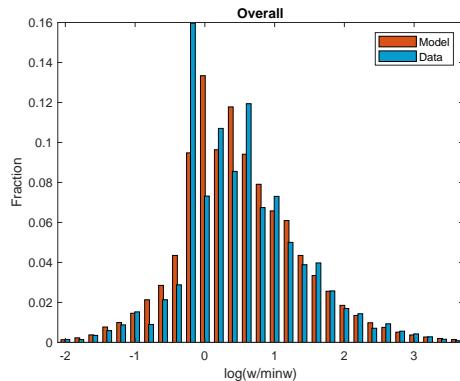
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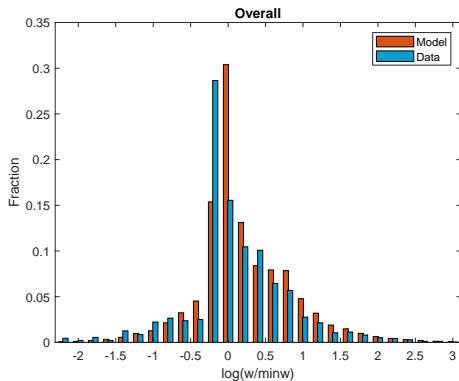
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- Skill biased technical change (+45% in  $\phi_4$ ) (Haanwinckel, 2020)
- **Labor supply elasticity**  $\eta \approx 4$  in line with labor literature (Lamadon, Mogstad, and Setzler, 2019)

# Model-implied overall earnings distribution

► By skills



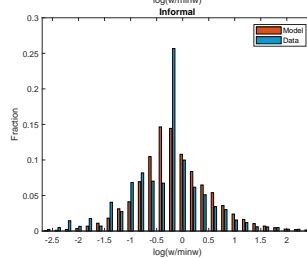
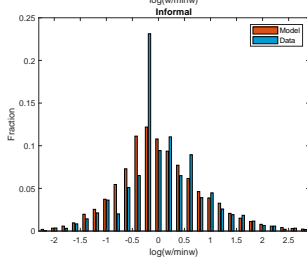
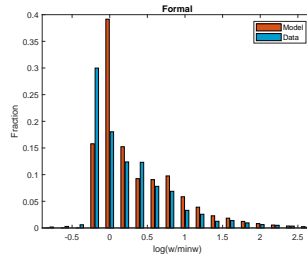
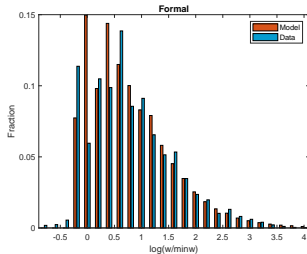
(a) 1996



(b) 2012

# Distribution of earnings by formality status

► By skills



(a) 1996

(b) 2012

## Counterfactual exercises



# Counterfactual exercises

- $\Delta \underline{w}$  = generates the observed bunching of formal workers in 2012, all else equal
- Minimum wage decreases formal inequality by 12.1% but increases agg inequality by 6.4%

	1996	All parameters at 1996 values, except...			
		$\Delta \underline{w}$ (minimum wage)	$\Delta \rho$ (enforcement)	$\Delta N_h$ (skill comp)	$\Delta \xi_h(z)$ (SBTC)
V(log earnings)					
overall	<b>0.78</b>	<b>0.83</b>	0.78	0.79	0.98
formal	<b>0.58</b>	<b>0.51</b>	0.58	0.62	0.70
informal	<b>0.73</b>	<b>0.83</b>	0.72	0.67	0.94
Fraction at $\underline{w}$	<b>7.74</b>	<b>15.2</b>	8.33	3.66	14.0
Informal share	<b>39.1</b>	<b>72.8</b>	28.0	22.8	61.4

► All but  $\underline{w}$

► Inf share 1996-2012

# Counterfactual exercises

- Remaining parameters set at their calibrated values for 2012, one at a time
- Change in enforcement decreases informal share by 28% but does not affect inequality

	1996	All parameters at 1996 values, except...			
		$\Delta \underline{w}$ (minimum wage)	$\Delta \rho$ (enforcement)	$\Delta N_h$ (skill comp)	$\Delta \xi_h(z)$ (SBTC)
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# Counterfactual exercises

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

		All parameters at 1996 values, except...			
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► Inf share 1996-2012

# Counterfactual exercises

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

		All parameters at 1996 values, except...			
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► All but  $\underline{w}$

► Inf share 1996-2012

# Complementing the min. wage with formalization and education policies

- Estimated increase in enforcement does little in preventing unintended consequences

	1996	<u>Joint counterfactuals</u>			
		$\Delta \underline{w}$	$+\Delta \rho = 24\%$	$+\Delta \rho = 85\%$	$+\Delta N_h$
V(log earnings)					
overall	<b>0.78</b>	0.83	<b>0.84</b>	0.78	0.77
formal	<b>0.58</b>	0.51	<b>0.50</b>	0.49	0.54
informal	<b>0.73</b>	0.83	<b>0.81</b>	0.78	0.74
Fraction at $\underline{w}$	<b>7.74</b>	15.2	<b>15.8</b>	17.8	7.50
Informal share	<b>39.1</b>	72.8	<b>57.6</b>	23.6	47.4

► Model with unempl

► Parasites

# Complementing the min. wage with formalization and education policies

- $\Delta\rho = 85\%$  offsets the unintended consequences of min wage on inequality

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► Model with unempl

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# Complementing the min. wage with formalization and education policies

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

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► Model with unempl

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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 6.4%*
- Potential implications for other debates
  - Federal vs. regional minimum wages; non-conventional work arrangements (Uber, Lyft, etc.)



# Thank you!

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# References I



Autor, David H., Alan Manning, and Christopher L. Smith (Jan. 2016). "The Contribution of the Minimum Wage to US Wage Inequality over Three Decades: A Reassessment". In: *American Economic Journal: Applied Economics* 8.1, pp. 58–99.



Burdett, Kenneth and Dale Mortensen (May 1998). "Wage Differentials, Employer Size, and Unemployment". In: *International Economic Review* 39.2, pp. 257–73.



Burstein, Ariel and Jonathan Vogel (2017). "International Trade, Technology, and the Skill Premium". In: *Journal of Political Economy* 125.5, pp. 1356–1412.



Card, David and Alan B. Krueger (1994). "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania". In: *The American Economic Review* 84.4, pp. 772–793.



Colombi, Roberto (1990). "A New Model Of Income Distribution: The Pareto-Lognormal Distribution". In: *Income and Wealth Distribution, Inequality and Poverty*. Ed. by Camilo Dagum and Michele Zenga. Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 18–32.



Corseuil, Carlos Henrique L., Rita Almeida, and Pedro Carneiro (Jan. 2012). *Inspecção do Trabalho e Evolução do Emprego Formal no Brasil*. Discussion Papers 1688. Instituto de Pesquisa Econômica Aplicada - IPEA.



Derenoncourt, Ellora et al. (May 2021). *Racial Inequality, Minimum Wage Spillovers, and the Informal Sector*. Working Paper.



DiNardo, John, Nicole M. Fortin, and Thomas Lemieux (1996). "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach". In: *Econometrica* 64.5, pp. 1001–1044.



Engbom, Niklas and Christian Moser (Mar. 2021). *Earnings Inequality and the Minimum Wage: Evidence from Brazil*. Opportunity and Inclusive Growth Institute Working Papers 7. Federal Reserve Bank of Minneapolis.



Fernández, Manuel and Julián Messina (2018). "Skill premium, labor supply, and changes in the structure of wages in Latin America". In: *Journal of Development Economics* 135, pp. 555–573.

# References II



Flinn, Christopher J. (2010). *The Minimum Wage and Labor Market Outcomes*. The MIT Press.



