

# Minimum Wages and Informal Self-Employment: Evidence from Perú

*Workshop for Young Economists*

**Link to slides** ↓



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# How should we think about MW in developing countries?

- ▶ Theory:  $\downarrow$  monopsony power  $\underbrace{\text{efficiency}}$  +  $\underbrace{\text{transfer firm owners} \rightarrow \text{low-income individuals}}$   $\underbrace{\text{redistribution}}$
- ▶ Low- and middle-income countries are characterized by a large informal sector.  
Typically, it looks like this:



# How should we think about MW in developing countries?

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- ▶ Core Idea:

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

→ Informal sector mutes both efficiency and redistributive channels

# How should we think about MW in developing countries?

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## ► Core Idea:

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## ► This paper:

1. Combine employer-employee + firm balance sheet + household survey data to study peruvian national MW increase in 2016
2. Novel estimates of the effects of MW on workers and firms' margins of adjustment
3. Provide evidence of the salience of the informal sector in shaping these effects
4. Cost-benefit analysis to evaluate whether low-wage workers and low-income households are better off

# Roadmap

Model

Data

Empirics and Main Results

A Cost-Benefit Analysis

Concluding Remarks

# Workers

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

- ▶ Problem

1. Draw preferences for  $j \in \{1, \dots, J\}$  firms  $\{\eta_j\}_{j=1}^J$  and self-employment  $\eta_0$  s.t.

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

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

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

- ▶ Sorting

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

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

## Workers - Elasticities

Elasticity of labor supply is given by

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

$$- (\beta - \lambda) \underbrace{\int_{\varepsilon_j}^{\infty} \frac{\Omega_\varepsilon^\lambda}{(\varepsilon w_S)^\lambda + \Omega_\varepsilon^\lambda} \frac{(\varepsilon w_j)^{2\beta}}{\Omega_\varepsilon^{2\beta}} \varepsilon dG(\varepsilon)}_{\text{Concentration within firm sector}} \left[ \int_{\varepsilon_j}^{\infty} \frac{\Omega_\varepsilon^\lambda}{(\varepsilon w_S)^\lambda + \Omega_\varepsilon^\lambda} \frac{(\varepsilon w_j)^\beta}{\Omega_\varepsilon^\beta} \varepsilon dG(\varepsilon) \right]^{-1}$$

$$- \lambda \underbrace{\int_{\varepsilon_j}^{\infty} \frac{\Omega_\varepsilon^{2\lambda}}{[(\varepsilon w_S)^\lambda + \Omega_\varepsilon^\lambda]^2} \frac{(\varepsilon w_j)^{2\beta}}{\Omega_\varepsilon^{2\beta}} \varepsilon dG(\varepsilon)}_{\text{Concentration overall}} \left[ \int_{\varepsilon_j}^{\infty} \frac{\Omega_\varepsilon^\lambda}{(\varepsilon w_S)^\lambda + \Omega_\varepsilon^\lambda} \frac{(\varepsilon w_j)^\beta}{\Omega_\varepsilon^\beta} \varepsilon dG(\varepsilon) \right]^{-1}$$

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

# Firms

- ▶ Heterogeneity - productivity  $z \sim F(\cdot)$
- ▶ Problem
  1. Firms observe  $\varepsilon$  of workers who applied and maximize profits

