Minimum Wages and Informal Self-Employment: Evidence from Peru

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Motivation

1. Minimum wage can reduce monopsony power and improve *efficiency*
   (i) Raise wages and employment (Manning, 2003; Autor et al., 2016; Azar et al., 2023)
   (ii) Firms respond to wage increases of competitors (Engbom & Moser, 2023)
   (iii) Reallocation from low to high productivity firms (Dustmann et al., 2022)

2. Minimum wage can *redistribute* resources from firm owners to low-wage individuals (Cengiz et al., 2019; Giupponi et al., 2024; Berger et al., 2024)

3. Developing countries are characterized by a large informal sector
   - *"Not only formal and informal firms produce in the same industry but there is also a sizable interval in the productivity support where one can find both types of firms."* (Ulyssea, 2018)

How should we think about minimum wages in developing countries?

This paper

Study the impacts of the minimum wage on firms & workers in Peru and the salience of the informal sector

1. How do firms respond to minimum wage increases?
2. What is the impact on workers employment and wage prospects?
3. Does low vs high presence of the informal sector matter?
4. Redistribution: Winners & Losers

Main Findings

1. Exploit firm exposure to minimum wage increases and workers' location on the wage distribution
   - Combine novel employer-employee data with household survey data and firm balance sheet data
   - Firm and worker-level empirical approaches
2. Effect of minimum wage on formal firms
3. Effect of minimum wage on formal workers
4. Redistribution: Winners & Losers

Main Findings

1. Exploit firm exposure to minimum wage increases and workers' location on the wage distribution
2. Effect of minimum wage on formal firms
   - Avg. firm reduced employment. Implied own-wage elast. $= -0.85$
   - Surviving firms pass-through increased labor costs. Consumers bear 98% of it
   - Effects concentrated on firms exposed to closer competition with informal sector
3. Effect of minimum wage on formal workers
4. Redistribution: Winners & Losers

Main Findings

1. Exploit firm exposure to minimum wage increases and workers' location on the wage distribution
2. Effect of minimum wage on formal firms
3. Effect of minimum wage on formal workers
   - Conditional on formal employment, workers' wage increases up to the 80th percentile of earnings distribution
   - Low wage workers are 1.5 pp less likely to remain formally employed
   - Effects concentrated on occupations with large formal vs informal competition
   - Size of formal sector decreased by 6.6%
4. Redistribution: Winners & Losers

Main Findings

1. Exploit firm exposure to minimum wage increases and workers' location on the wage distribution
2. Effect of minimum wage on formal firms
3. Effect of minimum wage on formal workers
4. Redistribution: Winners & Losers
   - Estimate effects on income and expenses.
   - Low-wage formal workers are better off at the expense of high-wage workers
   - Redistribution towards low-income households is limited, as these households are largely composed of informal worker

Contribution

1. **Minimum Wage**
   - Minimum wage impacts on labor market outcomes (Dustmann et al., 2022; Engbom & Moser, 2022; Azar et al., 2024)
   - Minimum wage and firms margins of response (Harastozi & Lindner, 2019)
   - Minimum wage and redistribution (Cengiz et al., 2019; Berger et al., 2024)

   Contribution: Bridge these literatures into a comprehensive analysis of a minimum wage increase
2. **Informality in Labor Markets**
   - Theories of informality (Meghir et al., 2015; Ulyssea, 2019; Haanwinckel, 2024)
   - Informality and concentration in labor markets (Amodio et al., 2023)

   Contribution: Propose a framework that combines oligopsony and involuntary exits from formal employment

Today's Talk

1. Conceptual Framework

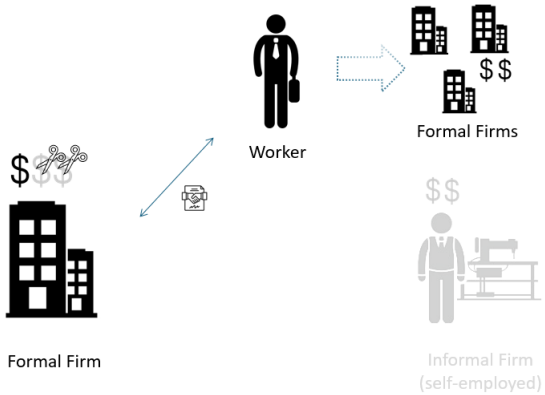
2. Setting & Data

3. Effects of minimum wage on formal firms

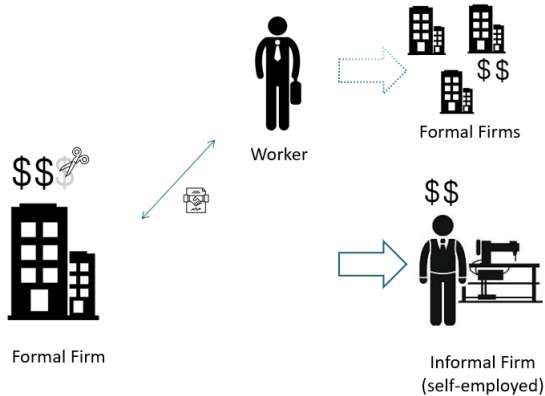
4. Effects of minimum wage on formal workers

