Minimum Wages and Informal Self-Employment: Evidence from Peru

Paúl J. Corcuera García

Universidad de Piura

August 16th, 2024

Motivation

► How should we think of minimum wages in developing countries?

   – Theory: $\underbrace{\downarrow \text{monopsony power}}_{\text{efficiency}}$ + $\underbrace{\text{transfer from firm owners} \rightarrow \text{low-income individuals}}_{\text{redistribution}}$

   – Many low and middle-income 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)

► Core Idea:

   – Competition between formal and informal sector shapes market power

   – Harder for firms to adjust to MW increase (↑ wages or ↑ prices)

   – Involuntary exit from formal employment among least productive workers

   ⇒ Informal sector mutes both efficiency and redistributional channels

Motivation

▶ How should we think of minimum wages in developing countries?

 – Theory: $\underbrace{\downarrow \text{monopsony power}}_{\text{efficiency}}$ + $\underbrace{\text{transfer from firm owners} \rightarrow \text{low-income individuals}}_{\text{redistribution}}$

 – Many low and middle-income 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)

▶ Core Idea:

 – Competition between formal and informal sector shapes market power
 – Harder for firms to adjust to MW increase (↑ wages or ↑ prices)
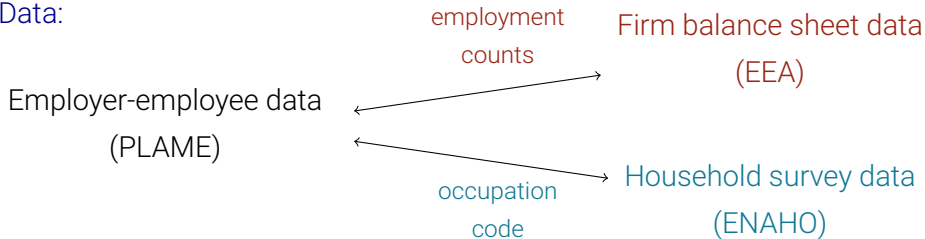 – Involuntary exit from formal employment among least productive workers

 ⇒ Informal sector mutes both efficiency and redistributional channels

This paper

1. **Context:** Peruvian minimum wage increase enacted in May, 2016.
   Informality is predominantly self-employment (Amodio et al., 2023) ▸ MW Increase

2. **Data:**

   employment counts

   Employer-employee data (PLAME) → Firm balance sheet data (EEA)

   Employer-employee data (PLAME) ← Firm balance sheet data (EEA)

   occupation code → Household survey data (ENAHO)

3. **Results (A):** Salience of informal sector → effects of MW on workers and firms

4. **Results (B):** Study how (A) affect in terms of redistribution (indiv and hh level)

Roadmap

Model

Workers

▶ Heterogeneity - worker productivity $\varepsilon \sim G(\cdot)$

▶ Problem

1. Draw preferences for $j \in \{1, \ldots, J\}$ firms $\{\eta_j\}_{j=1}^J$ and self-employment η_0 s.t.

$$\text{CDF}\left(\{\eta_{i,j}\}_{j=0}^J\right) = \exp\left\{-\exp(\eta_{i,0}) - \left[\sum_{j=1}^J \exp\left(-\eta_{i,j} \cdot \frac{\beta}{\lambda}\right)\right]^{\frac{\beta}{\lambda}}\right\}$$

2. Choose employment option given w_S, $(w_k, \underline{\varepsilon}_k)_{k=1}^J$ and min earnings $\underline{y}$

$$\max\{\exp\left(\lambda \log\left(\varepsilon w_S\right) + \eta_{i,0}\right)^{\frac{1}{\lambda}}, \mathbf{1}\{\varepsilon \geq \underline{\varepsilon}_j\} \exp\left(\lambda \log\left(\max\{\varepsilon w_j, \underline{y}\}\right) + \eta_{i,j}\right)^{\frac{1}{\lambda}} \quad j \geq 1\}$$

▶ Sorting

$$\mathbf{Pr}_{\text{informal}}(\varepsilon, \mathbf{w}) = \frac{(\varepsilon w_S)^\lambda}{(\varepsilon w_S)^\lambda + \Omega_\varepsilon^\lambda} \quad , \quad \mathbf{Pr}_{\text{formal, j}}(\varepsilon, \mathbf{w}) = \frac{\Omega_\varepsilon^\lambda}{(\varepsilon w_S)^\lambda + \Omega_\varepsilon^\lambda} \frac{\mathbf{1}\{\varepsilon \geq \underline{\varepsilon}_j\} \max\{\underline{y}, \varepsilon w_j\}^\beta}{\Omega_\varepsilon^\beta}$$

where $\Omega_\varepsilon = \left(\sum_{k=1}^J \mathbf{1}\{\varepsilon \geq \underline{\varepsilon}_k\} \max\{\underline{y}, \varepsilon w_k\}^\beta\right)^{1/\beta}$