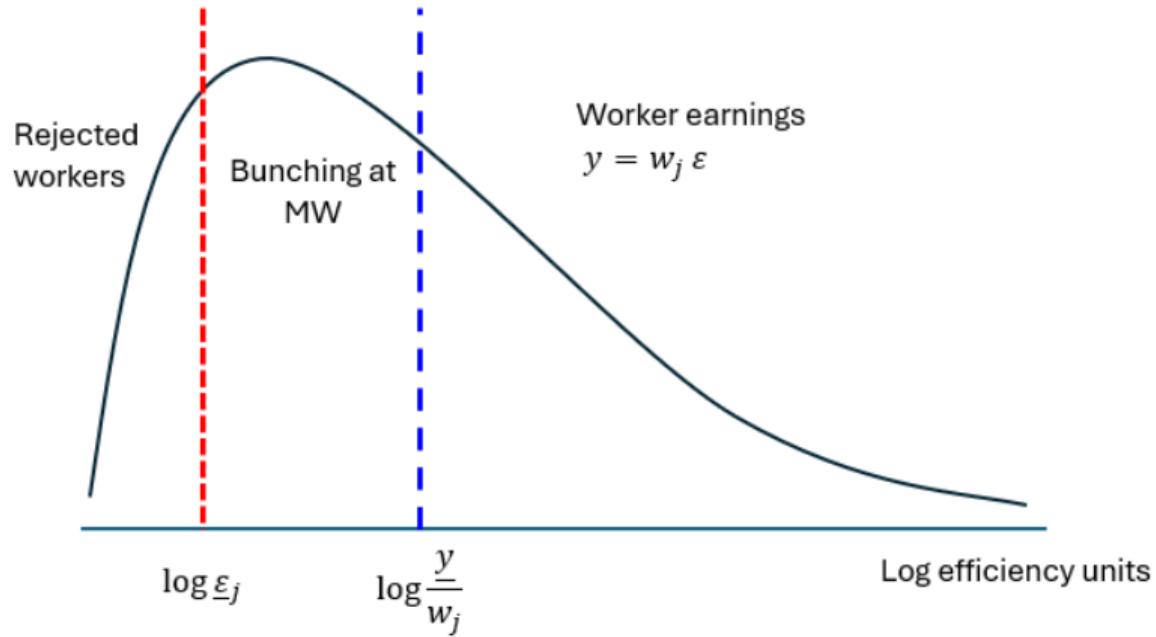
$$\max_{w_j, \underline{\varepsilon}_j} p_j z f(\ell(w_j, \underline{\varepsilon}_j, w_{-j})) - w_j \ell(w_j, \underline{\varepsilon}_j, w_{-j})$$

2. It yields

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

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

## Graphically...



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## 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
  - ✓ Share observables with EE data, will use ML methods to impute treatment ( $\approx$  fuzzy matching)
- ▶ 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

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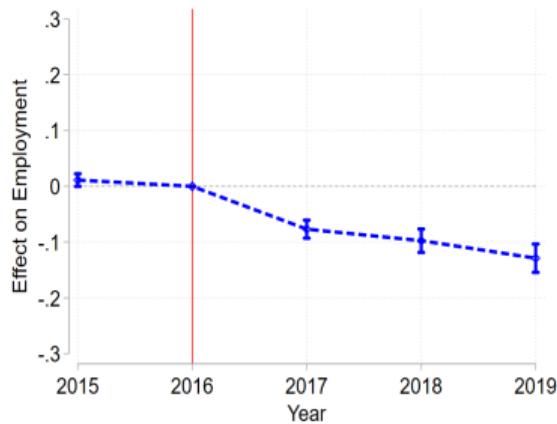
Concluding Remarks

# Empirical Strategy: Firm Approach

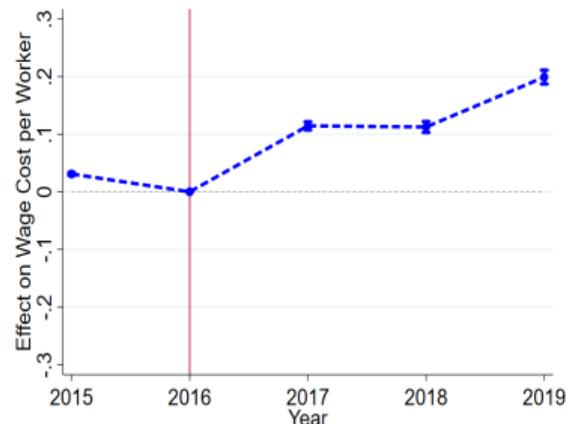
$$\frac{y_{jt} - y_{j2016}}{y_{j2016}} = \alpha_t + \beta_t \underbrace{\text{FA}_j}_{\text{Fraction below MW in 2016}} + \gamma_t X_{jt} + u_{jt}$$

- ▶ Linearity of FA (employment)
- ▶ Linearity of FA (wage)

Employment effects



Wage effects



- ▶ How does it compare to the literature?