Gomes, Diego B.P., Felipe S. Iachan, and Cezar Santos (2020). "Labor earnings dynamics in a developing economy with a large informal sector". In: *Journal of Economic Dynamics and Control* 113, p. 103854. ISSN: 0165-1889. DOI: <https://doi.org/10.1016/j.jedc.2020.103854>. URL: <https://www.sciencedirect.com/science/article/pii/S0165188920300245>.



Haanwinckel, Daniel (Apr. 2020). *Supply, Demand, Institutions, and Firms: A Theory of Labor Market Sorting and the Wage Distribution*. Working Paper.



Haanwinckel, Daniel and Rodrigo R. Soares (May 2016). *Workforce Composition, Productivity, and Labor Regulations in a Compensating Differentials Theory of Informality*. IZA Discussion Papers 9951. Institute of Labor Economics (IZA).



Harasztosi, Peter and Attila Lindner (Aug. 2019). "Who Pays for the Minimum Wage?" In: *American Economic Review* 109.8, pp. 2693–2727.



Jales, Hugo (2018). "Estimating the effects of the minimum wage in a developing country: A density discontinuity design approach". In: *Journal of Applied Econometrics* 33.1, pp. 29–51.



Jales, Hugo and Zhengfei Yu (June 2020). *Labor Market Policies in a Roy-Rosen Bargaining Economy*. GLO Discussion Paper Series 577. Global Labor Organization (GLO).



Katz, Lawrence F. and Kevin M. Murphy (Feb. 1992). "Changes in Relative Wages, 1963–1987: Supply and Demand Factors\*". In: *The Quarterly Journal of Economics* 107.1, pp. 35–78.



La Porta, Rafael and Andrei Shleifer (2008). "The Unofficial Economy and Economic Development". In: *Brookings Papers on Economic Activity* 2008, pp. 275–352.



— (Sept. 2014). "Informality and Development". In: *Journal of Economic Perspectives* 28.3, pp. 109–26.

# References III



Lamadon, Thibaut, Magne Mogstad, and Bradley Setzler (June 2019). *Imperfect Competition, Compensating Differentials and Rent Sharing in the U.S. Labor Market*. Working Paper 25954. National Bureau of Economic Research.



Lee, David S. (1999). "Wage Inequality in the United States during the 1980s: Rising Dispersion or Falling Minimum Wage?" In: *The Quarterly Journal of Economics* 114.3, pp. 977–1023.



Meghir, Costas, Renata Narita, and Jean-Marc Robin (Apr. 2015). "Wages and Informality in Developing Countries". In: *American Economic Review* 105.4, pp. 1509–46.



Rauch, James E. (1991). "Modelling the informal sector formally". In: *Journal of Development Economics* 35.1, pp. 33–47.



Souza, André Portela et al. (May 2012). *Custo do Trabalho no Brasil: Proposta de uma nova metodologia de mensuração*. FGV/EESP.



Ulyssea, Gabriel (Jan. 2010). "Regulation of entry, labor market institutions and the informal sector". In: *Journal of Development Economics* 91.1, pp. 87–99.



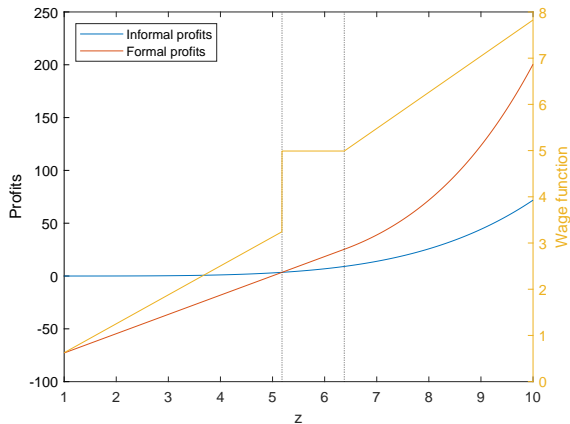
— (Aug. 2018). "Firms, Informality, and Development: Theory and Evidence from Brazil". In: *American Economic Review* 108.8, pp. 2015–47.



— (2020). "Informality: Causes and Consequences for Development". In: *Annual Review of Economics* 12.1, pp. 525–546.

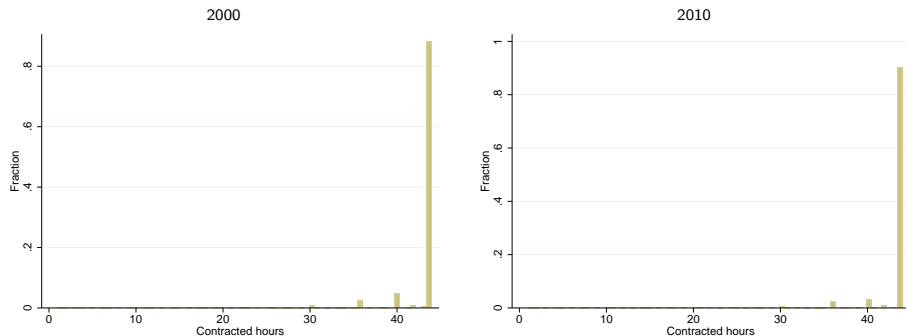
# Appendix

# 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.

# Distribution of hour on contract from RAIS

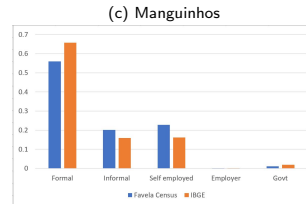
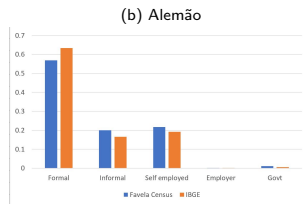
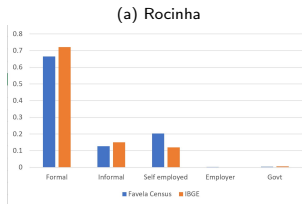


*Notes:* Histogram of contracted hours in the formal sector. I restrict analysis to male workers 25-55 not in the public sector. *Sources:* 2000 and 2010 RAIS.

# 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

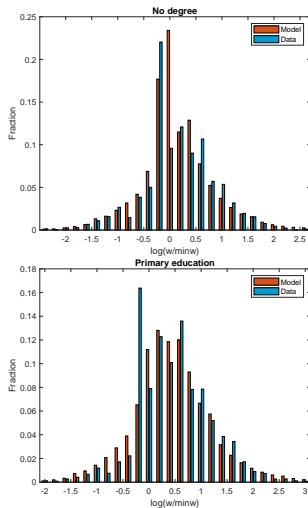
Notes: Estimated population for 2010 IBGE Census (sample weights used) versus total number of respondents in 2010 Favela Census.



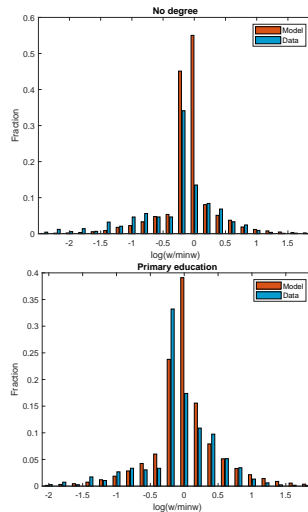
Notes: Comparison of occupation distribution between IBGE Census and Favela Census.