Workers - Elasticities

Elasticity of labor supply is given by

$$\frac{\partial \log \ell(w_j, \underline{\varepsilon}_j, w_{-j})}{\partial \log w_j} = \beta$$

$$- (\beta - \lambda) \int_{\underline{\varepsilon}_j}^{\infty} \frac{\Omega_\varepsilon^\lambda}{(\varepsilon w_S)^\lambda + \Omega_\varepsilon^\lambda} \frac{(\varepsilon w_j)^{2\beta}}{\Omega_\varepsilon^{2\beta}} \, \varepsilon \, dG(\varepsilon) \left[\int_{\underline{\varepsilon}_j}^{\infty} \frac{\Omega_\varepsilon^\lambda}{(\varepsilon w_S)^\lambda + \Omega_\varepsilon^\lambda} \frac{(\varepsilon w_j)^{\beta}}{\Omega_\varepsilon^{\beta}} \, \varepsilon \, dG(\varepsilon) \right]^{-1}$$

Concentration within firm sector

$$- \lambda \int_{\underline{\varepsilon}_j}^{\infty} \frac{\Omega_\varepsilon^{2\lambda}}{[(\varepsilon w_S)^\lambda + \Omega_\varepsilon^\lambda]^2} \frac{(\varepsilon w_j)^{2\beta}}{\Omega_\varepsilon^{2\beta}} \, \varepsilon \, dG(\varepsilon) \left[\int_{\underline{\varepsilon}_j}^{\infty} \frac{\Omega_\varepsilon^\lambda}{(\varepsilon w_S)^\lambda + \Omega_\varepsilon^\lambda} \frac{(\varepsilon w_j)^{\beta}}{\Omega_\varepsilon^{\beta}} \, \varepsilon \, dG(\varepsilon) \right]^{-1}$$

Concentration overall

Then $\uparrow$ concentration means $\partial \log \ell / \partial \log w_j \to 0$, and $\downarrow$ concentration means $\partial \log \ell / \partial \log w_j \to \beta$

Firms

- ► Heterogeneity - productivity $z \sim F(\cdot)$

- ► Problem

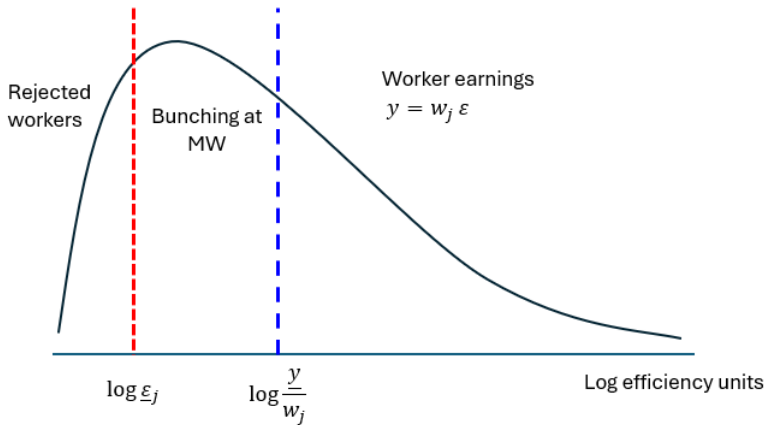   1. Firms observe ε of workers who applied and maximize profits

    $$\max_{w_j, \underline{\varepsilon}_j} \quad p_j \, z \, f\left(\ell(w_j, \underline{\varepsilon}_j, w_{-j})\right) - w_j \ell(w_j, \underline{\varepsilon}_j, w_{-j})$$

    2. It yields

    $$z \, p_j f'(\ell) = \left(1 + \frac{1}{\frac{\partial \log \ell}{\partial \log w_j}}\right) w_j$$

    $$z \, p_j f'(\ell) \, \underline{\varepsilon}_j = \underline{y}$$

Graphically…

Rejected workers

Bunching at MW

Worker earnings
$y = w_j \, \varepsilon$

$\log \underline{\varepsilon}_j$

$\log \dfrac{y}{w_j}$

Log efficiency units

Data

Data Sources

- ▶ Employer-Employee Dataset (*Planilla Electrónica*) 2015-2019
  - ✓ Matched employer-employee of the universe of formal firms
  - ✓ Info on earnings, occupation, industry, other worker characteristics

- ▶ Firm-level Census (*Encuesta Económica Anual*) 2014-2018
  - ✓ Census of medium and large formal firms
  - ✓ Info on firms balance sheet

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

Empirics

Main Identification Strategies

1. Firm approach (Harasztosi & Lindner, 2019):

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

   ID Assumption: parallel trends between high and low exposed.