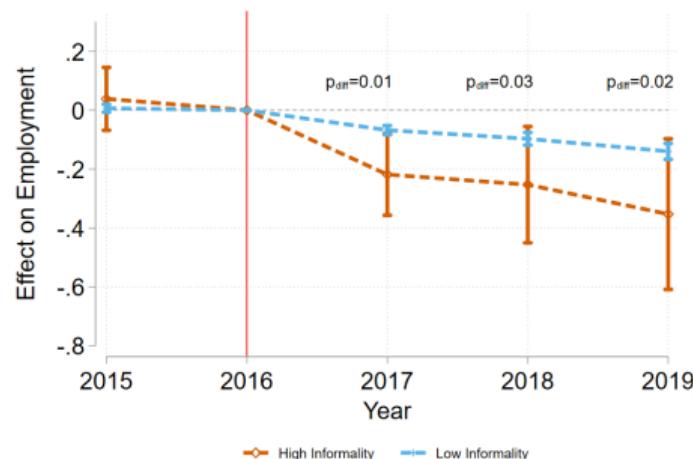
- ▶ Who are the most affected firms?

# Salience of Informal Sector

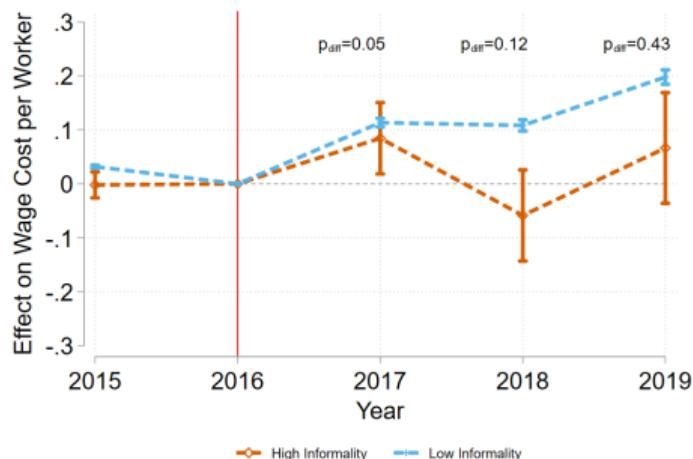
Compute share of informal employment at occupation  $o$ . Informal if belongs to top quartile.

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

Employment effects



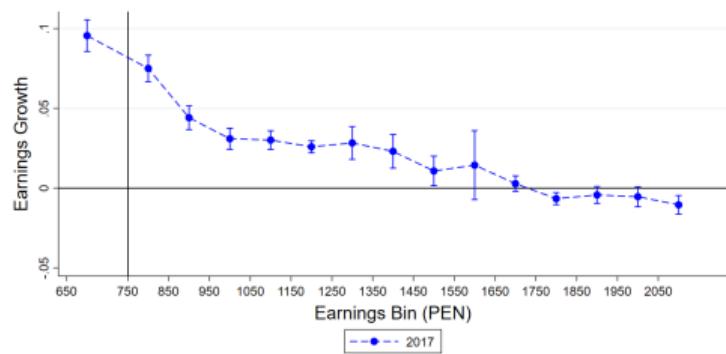
Wage effects



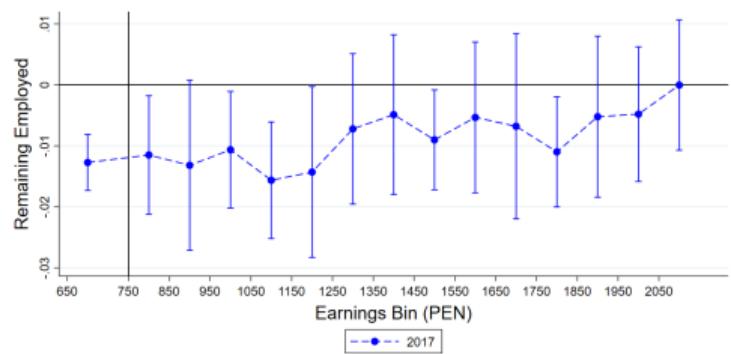
# Empirical Strategy: Worker Approach

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

Wage Effects



Employment Effects



- Do wage effects come from reallocation?