5. Redistribution analysis: Winners & Losers

Firms can exert market power and pay below comp. wage



Informality reduces scope to cut wages



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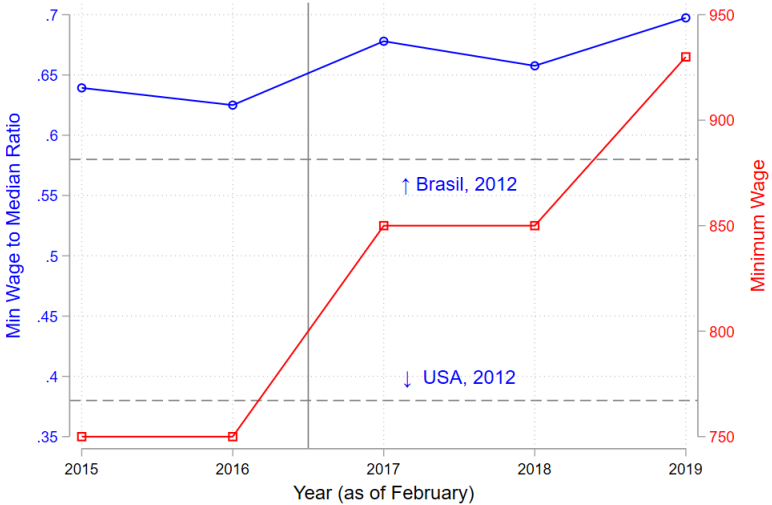
Bite of the minimum wage

Figure 1: Minimum wage to median ratio



Data Sources

- Employer-Employee Dataset (*Planilla Electrónica*) 2015-2019
  - ✓ Universe of formal sector firms
  - ✓ Allows to follow worker labor market outcomes (wages, occupation, sector, hours) and firms over time

- Firm-level Census (*Encuesta Económica Anual*) 2014-2018
  - ✓ Census of medium and large formal firms
  - ✓ Contains detailed information on firms' balance sheet
  - ✓ Fuzzy matched to employer-employee data ▸ Construction

- Household Survey (*Encuesta Nacional de Hogares*) 2014-2018
  - ✓ Annual survey of households, representative at national/state level (cross-sec & panel)
  - ✓ Detailed information on working status (employed/self-emp/formal/informal), industry, occ, hh-level consumption

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Empirical Strategy

Firm approach (Harasztosi & Lindner, 2019):

- Compute fraction of workers earning below the new minimum wage in Feb 2016.
- Estimate the following model:

$$\frac{y_{jt}-y_{j2016}}{y_{j2016}} = \alpha_t + \beta_t \underbrace{\text{FA}_j}_{\text{Fraction below MW in 2016}} + \gamma_t X_{jt} + u_{jt}$$

- **ID Assumption:** low versus high exposed firms would have trended similarly in abscence of minimum wage increase.
- Interact with firm specific measure of informality exposure:

$$\frac{y_{jt}-y_{j2016}}{y_{j2016}} = \alpha_t^0 + \alpha_t^1 \text{FA}_j + \beta_t^0 \text{FA}_j + \beta_t^1 \underbrace{\text{FI}_j}_{\text{Fraction informal occupation in 2016}} + \beta_t \text{FA}_j \times \text{FI}_j + \gamma_t X_{jt} + \epsilon_{jt}$$

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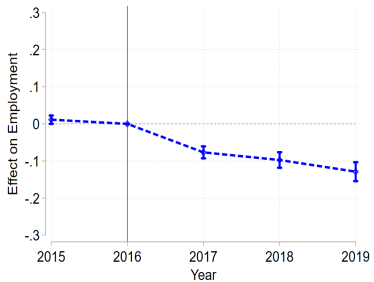
Effect on Employment and Average Wage

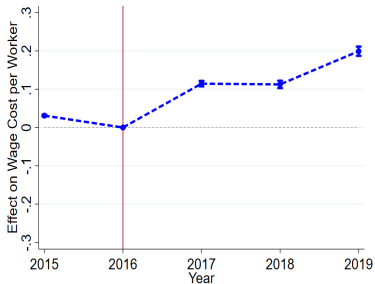
$$\frac{y_{jt}-y_{j2016}}{y_{j2016}} = \alpha_t + \beta_t \underbrace{FA_j}_{\text{Fraction below MW in 2016}} + \gamma_t X_{jt} + u_{jt}$$

▸ Linearity of FA (employment) ▸ Linearity of FA (wage)

Employment effects



Wage effects



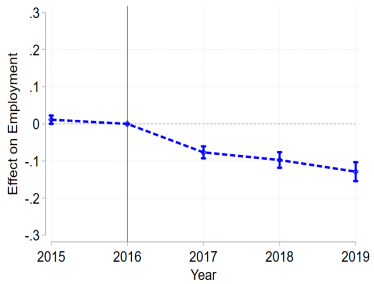
▸ How does it compare to the literature? ▸ Who are the most affected firms?

Effect on Employment and Average Wage

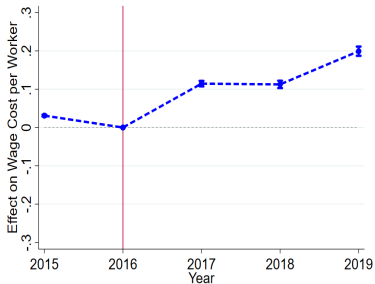
$$\frac{y_{jt}-y_{j2016}}{y_{j2016}} = \alpha_t + \beta_t \underbrace{FA_j}_{\text{Fraction below MW in 2016}} + \gamma_t X_{jt} + u_{jt} \quad \Rightarrow \text{own-wage elast.} = -0.85!$$

▸ Linearity of FA (employment) ▸ Linearity of FA (wage)