2. Worker approach (Dustmann et al., 2022):

$$y_{i,t} - y_{i,t-1} = \sum_{b=1}^{15} \gamma_{2016,b} \mathbf{1}\{earnings_{i,t-1} \in bin_b\}$$

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

   ID Assumption: macroeconomic time effects stable over time.

Main Results: Firm Approach

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

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

Employment effects
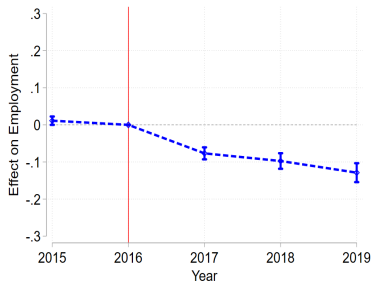
Wage effects
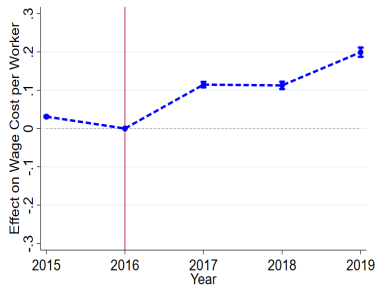
▸ How does it compare to the literature?   ▸ Who are the most affected firms?
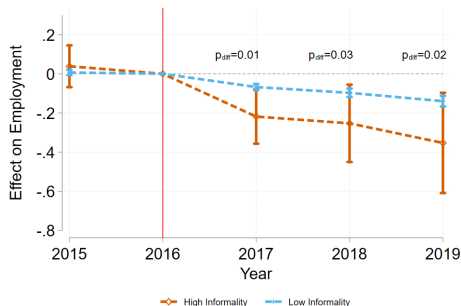
Main Results: Firm Approach

Compute share of informal employment at occupation o. Informal if belongs to top quartile.

$$\frac{y_{jt} - y_{j2016}}{y_{j2016}} = \alpha_t^0 + \alpha_t^1 \mathsf{FA}_j + \beta_t^0 \mathsf{FA}_j + \beta_t^1 \mathsf{FI}_j + \beta_t \mathsf{FA}_j \mathsf{FI}_j + \gamma_t X_{jt} + \epsilon_{jt}$$

▸ Revenues

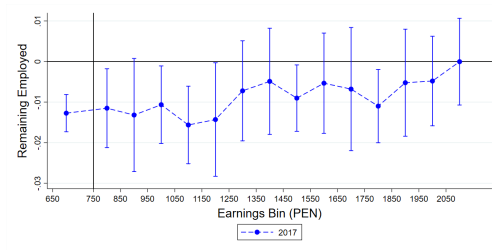Fraction informal occupation in 2016

Employment effects   Wage effects

Main Results: Worker Approach

$$y_{i,t} - y_{i,t-1} = \sum_{b=1}^{15} \gamma_{2016,b} \mathbf{1}\{earnings_{i,t-1} \in bin_b\}$$

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

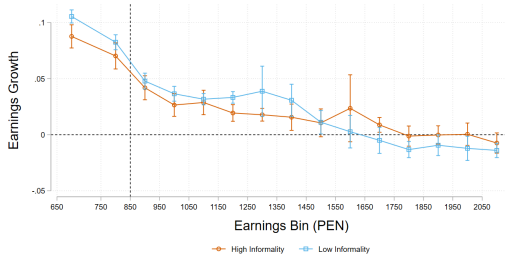Wage Effects (conditional on employment)   Employment Effects
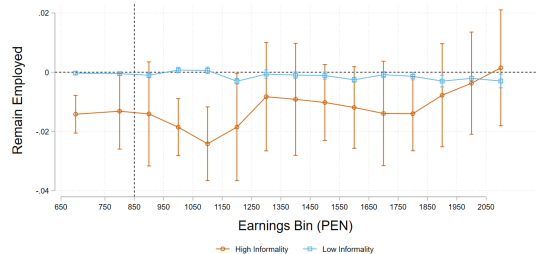

▸ Do wage effects come from reallocation?