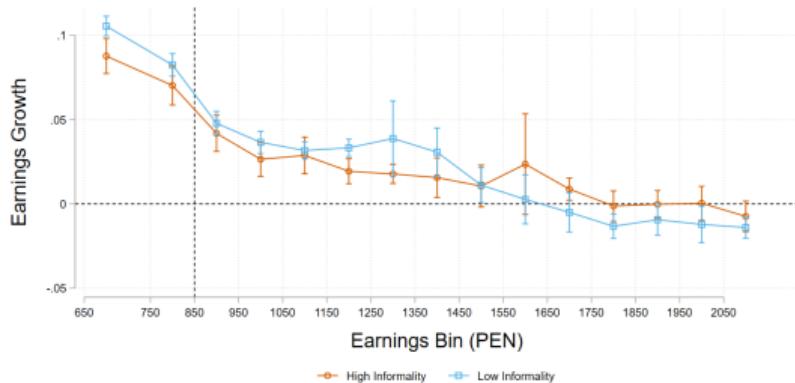
# Salience of Informal Sector

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

Employment Effects



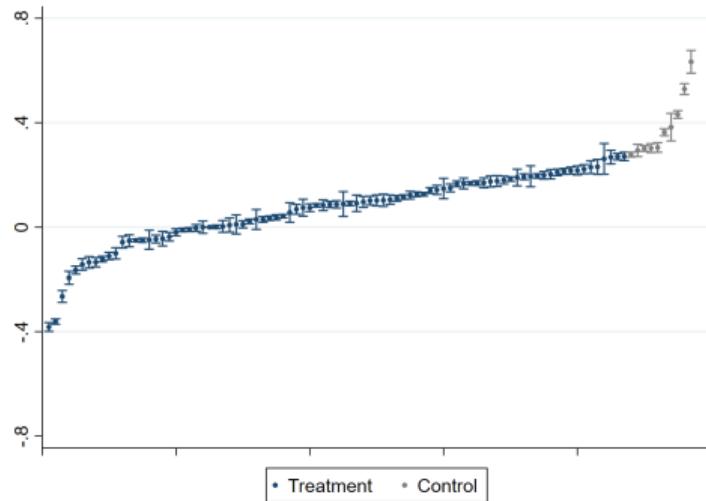
Wage Effects



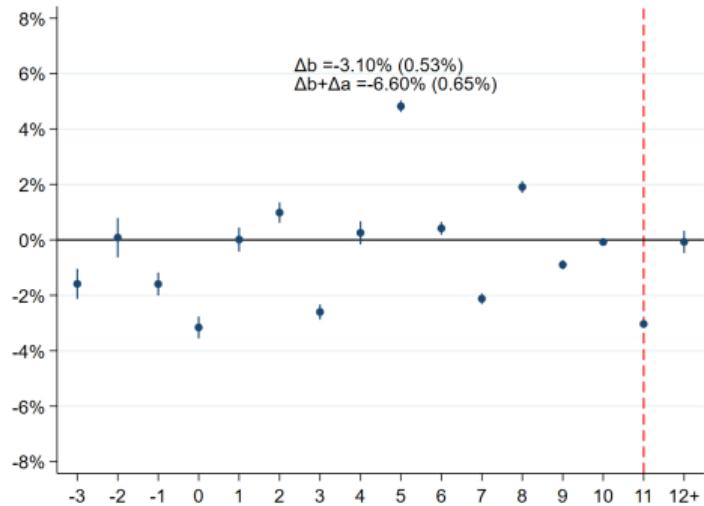
# Aggregate employment effects at formal sector

- ▶ Obtain place effects:  $\ln w_{it} = \ln \lambda_{r(i,t)} + \theta_t + X'_{it}\beta + u_{it}$
- ▶ Skill levels  $w_{it}^* = \exp(\ln w_{it} - \ln \lambda_{r(i,t)})$  as counterfactual

Distribution of Province Premia



Employment Effects



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# A cost-benefit analysis of the MW

Under the following conditions

1. No income effect in the informal sector ► Income in informal sector
  
2. No substitution effects away from products that use MW workers ► Substitution Effects

then the reduced form estimates can be sufficient to evaluate the changes in purchasing power.