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

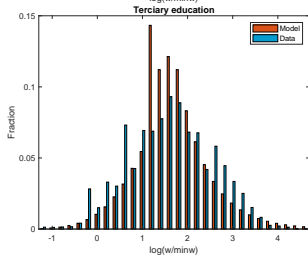
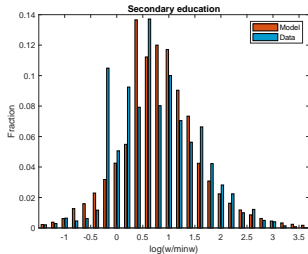
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(a) 1996

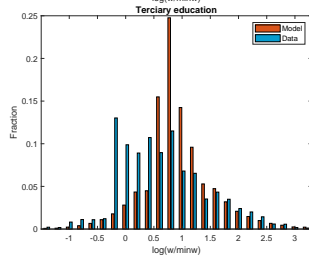
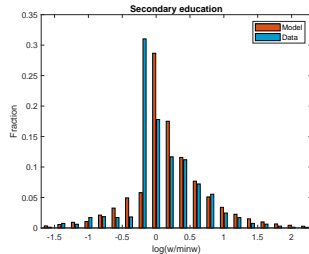


(b) 2012

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

[▶ Back](#)

(a) 1996

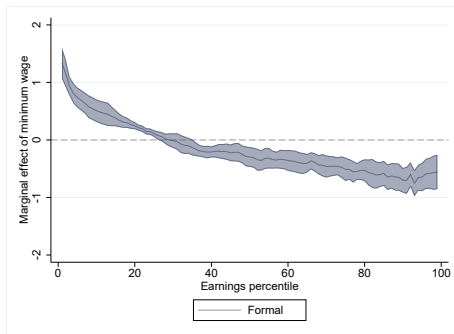


(b) 2012

# Reduced form evidence across earnings distribution

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

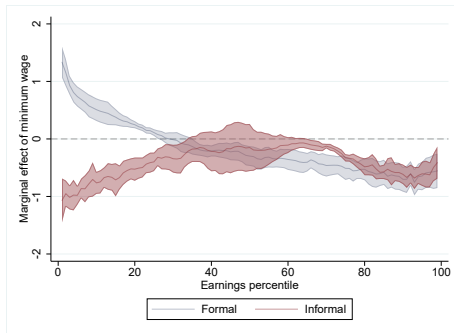
$$\log\left(\frac{w_{st}^p}{w_{st}^{50, Agg}}\right) = \beta_1 kaitz_{st} + \beta_2 kaitz_{st}^2 + \alpha(s, t) + \varepsilon_{st}$$



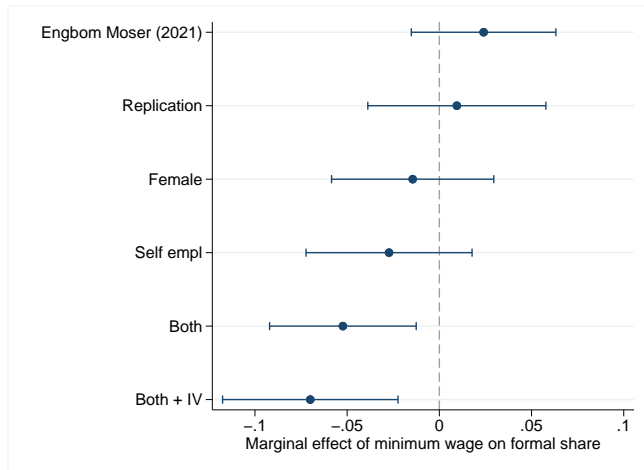
# Reduced form evidence across earnings distribution

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

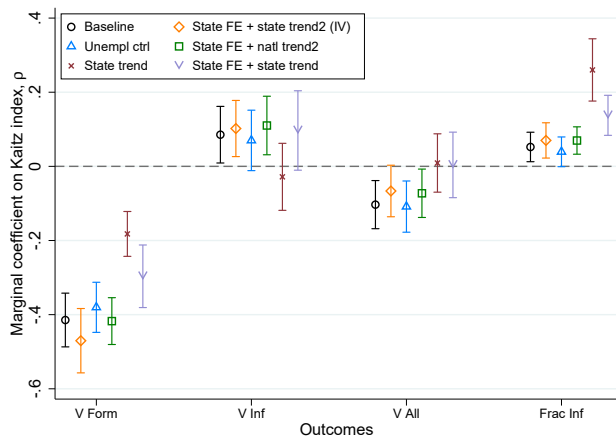
$$\log\left(\frac{w_{st}^p}{w_{st}^{50,Agg}}\right) = \beta_1 kaitz_{st} + \beta_2 kaitz_{st}^2 + \alpha(s, t) + \varepsilon_{st}$$



# Comparison with Engbom and Moser, 2021



# Robustness: regression specifications

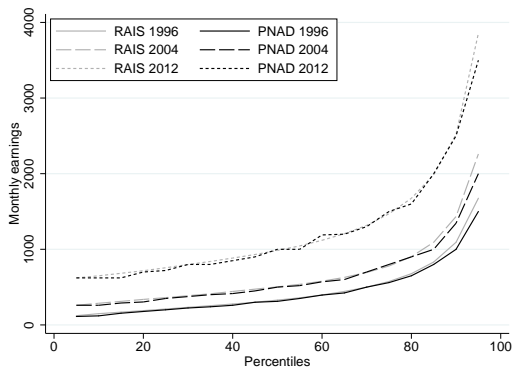


# The informal sector across industries

	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.

# Comparison of earnings in RAIS and PNAD

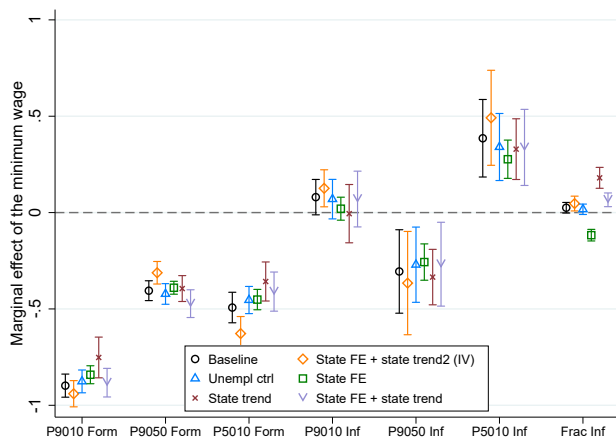


*Notes:* Comparison between earnings distributions in PNAD (black) and RAIS (grey) across different years (patterns). *Sources:* PNAD and RAIS.

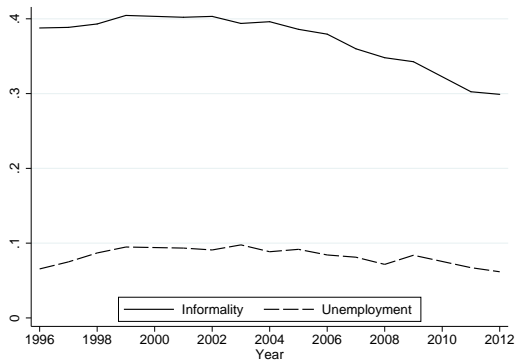


# Minimum wage, inequality, and the informal sector

p90-Kaitz index

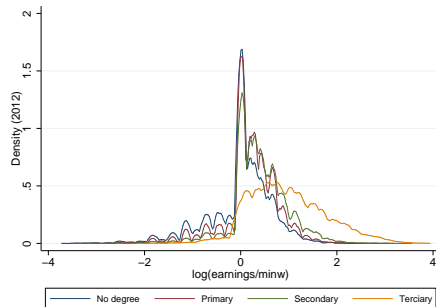
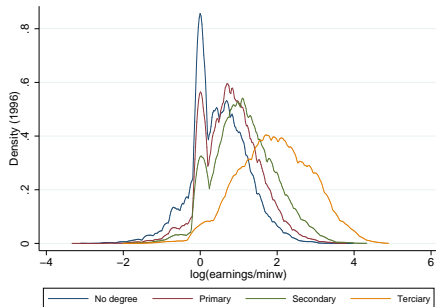


# Unemployment versus informality, 1996-2012



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

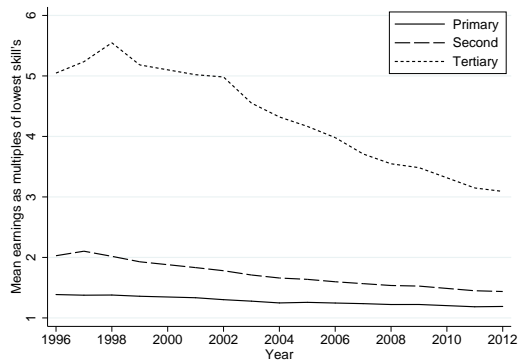
# Distribution of earnings across skills, 1996-2012



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

*Sources: PNAD.*

# Relative wages by skill, 1996-2012



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

# Inequality between vs. within firms

- Variance decomposition:  $Var(y_{ij}) = \underbrace{Var(\bar{y}_j)}_{\text{Between}} + \underbrace{Var(y_{ij}|i \in j)}_{\text{Within}}$ , 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 (58%)	0.535	0.460 (86%)
2003	0.484	0.272 (56%)	0.545	0.485 (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):

$Var(y_{ijt}) = Var(\bar{y}_{jt}) + Var(y_{ijt}|i \in j)$ . The numbers in parentheses represent the respective shares over total variance. Sources: 1997, 2003, and 2012 RAIS and 1997 and 2003 ECINF.