Main Results: Worker Approach

Compare workers who were at occupations highly exposed to informality vs others
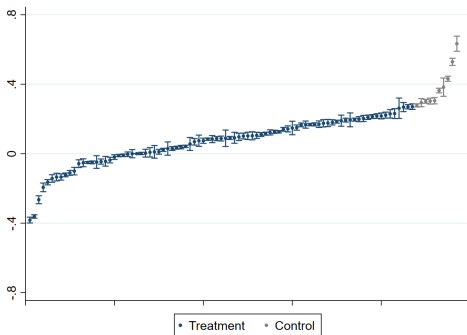

Wage Effects (conditional on employment)
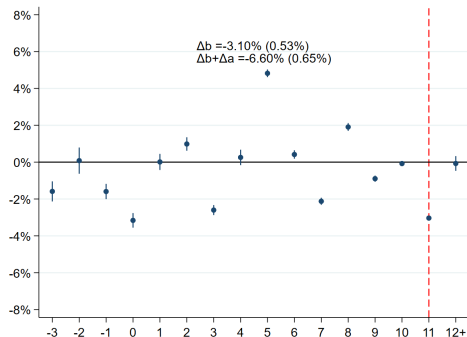
Employment Effects

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

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

Redistribution Analysis

Main Results: Expenses

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

▶ *Change in Labor Cost:* use firm approach on firm balance sheet data (≈ 0.123) `▶ 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 `▶ Binscatter`

Main Results: Income

The change in expected income at bin b is given by

$$\frac{\Delta I_b}{w_b} := \underbrace{\frac{\Delta w_b}{w_b}}_{\text{Worker approach}} + \underbrace{\frac{(w_b^{\text{inf}} - w_b)}{w_b}}_{\text{Estimate from ENAHO}} \quad \underbrace{\Delta \mathbf{P}_b(\text{leave})}_{\text{Worker approach}}$$
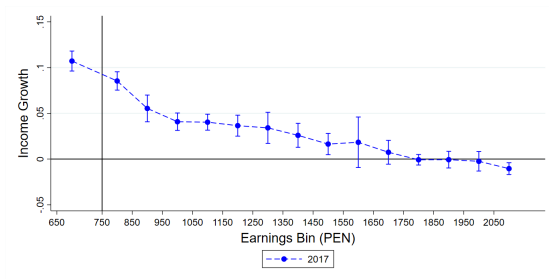
Income increase for a low-wage worker $\sum_{b=1}^{5} \frac{1}{5} \frac{\Delta I_b}{w_b}$ ▸ Alternative Approach

A back-of-the-envelope calculation: individuals (bins)

$$\frac{\Delta I_b}{w_b} \quad w_b - \frac{\Delta p_{MW}}{p_{MW,0}} \quad s_{MW,b}^e E_b \qquad \text{▸ Prices ENAHO} \quad \text{▸ Prices EEA}$$

Baseline bin $t-1$	$[650, 750)$	$[750, 850)$	$[950, 1050)$	$[1050, 1150)$	$[1150, 2050)$	$[2050, \max)$
Panel A. Income Change						
Mean MW formal wage ($\bar{w}_b$)	746	818	903	1,001	1,479	2,630
Effect exp. income ($\Delta I_b/w_b$)	0.11	0.08	0.05	0.04	0.02	0.00
$\quad \Delta I_b/w_b \times \bar{w}_b$	82.06	65.44	45.15	40.04	29.58	0.00
Panel B. Expenses Change						
Share cons by MW workers (s_{MW}^e)	0.23	0.23	0.24	0.24	0.24	0.26
Mean per cap. expenses (E_b)	590	643	700	613	792	1379
$\quad \Delta E_b$ (labor cost): $0.98 \times 0.123 \times s_{MW}^e E_b$	16.35	17.82	20.25	17.73	22.91	43.22
$\quad \Delta E_b$ (manuf. price): $0.40 \times s_{MW}^e E_b$	54.28	59.15	67.20	58.85	76.03	143.42
$\quad \Delta E_b$ (food price): $0.08 \times s_{MW}^e E_b$	10.85	11.83	13.44	11.77	15.21	28.68

A back-of-the-envelope calculation: households (income deciles)

$$\frac{\Delta I_{MW}}{I_{MW}} \quad I^l_{MW,d} - \frac{\Delta p_{MW}}{p_{MW,0}} \quad s^e_{MW,b}E_d$$

HH income decile	1	2	3	4	5	6	7	8	9	10
Panel A. Income Change										
Share formal emp	0.01	0.03	0.11	0.19	0.26	0.34	0.46	0.60	0.72	0.82
Share MW formal emp (s^l_{MW})	0.00	0.02	0.05	0.1	0.13	0.15	0.19	0.21	0.22	0.15
Mean MW formal income (I^l_{MW})	1	7	40	128	242	316	462	570	705	586
$\frac{\Delta I_{MW}}{I_{MW}} \times I^l_{MW}$	0.00	0.42	2.40	7.68	14.52	18.96	27.72	34.20	42.30	35.16
Panel B. Expenses Change										
Share cons by MW workers (s^e_{MW})	0.16	0.19	0.2	0.21	0.22	0.22	0.23	0.23	0.24	0.27
Mean expenses (E)	639	732	991	1,206	1,485	1,786	2,069	2,466	2,964	4,801
Δ E (labor cost): $0.98 \times 0.123 \times s^e_{MW}E$	12.32	16.76	23.89	30.52	39.38	47.36	57.36	68.36	85.74	156.25
Δ E (manuf. price): $0.40 \times s^e_{MW}E$	40.90	55.63	79.28	101.3	130.7	157.2	190.3	226.8	284.5	518.5
Δ E (food price): $0.08 \times s^e_{MW}E$	8.18	11.13	15.85	20.26	26.14	31.43	38.07	45.37	56.91	103.7