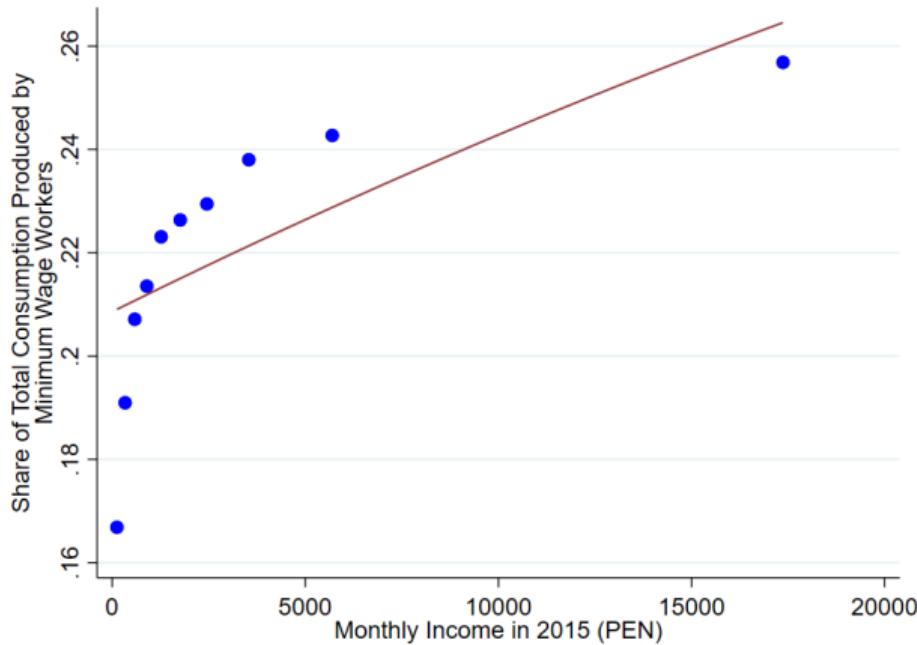
# Expenses - Firms' margins of adjustment (excl. closures)

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

## Expenses - Incidence of the MW

|   | 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       |
| <b>Incidence on consumers (<math>\Delta Rev - \Delta Mat - \Delta MiscItems</math>)</b> | 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      |
| <b>Incidence on firm owners (- <math>\Delta Profit - \Delta Depr</math>)</b>            | 0.004        | 0.0127       |
| <b>Fraction paid by consumers (percent)</b>   | <b>98.35</b> | <b>61.12</b> |
| <b>Fraction paid by firm owners (percent)</b>   | 1.65         | 38.88        |

# Expenses - Who pays for the MW?

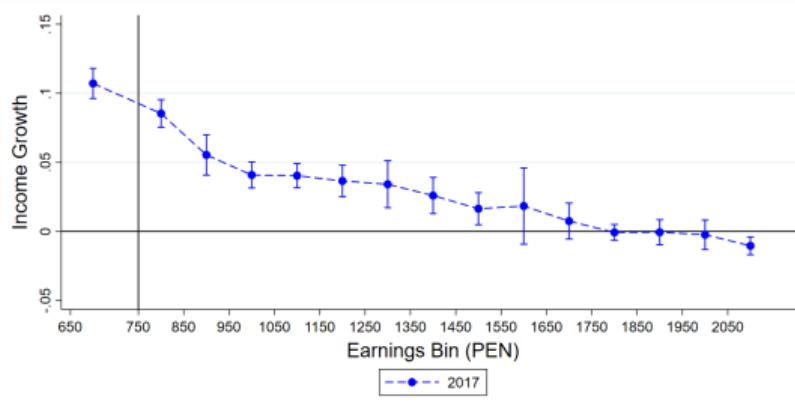


▶ Construction of this graph

# Income - Who gains from the MW?

The change in expected income at bin  $b$  is given by

$$\frac{\Delta I_b}{w_b} := \underbrace{\frac{\Delta w_b}{w_b}}_{\text{Worker approach}} + \underbrace{\frac{(w_b^{\inf} - w_b)}{w_b}}_{\text{Estimate from ENAHO}} \underbrace{\Delta P_b(\text{leave})}_{\text{Worker approach}}$$