Employment effects



Wage effects



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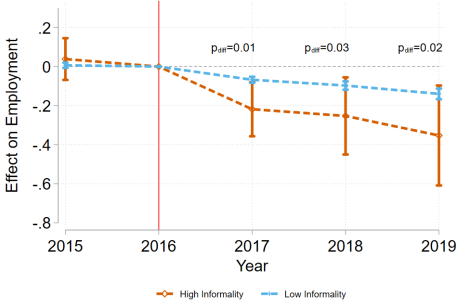
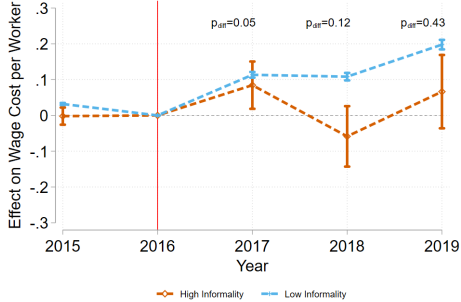
Effects by Informality

$$\frac{y_{jt}-y_{j2016}}{y_{j2016}} = \alpha_t^0 + \alpha_t^1 \text{FA}_j + \beta_t^0 \text{FA}_j + \beta_t^1 \underbrace{\text{FI}_j}_{\text{Fraction informal occupation in 2016}} + \beta_t \text{FA}_j \times \text{FI}_j + \gamma_t X_{jt} + \epsilon_{jt}$$

Employment effects



Wage effects



Today's Talk

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4. Effects of minimum wage on formal workers

5. Redistribution analysis: Winners & Losers

Empirical Strategy

Worker approach (Dustmann et al., 2022):

- Split workers into 15 earnings bins (100 PEN width)
- Compare changes before minimum wage (2015 vs 2016) to changes after minimum wage (2016 vs 2017)
- Estimate the following model:

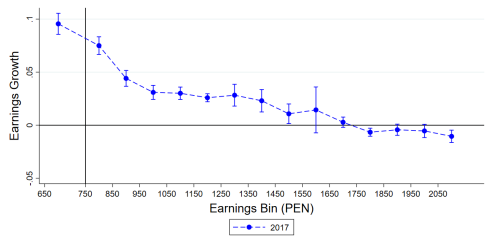
$$y_{i,t} - y_{i,t-1} = \sum_{b=1}^{15} \gamma_{2016,b} \mathbf{1}\{earnings_{i,t-1} \in bin_b\} + \sum_{b=1}^{15} \delta_b \mathbf{1}\{earnings_{i,t-1} \in bin_b\} \times POST_t + \beta X_{i,t-1} + \epsilon_{i,t}$$

- **ID Assumption:** macroeconomic time effects and mean reversion are stable over time.

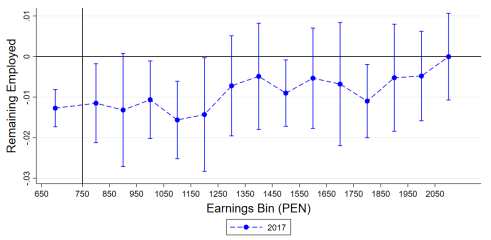
Effects on Employment and Wage

$$y_{i,t} - y_{i,t-1} = \sum_{b=1}^{15} \gamma_{2016,b} \mathbf{1}\{earnings_{i,t-1} \in bin_b\}$$
$$+ \sum_{b=1}^{15} \delta_b \mathbf{1}\{earnings_{i,t-1} \in bin_b\} \times POST_t + \beta X_{i,t-1} + \epsilon_{i,t}$$

Wage Effects (conditional on employment)



Employment Effects

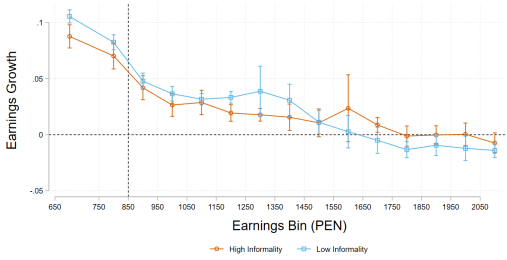


▸ Do wage effects come from reallocation?

Effects by Informality

Compare workers who were working at occupations classified as informal versus those who are not

Wage Effects (conditional on employment)



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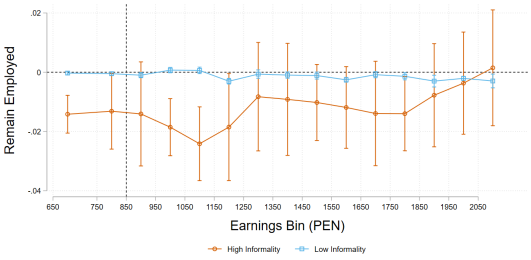

I also provide evidence that the size of the formal sector is indeed reduced. ▸ Evidence

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Change in Expenses

$$\Delta\text{Expenses} = \textit{Change in Labor Cost} \times \textit{Pass-through} \times \textit{Sh. consumption in MW-produced Goods} \times \textit{Total Expenses}$$

- *Change in Labor Cost:* use firm approach on firm balance sheet data ($\approx$ 12.3%) Table
- *Pass-through:* use firm approach on the decomposition Table

$$\frac{\Delta LaborCost}{Revenue2016} = \underbrace{\frac{\Delta Revenue}{Revenue2016} - \frac{\Delta Material}{Revenue2016} - \frac{\Delta MiscItems}{Revenue2016}}_{\text{Consumers Pay } (\approx 98\ \%)} - \underbrace{\frac{\Delta Depr}{Revenue2016} - \frac{\Delta Profit}{Revenue2016}}_{\text{Firm Owners Pay } (\approx 2\ \%)}.$$

- *Sh. consumption in MW-produced Goods:* follow Macurdy (2015) to estimate at household level using Peruvian Input-Output Table