# Bunching at the minimum wage vs. inequality and informality

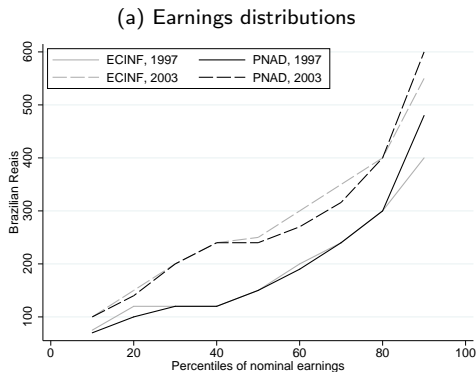
- Share of formal workers at the minimum wage as main explanatory variable

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

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.

# 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.

# 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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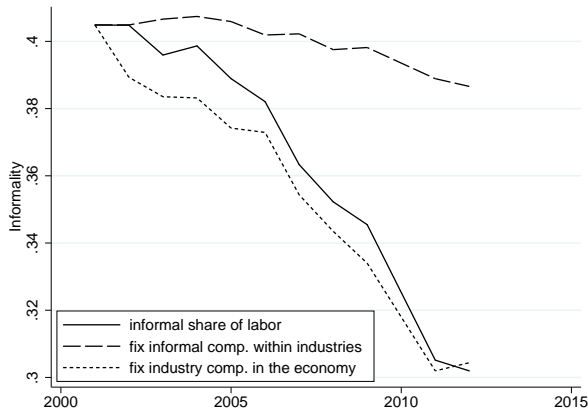


## Counterfactual - all parameters at 2012 except for the minimum wage

- 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
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

# 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](#)

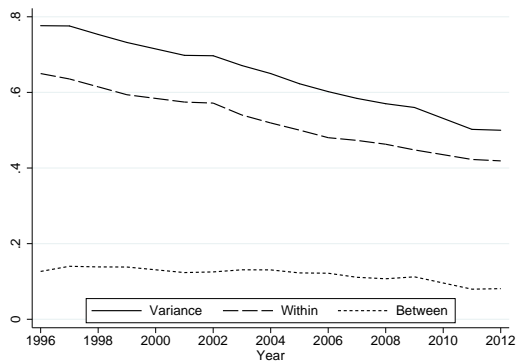
# Shift-share analysis on the evolution of informality: by education



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.

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

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

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

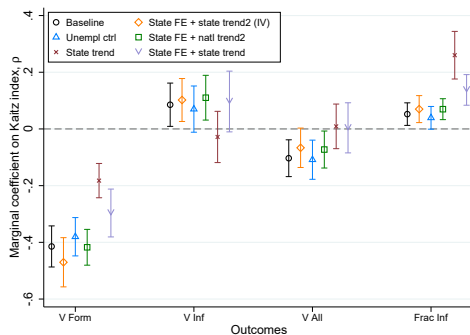
Variation: across states ( $s$ ) and over time ( $t$ )

- $y_{st}$ : 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:  $\rho = \hat{\beta}_1 + 2\hat{\beta}_2 \overline{kaitz}$

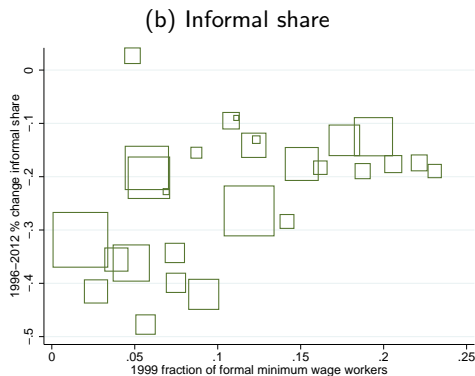
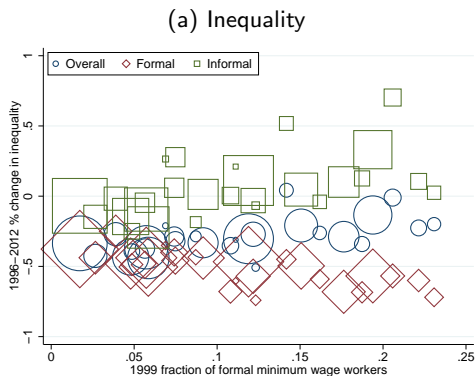
# Minimum wage, inequality, and the informal sector

- 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

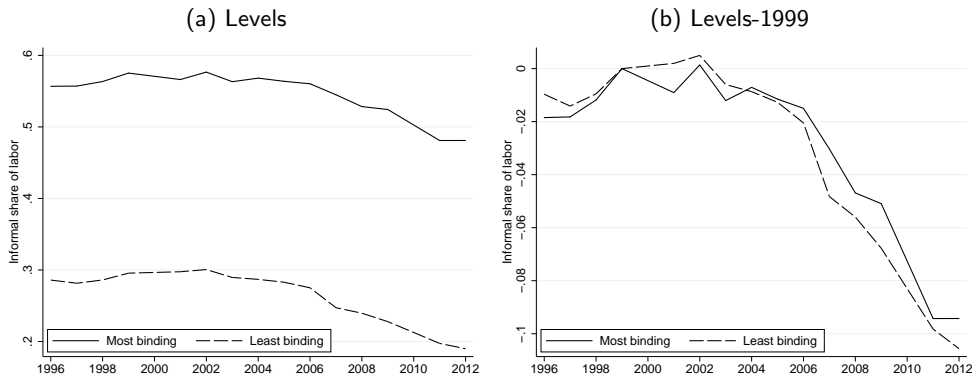


# Scatter plots: inequality and informality vs. initial exposure to min wage

- 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)



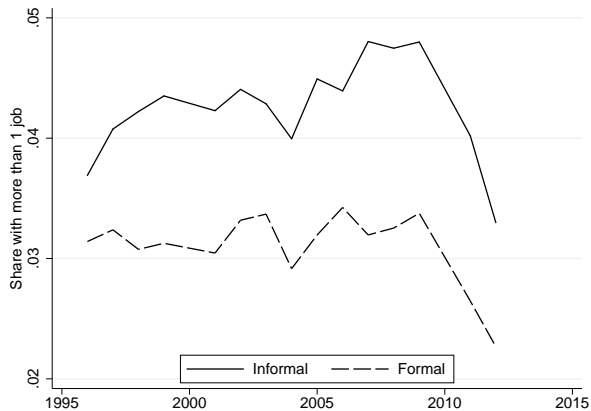
# Evolution of informal share in levels across states



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.