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

$$\frac{\Delta I_b}{w_b} = w_b - \frac{\Delta p_{MW}}{p_{MW,0}} s_{MW,b}^e E_b$$

| 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        |
| $\Delta I_b/w_b \times \bar{w}_b$                                  | 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        |
| $\Delta E_b$ (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       |
| $\Delta E_b$ (manuf. price): $0.40 \times s_{MW}^e E_b$            | 54.28      | 59.15      | 67.20       | 58.85        | 76.03        | 143.42      |
| $\Delta E_b$ (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)

$$\frac{\Delta I_{MW}}{I_{MW}} \quad I_{MW,d}^l - \frac{\Delta p_{MW}}{p_{MW,0}} \quad s_{MW,b}^e E_d$$

| 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 ( $s_{MW}^l$ )                             | 0.00  | 0.02  | 0.05  | 0.1   | 0.13  | 0.15  | 0.19  | 0.21  | 0.22  | 0.15   |
| Mean MW formal income ( $I_{MW}^l$ )                           | 1     | 7     | 40    | 128   | 242   | 316   | 462   | 570   | 705   | 586    |
| $\frac{\Delta I_{MW}}{I_{MW}} \times I_{MW}^l$                 | 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 ( $s_{MW}^e$ )                        | 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  |
| $\Delta E$ (labor cost): $0.98 \times 0.123 \times s_{MW}^e E$ | 12.32 | 16.76 | 23.89 | 30.52 | 39.38 | 47.36 | 57.36 | 68.36 | 85.74 | 156.25 |
| $\Delta E$ (manuf. price): $0.40 \times s_{MW}^e E$            | 40.90 | 55.63 | 79.28 | 101.3 | 130.7 | 157.2 | 190.3 | 226.8 | 284.5 | 518.5  |
| $\Delta E$ (food price): $0.08 \times s_{MW}^e E$              | 8.18  | 11.13 | 15.85 | 20.26 | 26.14 | 31.43 | 38.07 | 45.37 | 56.91 | 103.7  |

# Roadmap

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# 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 ; Harasztsosi 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!

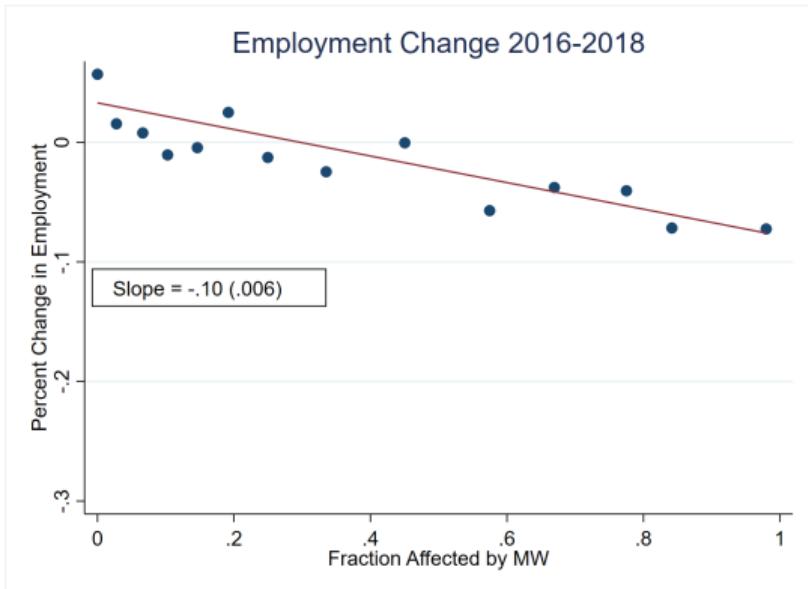
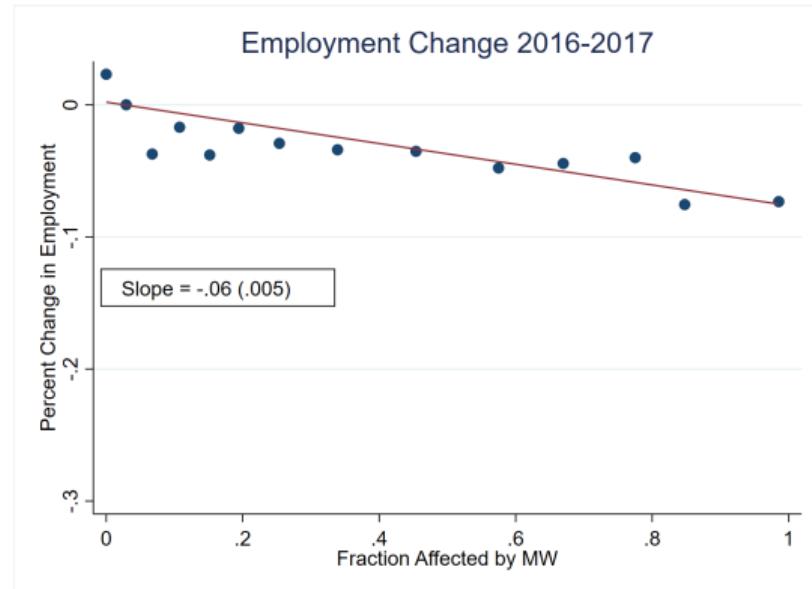
## Who are the most affected firms?