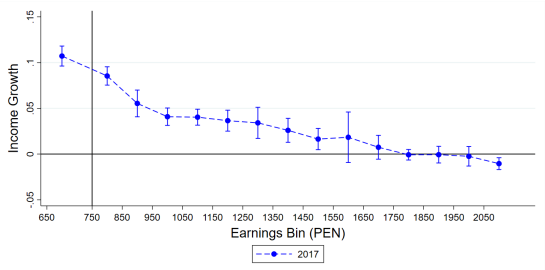
Changes in Income

Alternative Approach

$$\Delta \text{Income} = \textit{Percentage Change in Income} \times \textit{Initial Income}$$

where the pct change in income is given by

$$\frac{\Delta I_b}{w_b} := \underbrace{\frac{\Delta w_b}{w_b}}_{\text{Worker approach}} + \underbrace{\frac{(w_b^{\text{inf}} - w_b)}{w_b}}_{\text{Estimate from ENAHO}} \quad \underbrace{\Delta \mathbf{Prob}_b(\text{become informal})}_{\text{Worker approach}}$$



Redistribution analysis by worker earnings bins

Baseline bin $t-1$	$[650, 750)$	$[750, 850)$	$[950, 1050)$	$[1050, 1150)$	$[1150, 2050)$	$[2050, \max)$
Panel A. Income Change						
Mean formal wage	746	818	903	1,001	1,479	2,630
ΔIncome	82.06	65.44	45.15	40.04	29.58	0.00
Panel B. Expenses Change						
Mean per capita expenses	590	643	700	613	792	1379
ΔExpenses	16.35	17.82	20.25	17.73	22.91	43.22
ΔIncome - ΔExpenses	65.71	47.62	25.25	22.31	6.67	-43.22

Redistribution analysis by household income deciles

HH income decile	1	2	3	4	5	6	7	8	9	10
Panel A. Income Change										
Prop. formal employment	0.01	0.03	0.11	0.19	0.26	0.34	0.46	0.60	0.72	0.82
Prop. formal employment near MW	0.00	0.02	0.05	0.1	0.13	0.15	0.19	0.21	0.22	0.15
Mean formal wage near MW	1	7	40	128	242	316	462	570	705	586
ΔIncome	0.00	0.42	2.40	7.68	14.52	18.96	27.72	34.20	42.30	35.16
Panel B. Expenses Change										
Mean expenses	639	732	991	1,206	1,485	1,786	2,069	2,466	2,964	4,801
ΔExpenses	12.32	16.76	23.89	30.52	39.38	47.36	57.36	68.36	85.74	156.25
ΔIncome - ΔExpenses	-12.32	-16.34	-21.49	-22.84	-24.86	-28.40	-29.64	-34.16	-43.44	-121.09

Conclusion

1. Informal sector shapes the response to the minimum wage:
   - Its presence reduces labor market power to some formal firms.
   - Induces more involuntary exits from formality all together.

2. Surviving firms passthrough costs onto richer households, consistent with inflation inequality (Jaravel, 2021).

3. Low-wage formal workers are better off, although resources do not redistribute towards low-income households due to their composition.

4. Avenue of future research: non-pecuniary consequences such as job ladder implications, temporary employment, etc.

Thank you!

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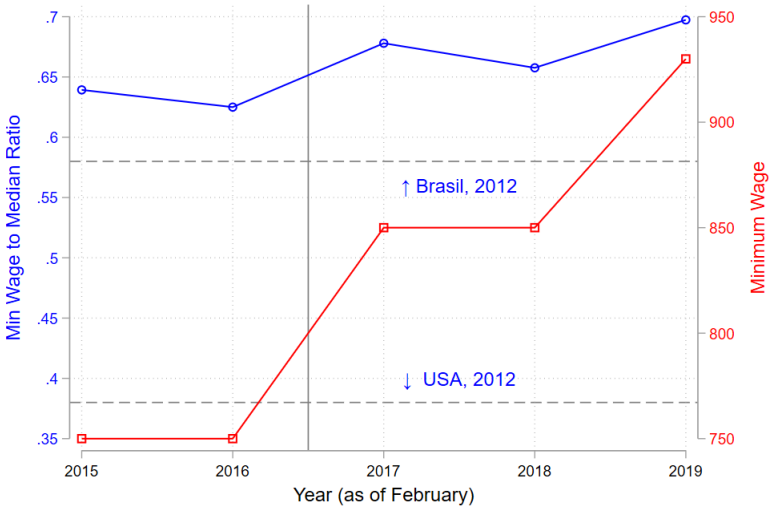
Appendix

Increase in the Minimum Wage in Perú

Back



Who are the most affected firms?

	Quartiles of FA_j in 2016			
	Q1	Q2	Q3	Q4
Lima	0.47	0.41	0.38	0.39
Avg Wage (PEN)	2480.81	1693.09	1170.64	888.55
Number of Workers	129.60	157.78	127.36	16.20
Firm Age	16.03	14.44	11.53	9.39
Manufacture	0.18	0.21	0.19	0.22
Commerce	0.35	0.31	0.30	0.31
Services	0.04	0.06	0.12	0.15
Observations	5,875	5,908	5,849	5,845

◂ Back

Who are the MW workers?