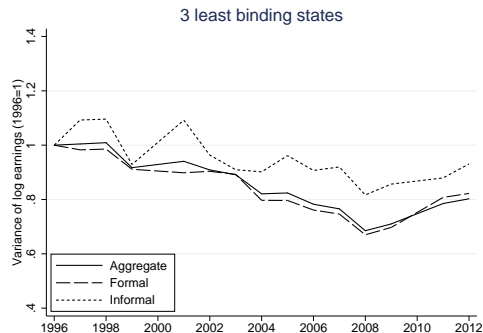
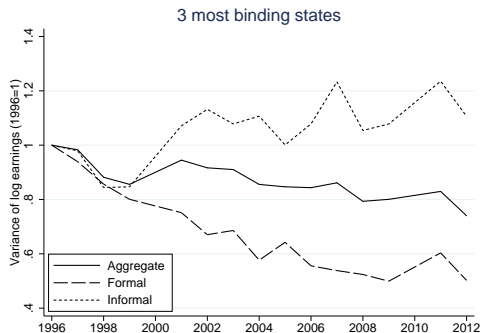


# Share of formal/informal workers with more than one job, 1996-2012



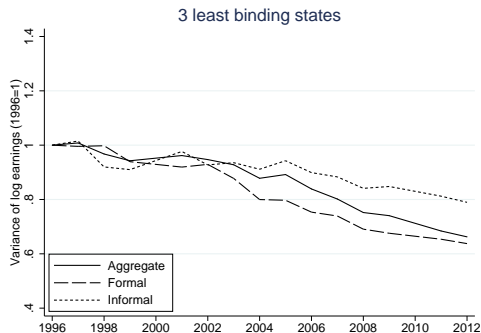
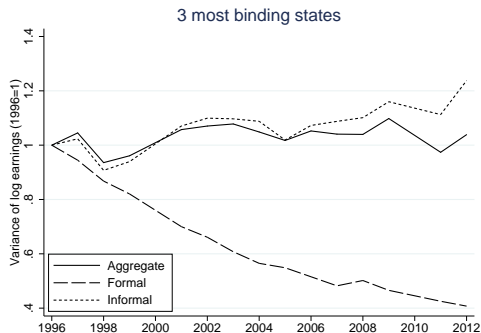
Notes: Share of workers in the formal and informal sectors with more than one job in the reference week. Sources: PNAD.

# Cross-state variation and earnings inequality - hourly wages



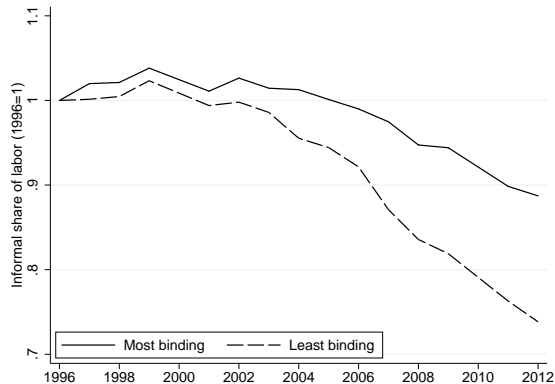
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# Cross-state variation and inequality - including self employed



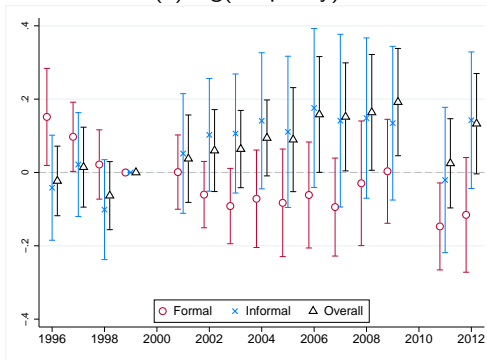
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# Cross-state variation and the informal sector - including self employed