Conclusions

1. Empirics
   - Informal sector shapes the response to the MW through market power (Amodio et al., 2023)
   - Less market power exerted on low-quality workers, muting efficiency gains from MW due to involuntary exits from formality (Dustmann et al., 2022 ; Harasztosi and Lindner, 2019)
   - Surviving firms pass-through these costs onto consumers, and richer households are the ones who bear most of it → inflation inequality! (Jaravel, 2021)
   - Rich individuals transfer resources to formal workers at middle class and above. No redistribution to poor households (lack formal workers!)

2. Caveat - More work to be done!
   - This paper considers a pecuniary (purchasing power) approach: job ladder implications, temporary employment, etc.

Thank you!
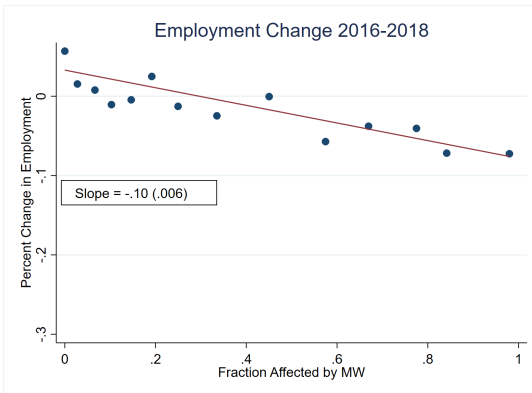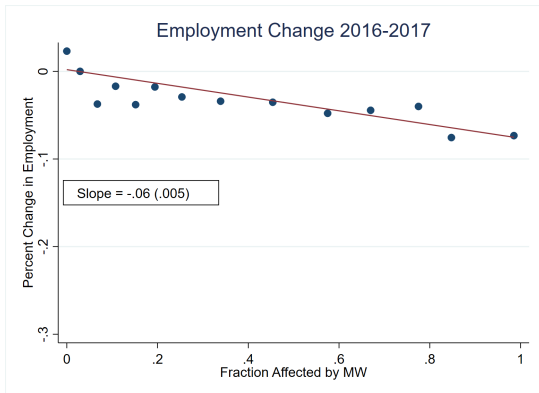
Appendix

Increase in the Minimum Wage in Perú ▸ Back

MW to Median Earnings in Peru
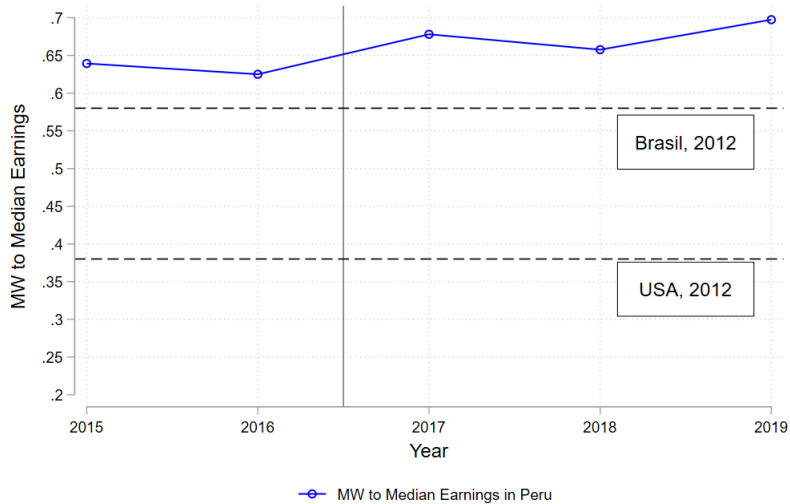
Who are the most affected firms?

	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

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

Is the relationship approx. linear?

Employment Change 2016-2017

Slope = -.06 (.005)

x-axis: Fraction Affected by MW
y-axis: Percent Change in Employment

Employment Change 2016-2018

Slope = -.10 (.006)

x-axis: Fraction Affected by MW
y-axis: Percent Change in Employment

◀ Back

Is the relationship approx. linear?