	Earnings bin in 2016 (PEN)		
	$650 < y_{t-1} \leq 850$	$850 < y_{t-1} \leq 1250$	$1,250 < y_{t-1} \leq 3,250$
Lima	0.14	0.18	0.18
Female	0.42	0.38	0.27
By education			
Share low skilled	0.05	0.05	0.03
Share medium skilled	0.48	0.50	0.44
Share high skilled	0.47	0.45	0.53
By age			
Share less than 24	0.09	0.08	0.02
Share 24-44	0.63	0.72	0.76
Share 45-65	0.27	0.19	0.22
By contract			
Permanent	0.36	0.22	0.30
Part-time	0.02	0.01	0.01

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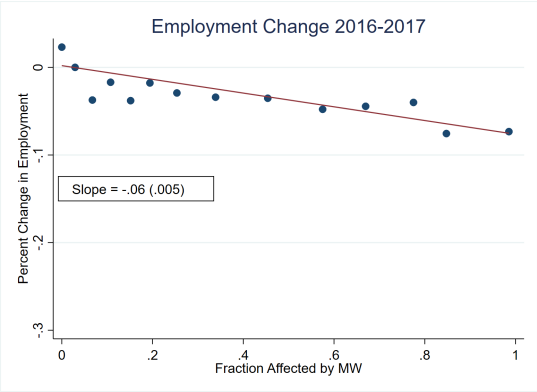
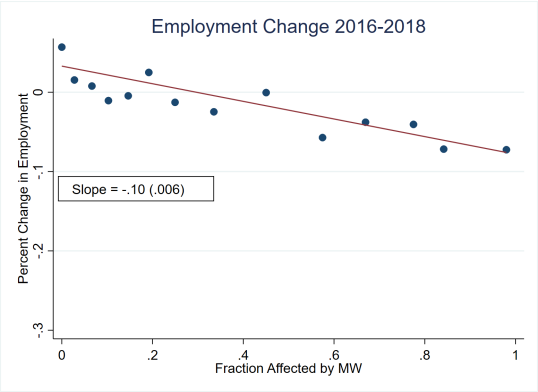
Is the relationship approx. linear?

Figure 7: Linearity of FA measure

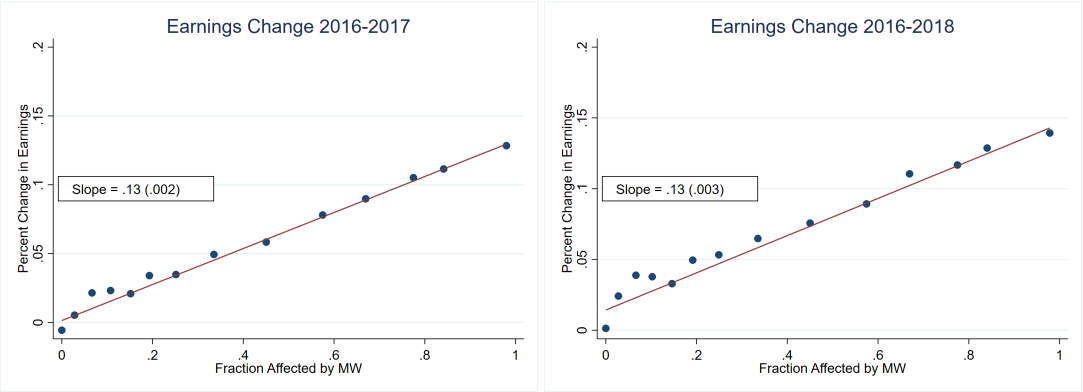




Back

Is the relationship approx. linear?

Figure 8: Linearity of FA measure



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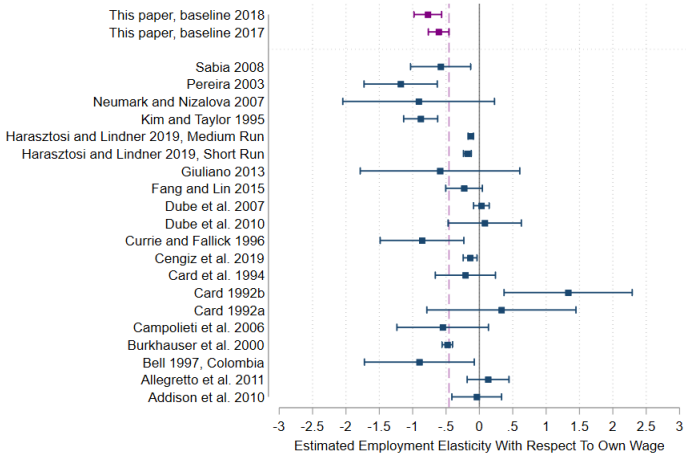
Own-wage elasticity in recent literature



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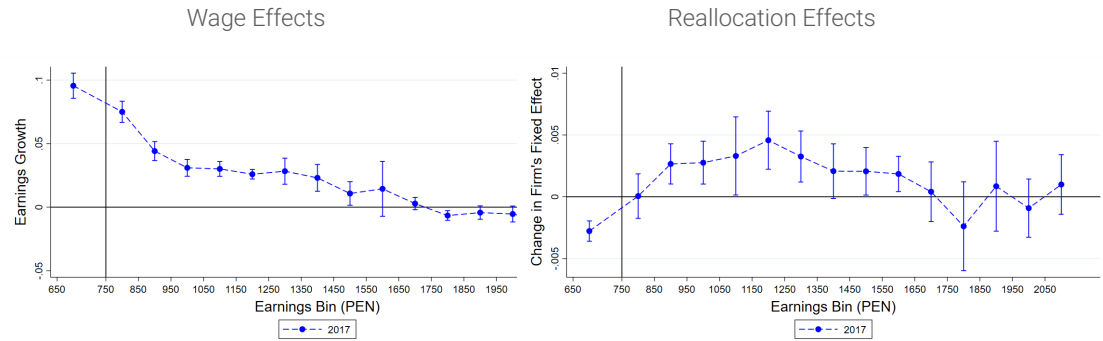
Small gains from reallocation