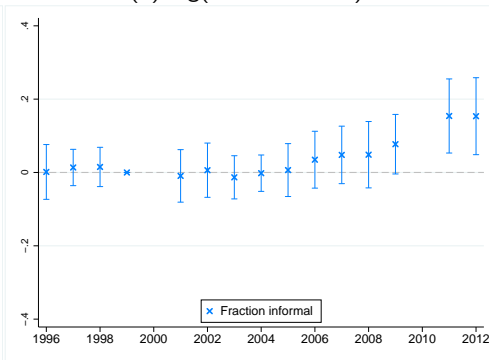


# DiD results - median split of states

(a)  $\log(\text{Inequality})$

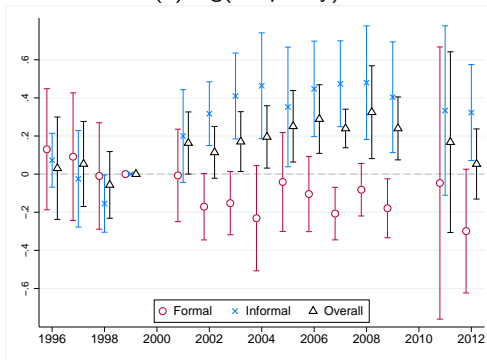


(b)  $\log(\text{Informal share})$

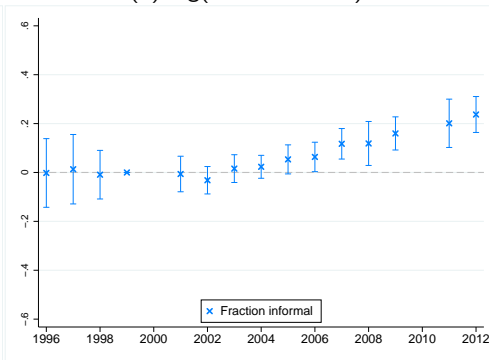


# DiD results - hourly earnings

(a)  $\log(\text{Inequality})$

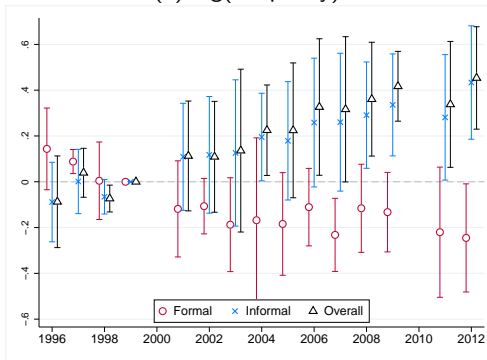


(b)  $\log(\text{Informal share})$

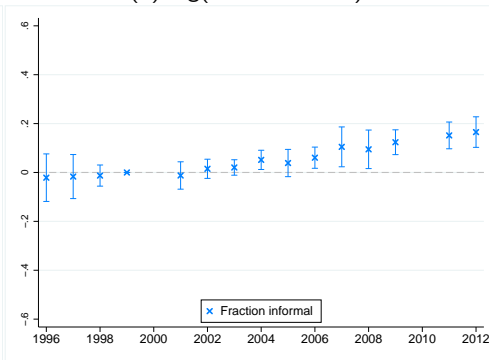


# DiD results - including self employed

(a)  $\log(\text{Inequality})$

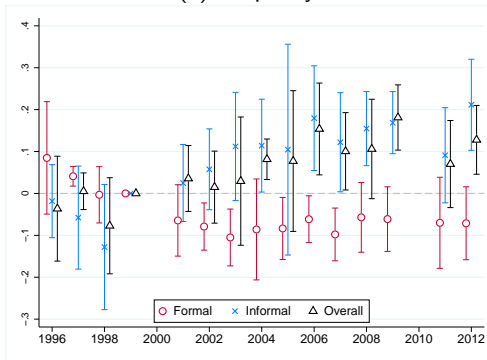


(b)  $\log(\text{Informal share})$

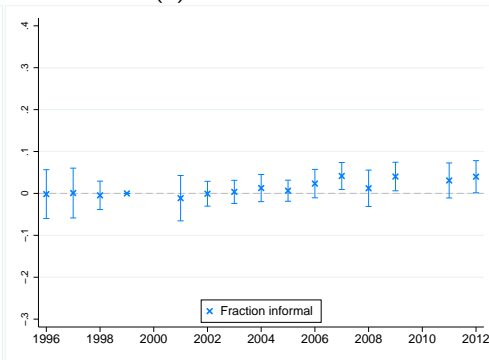


# DiD results in levels

(a) Inequality



(b) Informal share

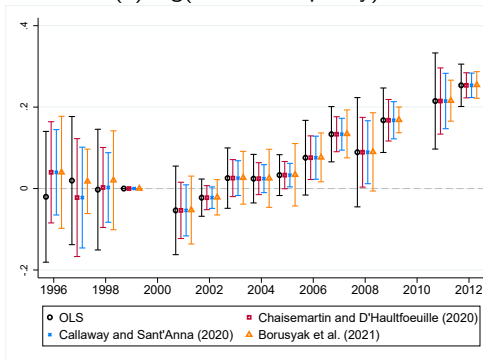


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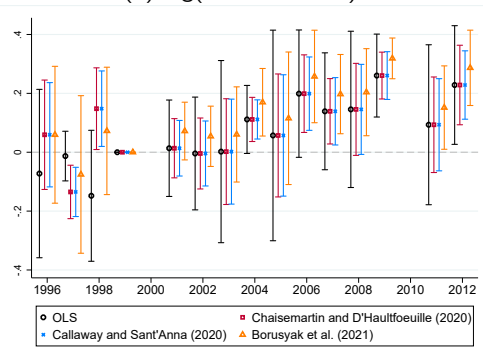


# DiD results - robustness to different estimators

(a)  $\log(\text{Overall inequality})$

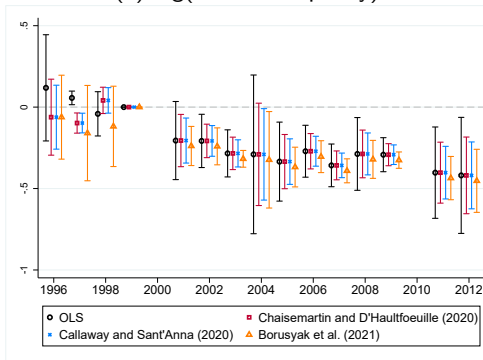


(b)  $\log(\text{Informal share})$

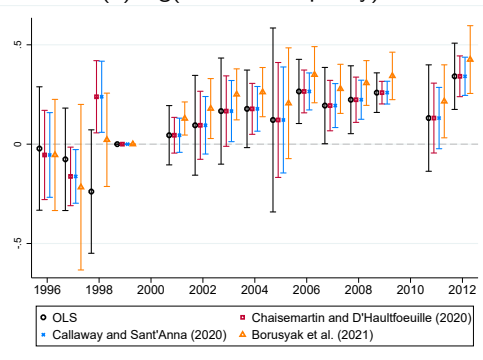


# DiD results - robustness to different estimators

(a) log(Formal inequality)



(b) log(Informal inequality)

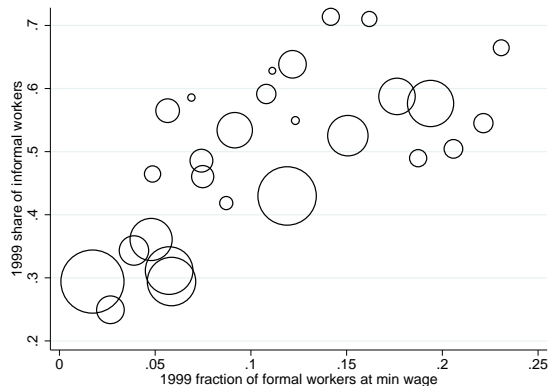


# DiD results

- Effects are stronger in most binding groups

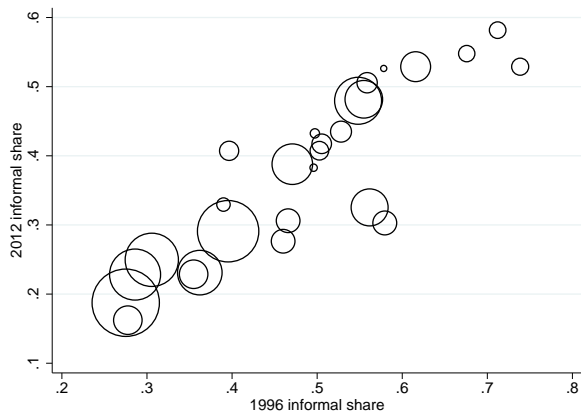
	$\log(V^{agg})$	$\log(V^{form})$	$\log(V^{inf})$	$\log(InfShare)$
$\beta_6 \times \text{Post}$	-0.008 (0.063)	-0.222 (0.091)**	-0.020 (0.091)	0.013 (0.033)
$\beta_7 \times \text{Post}$	0.085 (0.065)	-0.265 (0.110)**	0.173 (0.075)**	0.043 (0.043)
$\beta_8 \times \text{Post}$	0.213 (0.052)***	-0.261 (0.075)***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

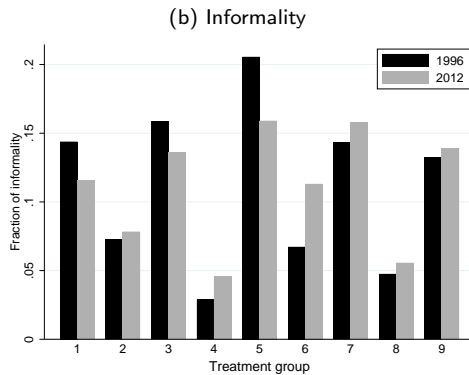
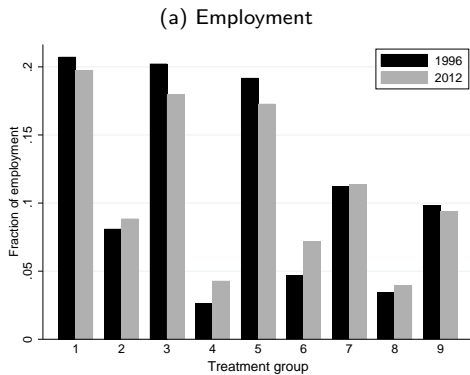
# Informal share over time



*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.

# Fraction of employment/informality in each group

1=least binding



# Evolution of mean/median earnings across sectors



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

# Proof of inequality proposition (first half)

I first prove the first half of the proposition.

Write aggregate variance as:

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

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

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

which establishes the decomposition of the minimum wage effects.

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



# Proof of inequality proposition (second half)

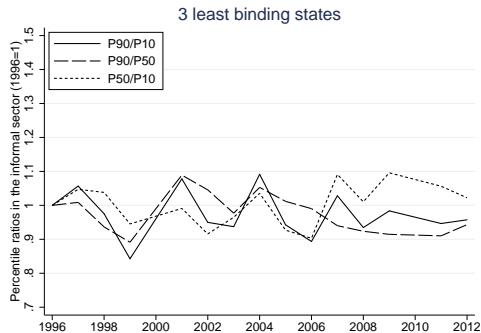
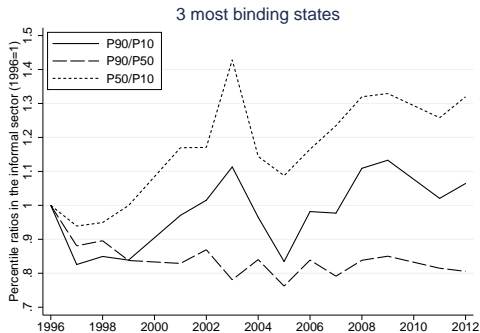
To show part 1. of the second half, I calculate the variance of log earnings in an economy without the informal sector. I then show that increasing the minimum wage reduces inequality necessarily.

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.