Earnings Change 2016-2017

Slope = .13 (.002)

Earnings Change 2016-2018

Slope = .13 (.003)

◀ Back
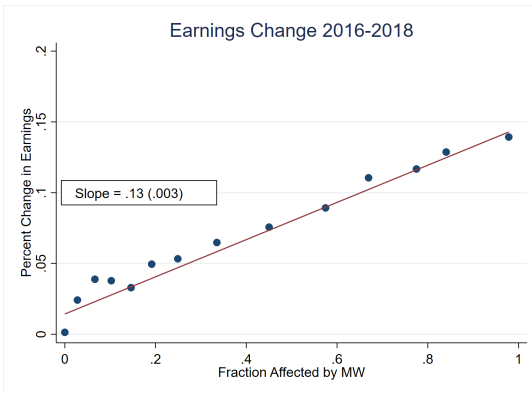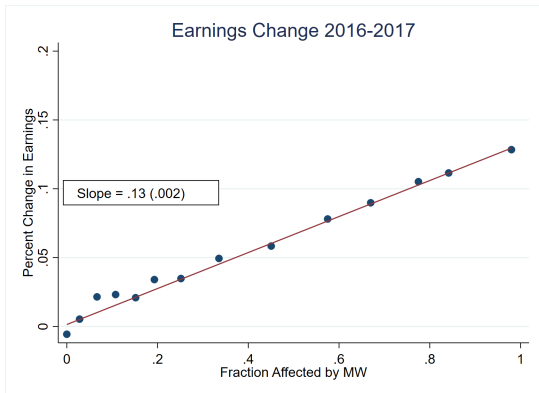
Own-wage elasticity in recent literature

Estimated Employment Elasticity With Respect To Own Wage

Categories (top to bottom):
This paper, baseline 2018
This paper, baseline 2017

Sabia 2008
Pereira 2003
Neumark and Nizalova 2007
Kim and Taylor 1995
Harasztosi and Lindner 2019, Medium Run
Harasztosi and Lindner 2019, Short Run
Giuliano 2013
Fang and Lin 2015
Dube et al. 2007
Dube et al. 2010
Currie and Fallick 1996
Cengiz et al. 2019
Card et al. 1994
Card 1992b
Card 1992a
Campolieti et al. 2006
Burkhauser et al. 2000
Bell 1997, Colombia
Allegretto et al. 2011
Addison et al. 2010

◄ Back

Minimal gains from reallocation
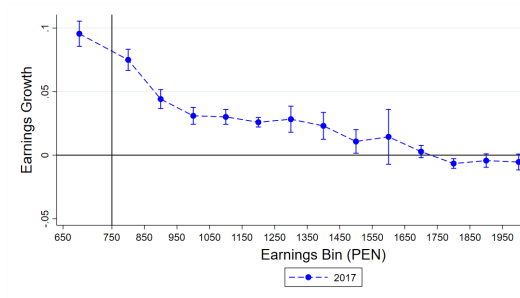
Wage Effects — Reallocation Effects
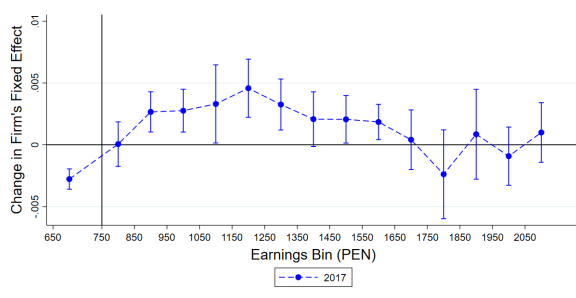
Imputation of Earnings

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 $g(i)$.

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

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

Firm design on balance sheet data

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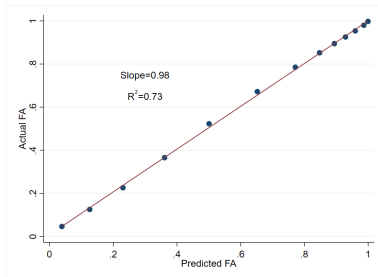
Expenses - Firms' margins of adjustment (excl. closures) ◂ Back

	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 ◂ Back

	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

Expenses - Who pays for the MW?
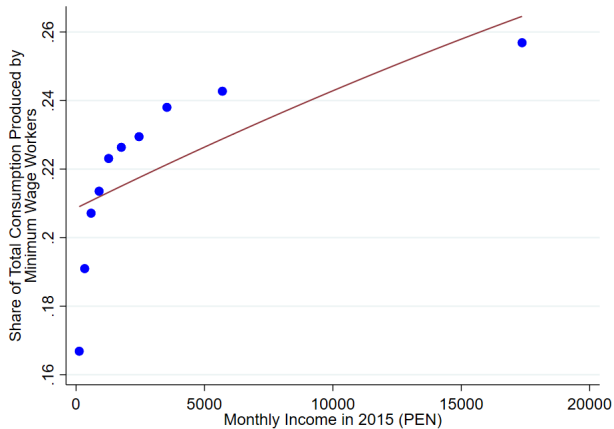
Who pays for the MW?