Figure 9: Wage and reallocation effects of the minimum wage



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Who pays for the MW? (Macurdy, 2015)

- Compute how much is industry s exposed to the MW

$$e_s = (I - BU)^{-1} B \frac{\text{wagebill}_s^{MW}}{\text{wagebill}_s} \times \frac{2}{3}$$

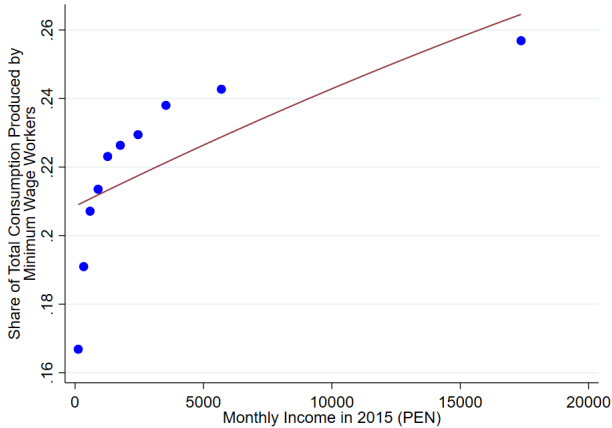
  - $B(i,j)$: share of commodity j produced by industry s
  - $U(i,j)$: share of commodity j used by industry s

- Using budget information in ENAHO, I match every product to a particular industry that produces it
- Compute the following measure

$$\text{Sh. cons produced by MW workers} = \sum_s \text{share of expenses in s} \times e_s$$

Who pays for the MW? (Macurdy, 2015)

Figure 10: Share of consumption produced by min wage workers

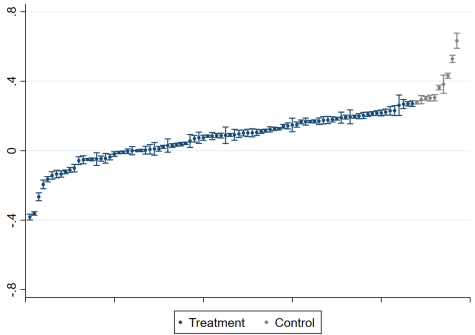


Aggregate employment effects at formal sector (Giuponni et al., 2024)

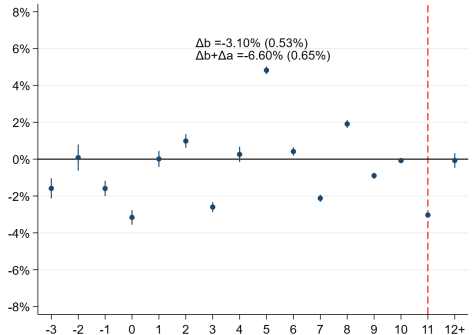
Back

1. Obtain place effects: $\ln w_{it} = \ln \lambda_{r(i,t)} + \theta_t + X'_{it}\beta + u_{it}$
2. Obtain *skill levels* $w^*_{it} = \exp(\ln w_{it} - \ln \lambda_{r(i,t)})$
3. $\Delta\%$Employment in low-wage regions compared to those of same *skill level* at high-wage regions

Distribution of Province Premia



Employment Effects



Imputation of Earnings

To address censoring at the 95th percentile of each year, I impute upper tail earnings following CCK(2016).

- I create 10-year age cells (20 to 29, 30 to 39, ..., 50 to 59), and 6 education cells (missing, no qualifications, secondary, some post sec, univ graduate, post graduate).
- I construct the mean log-earnings of individual i in all other periods, and for all their coworkers. For singleton workers or singleton firms I use the sample mean of gender $g(i)$.

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Imputation of Earnings

- I fit a series of Tobit models separately by year, gender, educ, and age range cells that include the following variables: age, mean log earnings, in other years, fraction of censored earnings in other years, number of full-time employees of gender g and its square, dummy for 11 or more employees, fraction of univ graduates at the firm, mean log wage co-workers and fraction of coworkers with censored earnings, dummy for singleton individuals, and a dummy for employees of 1-worker firms.
- If $y \sim N(X'\beta, \sigma)$ and censoring is such that $y \geq c$ is censored. Let $k = \Phi\left[(c - X'\beta)/\sigma\right]$, where $\Phi(\cdot)$ is the standard normal CDF. Let $u \sim U[0,1]$, then

$$y^u = X'\beta + \sigma\Phi^{-1}\left[k + u(1-k)\right]$$

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Firm design on balance sheet data

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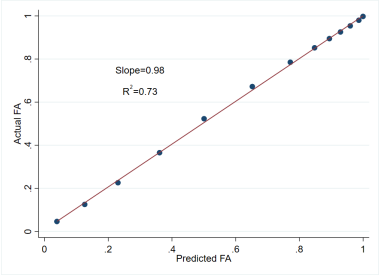
- Cannot directly compute fraction affected in firm-level census
- Share common variables with employer-employee data: employment counts (by gender, contracts) and average wage cost per worker
- Regression forest using random 75% sample of employer-employee obs as training data to predict FA_j on firm-level census



Expenses - Firms' margins of adjustment (excl. closures)