# Breaking down informal inequality

- Increase in informal inequality in most exposed states driven by median earnings
  - P50/P10 increased sharply, P90/P50 decreased mildly

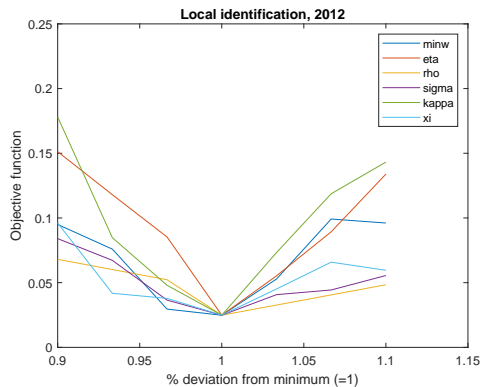
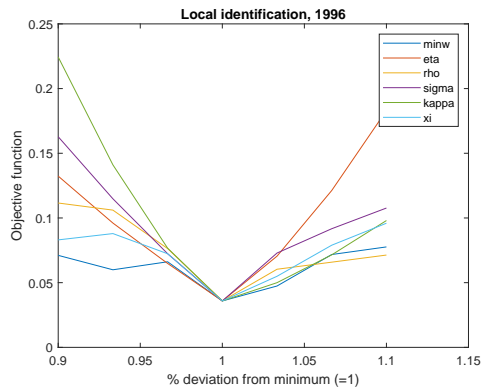


# Calibration results: model vs. data on targeted moments

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

# Identification of parameters

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



# Unemployment and monopsonistic competition

## 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:

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

# Unemployment and monopsonistic competition

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
$\rho$	Probability of detection	0.269	0.327	Informal share
$b$	Unemployment benefits	0.620	1.237	Unemployment rate
$\phi_4$	Demand shifter parameters	0.089	0.118	Relative wages (terc/sec)
$\phi_3$		0.014	0.044	Relative wages (sec/prim)
$\phi_2$		-0.027	-0.046	Relative wages (prim/no deg)
$\eta$	Labor supply elast.	4.856	4.121	Formal wage premium
$\sigma$	Standard deviation	0.957	1.324	Formal inequality
$\kappa$	Pareto tail	6.523	6.236	Informal inequality

# Unemployment and monopsonistic competition

Calibration: moments

	1996		2012	
	Data	Model	Data	Model
Mean earnings				
Formal/Informal	<b>2.06</b>	<b>2.13</b>	<b>1.65</b>	<b>1.68</b>
Primary/No degree	<b>1.39</b>	<b>1.39</b>	<b>1.19</b>	<b>1.20</b>
Secondary/Primary	<b>1.46</b>	<b>1.45</b>	<b>1.21</b>	<b>1.21</b>
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Informal	<b>0.66</b>	<b>0.66</b>	<b>0.62</b>	<b>0.51</b>
Formal bunching at min wage	<b>0.077</b>	<b>0.077</b>	<b>0.158</b>	<b>0.159</b>
Informal share of labor	<b>0.390</b>	<b>0.386</b>	<b>0.299</b>	<b>0.299</b>
Unemployment share	<b>0.065</b>	<b>0.065</b>	<b>0.062</b>	<b>0.062</b>

# Unemployment and monopsonistic competition

## 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

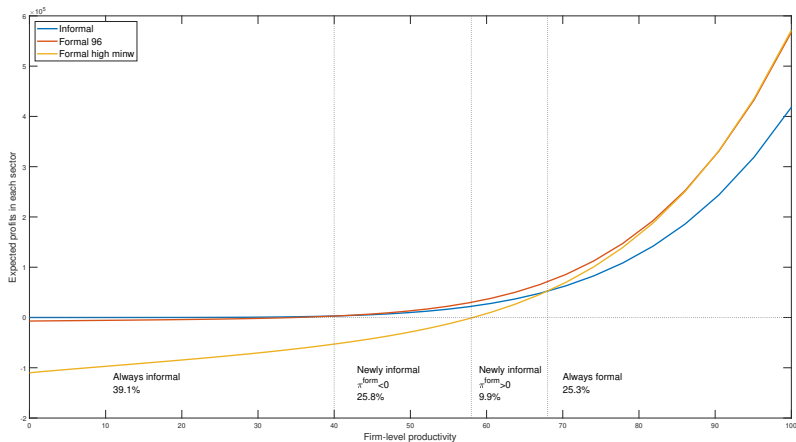
	1996	All parameters at 1996 values, except...		
		$\Delta \underline{w} = 120\%$ (minimum wage)	$\Delta \rho$ (enforcement)	$N_h$ (skill comp)
V(log earnings)				
overall	<b>0.73</b>	0.81	0.72	0.71
formal	<b>0.52</b>	0.43	0.52	0.56
informal	<b>0.66</b>	0.81	0.65	0.58
Fraction at $\underline{w}$	<b>0.077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



# Informality response to minimum wage: a break down

[▶ Back](#)

- 27.7% 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		

# Difference-in-differences analysis

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

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- Event study specification (state  $s$ , treatment group  $g$ , time  $t$ ):

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

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

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  - $\delta$ : fixed effects over state and time
  - $X_{st}$ : education, age, race, and gender compositions of labor force and unemployment rate

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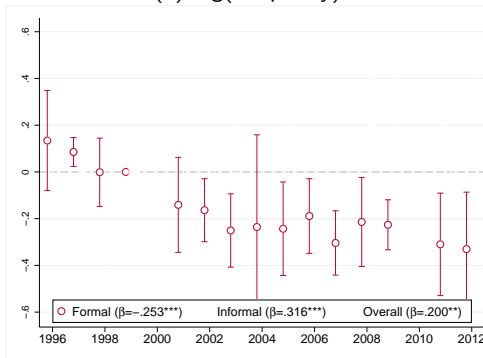
- Control for other drivers of inequality:
  - $\delta$ : fixed effects over state and time
  - $X_{st}$ : education, age, race, and gender compositions of labor force and unemployment rate
- Identification: absent increase in federal min wage, outcomes would follow parallel trends

# DiD results: most vs. least exposed states ( $\beta_{k9}$ )

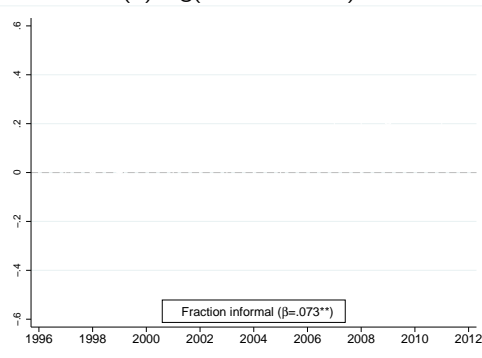
Most exposed states experienced...

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

(a) log(Inequality)



(b) log(Informal share)

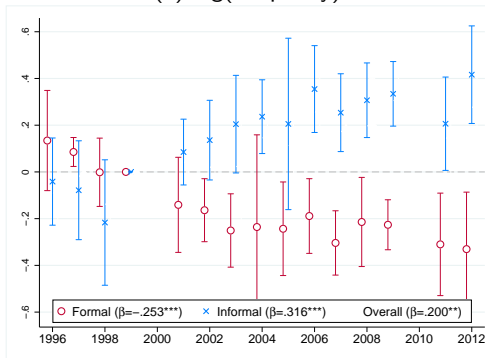


# DiD results: most vs. least exposed states ( $\beta_{k9}$ )

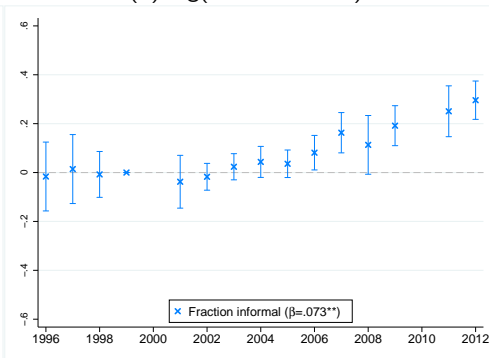
Most exposed states experienced...