▶ 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

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

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
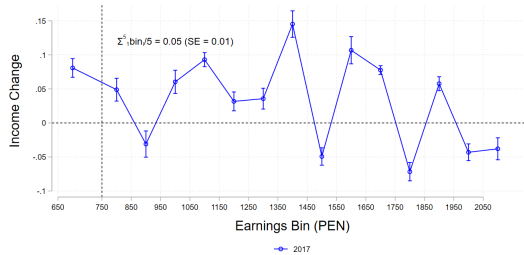
Income in the Informal Sector

Changes in Income for Informal Workers
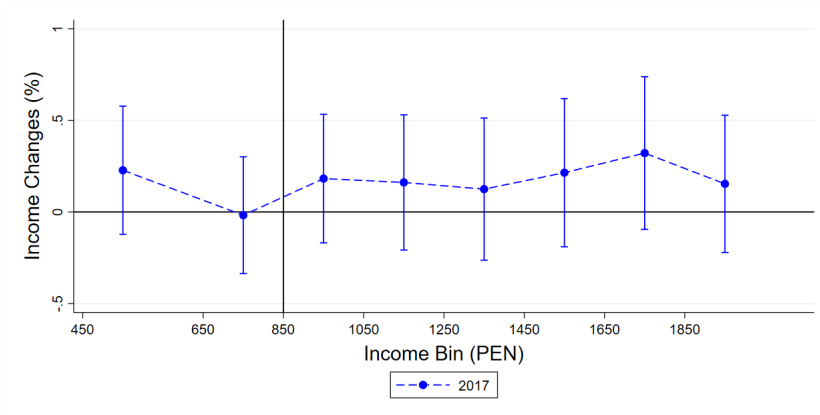
MW Consumption Post-Policy

MW Consumption Pre

MW Consumption Post

◄ Back
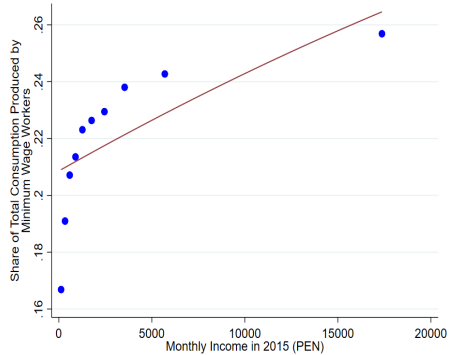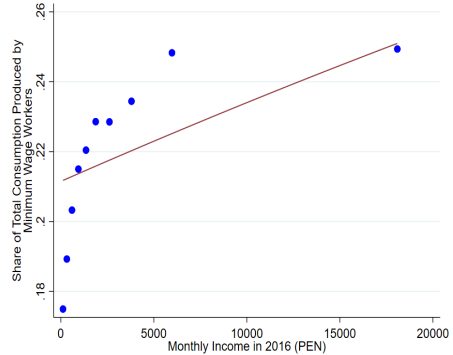
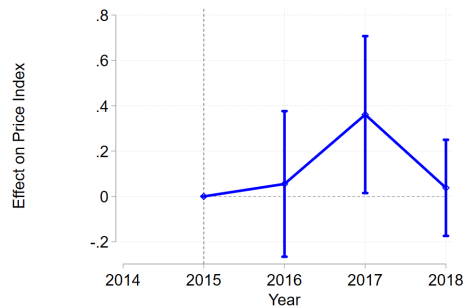# Laspeyre Prices from Survey Data

Change in food price index
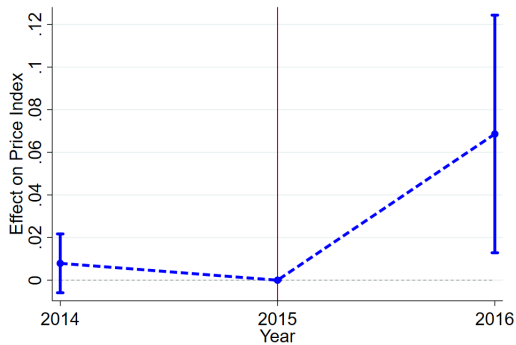
Laspeyre Prices from Balance Sheet Data