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	2015 and 2016	2015 and 2017	2015 and 2014
Panel A. Change in total labor cost			
Fraction affected	**0.123**	**0.219**	0.031
	(0.039)	(0.051)	(0.022)
Panel B. Change in revenue			
Fraction affected	**0.074**	**0.051**	0.011
	(0.036)	(0.046)	(0.027)
Panel C. Change in materials			
Fraction affected	0.079	-0.140	-0.147
	(0.152)	(0.176)	(0.151)
Panel D. Change in capital			
Fraction affected	0.135	0.165	0.006
	(0.068)	(0.087)	(0.055)
Panel E. Change in profits (relative to revenue in 2015)			
Fraction affected	-0.002	-0.006	-0.008
	(0.010)	(0.012)	(0.008)
Observations	3,440	3,185	4,343
Controls	Yes	Yes	Yes

Expenses - Incidence of the MW

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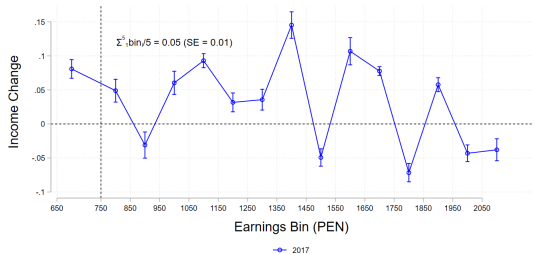
	Changes 2016	Changes 2017
Change in total labor cost relative to revenue in 2015	0.0243	0.0327
Ch in revenue rel to revenue in 2015 ($\Delta Revenue$)	0.0757	0.0614
Ch in materials rel to revenue in 2015 ($\Delta Material$)	0.0065	-0.0028
Ch in miscitems rel to revenue in 2015 ($\Delta MiscItems$)	0.0453	0.0442
Incidence on consumers ($\Delta Rev - \Delta Mat - \Delta MiscItems$)	0.0239	0.02
Ch in profits rel to revenue in 2015 ($\Delta Profit$)	-0.0007	-0.0095
Ch in depreciation rel to revenue in 2015 ($\Delta Depr$)	0.0004	-0.0032
Incidence on firm owners ($-\Delta Profit - \Delta Depr$)	0.004	0.0127
Fraction paid by consumers (percent)	**98.35**	**61.12**
Fraction paid by firm owners (percent)	1.65	38.88

Alternative Income Change

1. Fit a model that predicts how much a formal employee at $t-1$ would earn in the informal sector at t
2. Impute observations that correspond to non-employment in EE data
3. Re-run the worker approach



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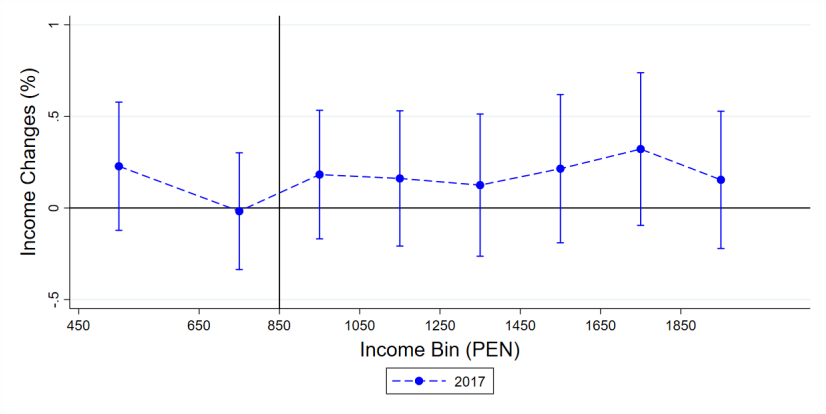
Income in the Informal Sector

Figure 12: Changes in Income for Informal Workers



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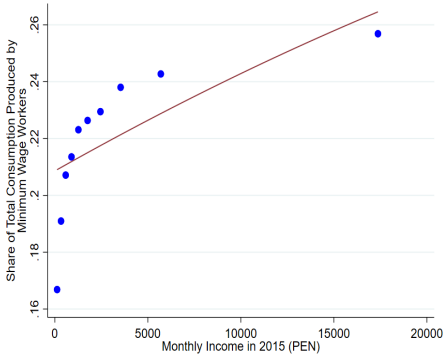
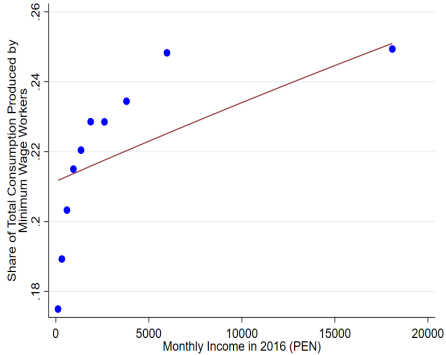
MW Consumption Post-Policy

MW Consumption Pre



MW Consumption Post



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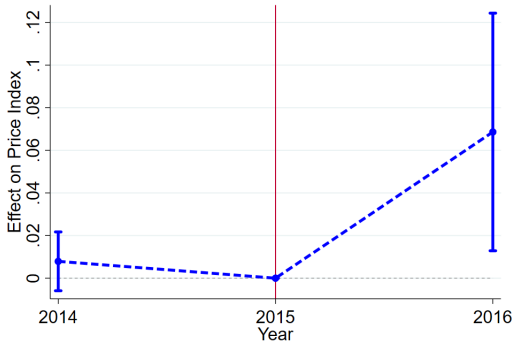
Laspeyre Prices from Survey Data