- 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)



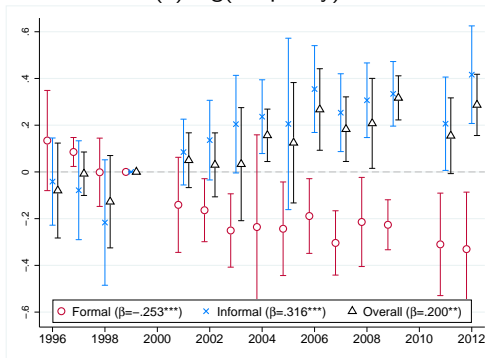


# DiD results: most vs. least exposed states ( $\beta_{k9}$ )

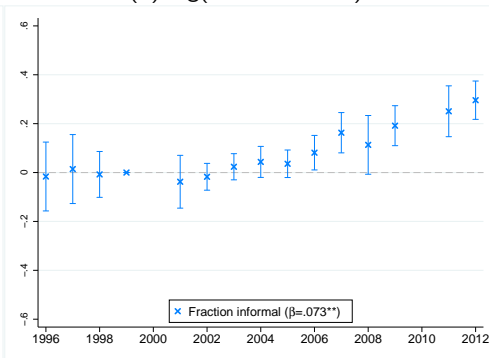
Most exposed states experienced...

- 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)



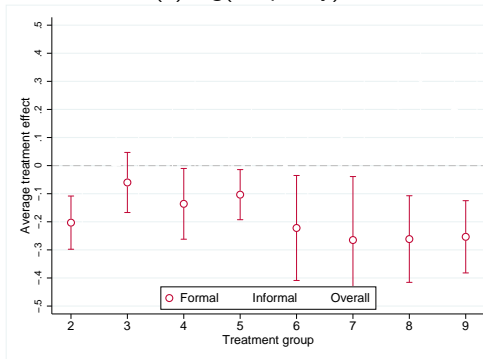
(b) log(Informal share)



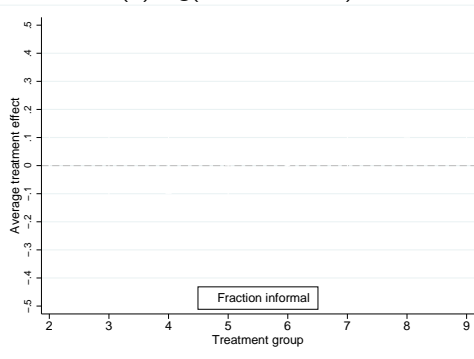
# DiD results: average treatment effects across treatment groups

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

(a) log(Inequality)

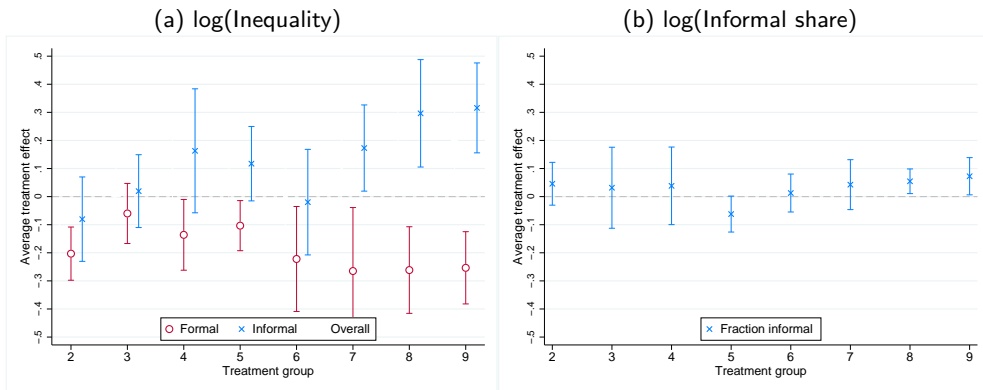


(b) log(Informal share)



# DiD results: average treatment effects across treatment groups

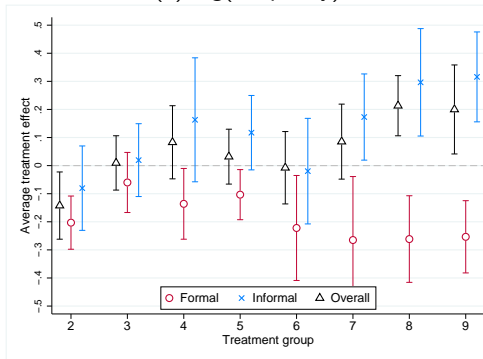
- Minimum wage **reduces formal inequality** in all treatment groups (relative to group 1)
- Stronger **informal margins of adjustment** in states that are more exposed



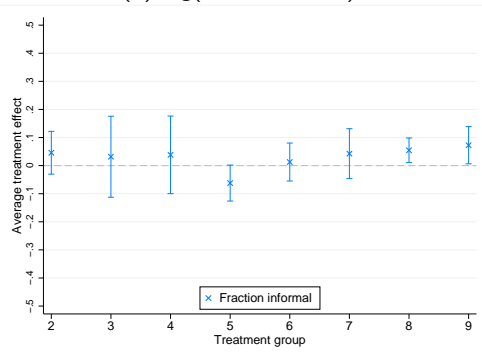
# DiD results: average treatment effects across treatment groups

- 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)



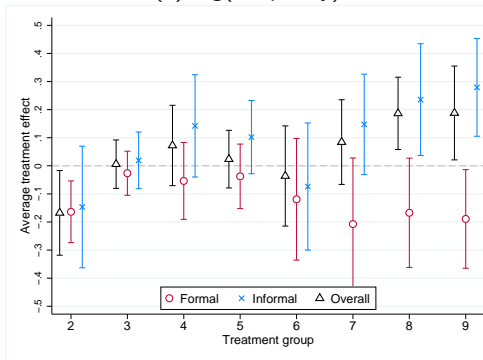
(b) log(Informal share)



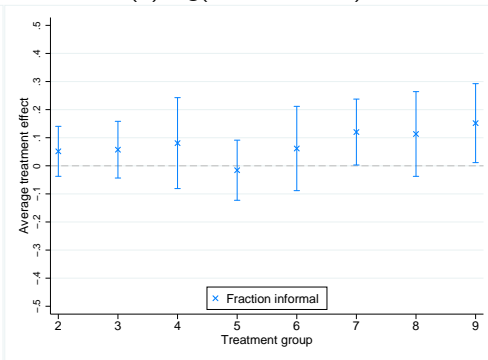
# DiD results: controlling for evolution of informality

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

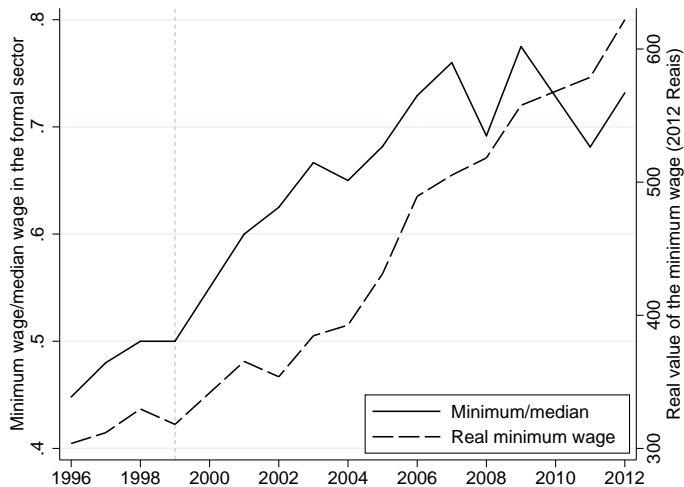
(a) log(Inequality)



(b) log(Informal share)



## Other measures for the minimum wage



# Worker welfare and the minimum wage

## 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:*

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

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



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

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:  $\frac{\partial L^D}{\partial \underline{w}} < 0$ .