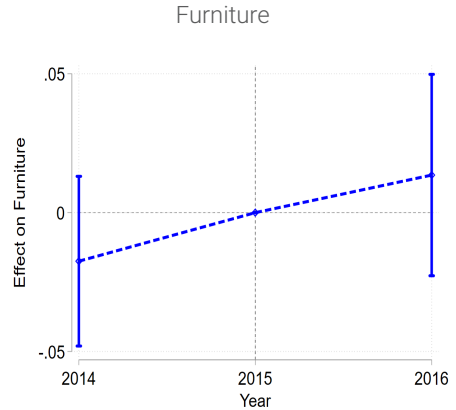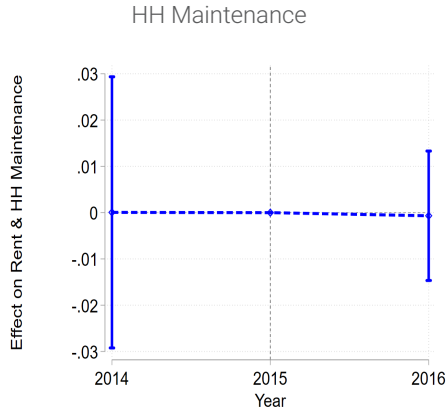## Compare provinces with high vs low presence of informality

Effects on Revenue
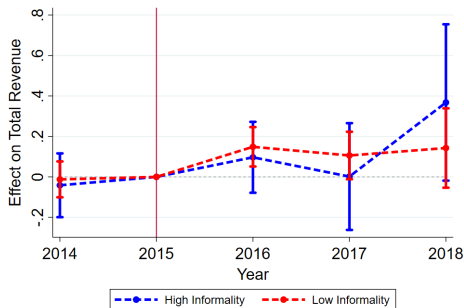
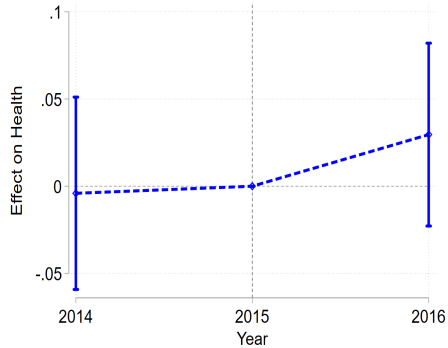Effects on Output Price (Manufacture)

Changes in Expense Shares

Food — Effect on Food vs Year (2014, 2015, 2016)

Clothing — Effect on Clothing vs Year (2014, 2015, 2016)

Back

Changes in Expense Shares

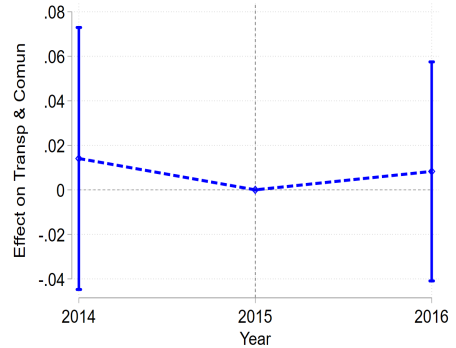HH Maintenance

Furniture

Back
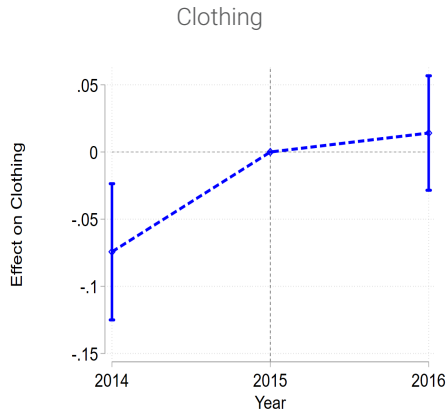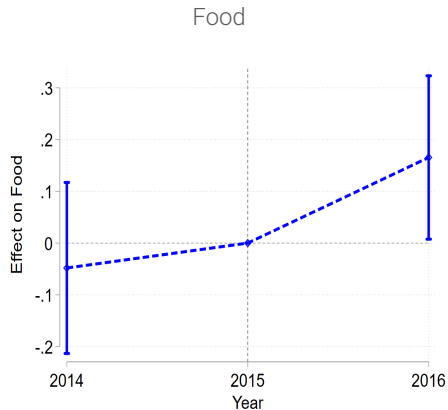
Changes in Expense Shares

Health

Transportation & Communication

Back

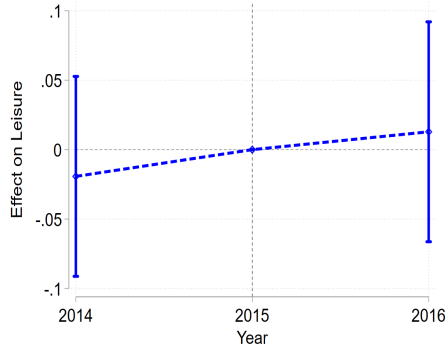# Changes in Expense Shares

Leisure

Miscellaneous Expenses

Back