Figure 14: Change in food price index



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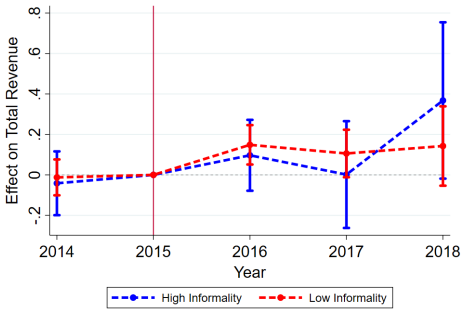
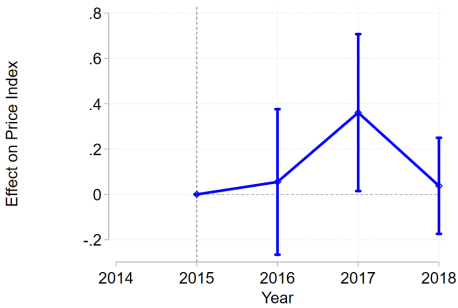
Laspeyre Prices from Balance Sheet Data

Compare provinces with high vs low presence of informality

Effects on Revenue



Effects on Output Price (Manufacture)



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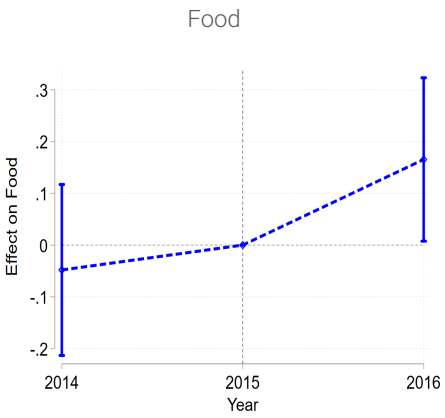
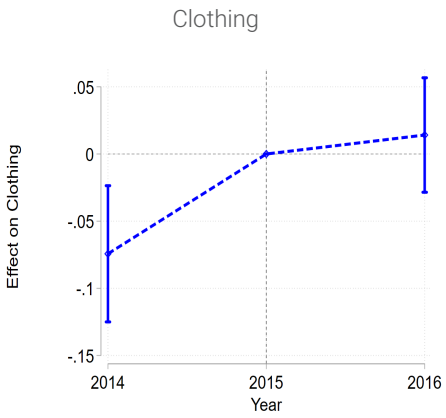
Changes in Expense Shares





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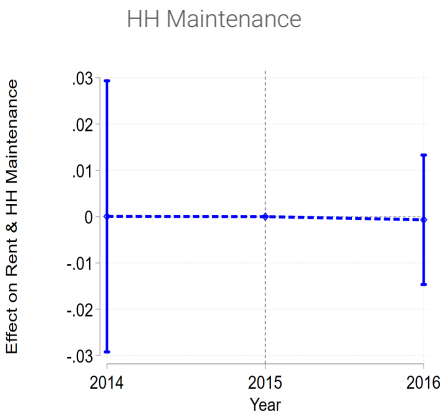
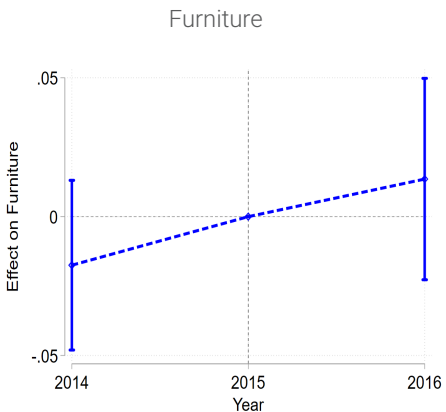
Changes in Expense Shares





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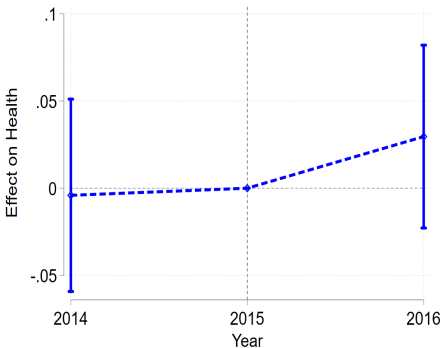
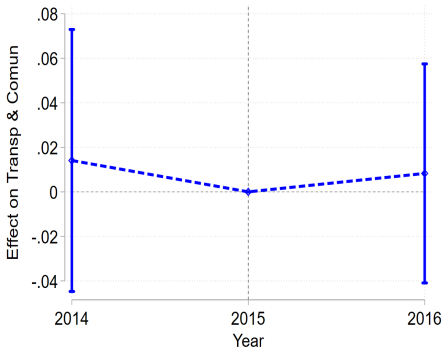
Changes in Expense Shares

Health



Transportation & Communication



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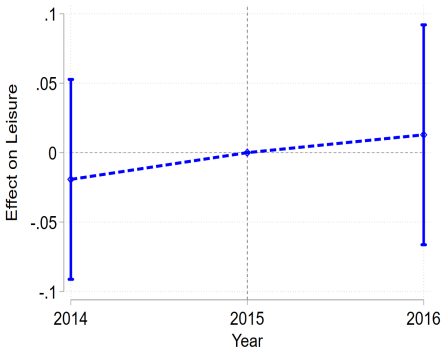
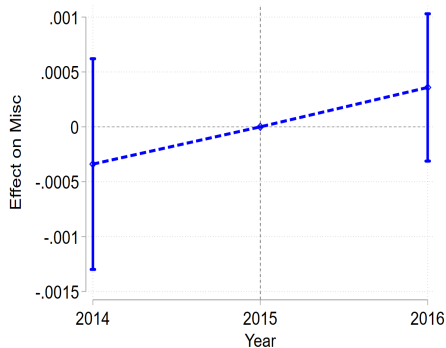
Changes in Expense Shares

Leisure



Miscellaneous Expenses



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