|                   | 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  |

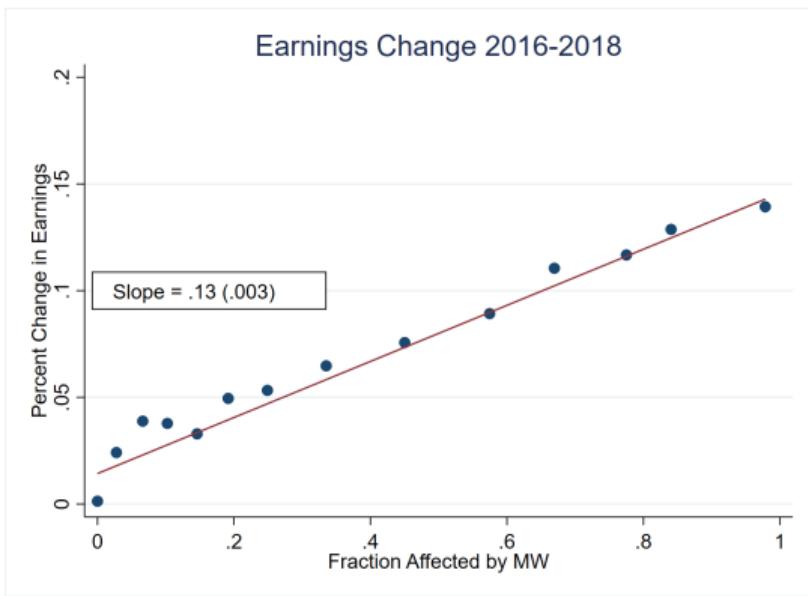
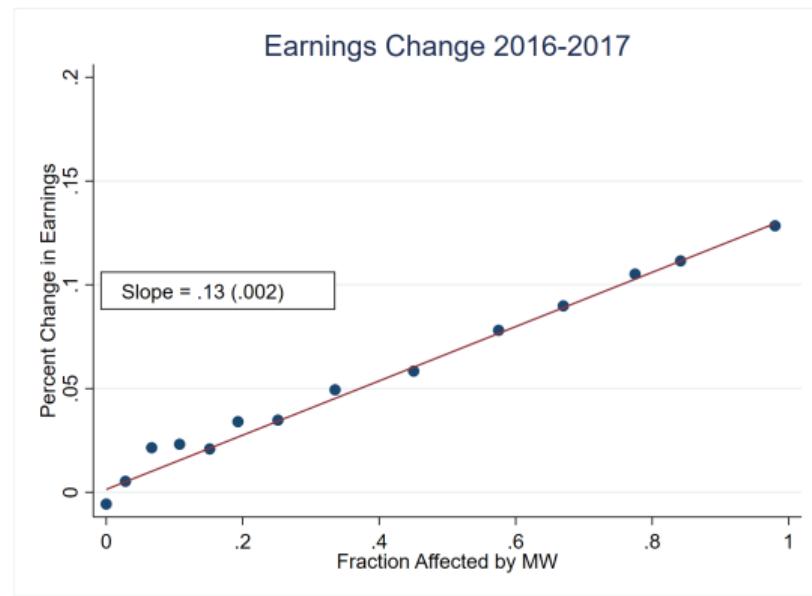
## Who are the MW workers?

|                      | 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                         |

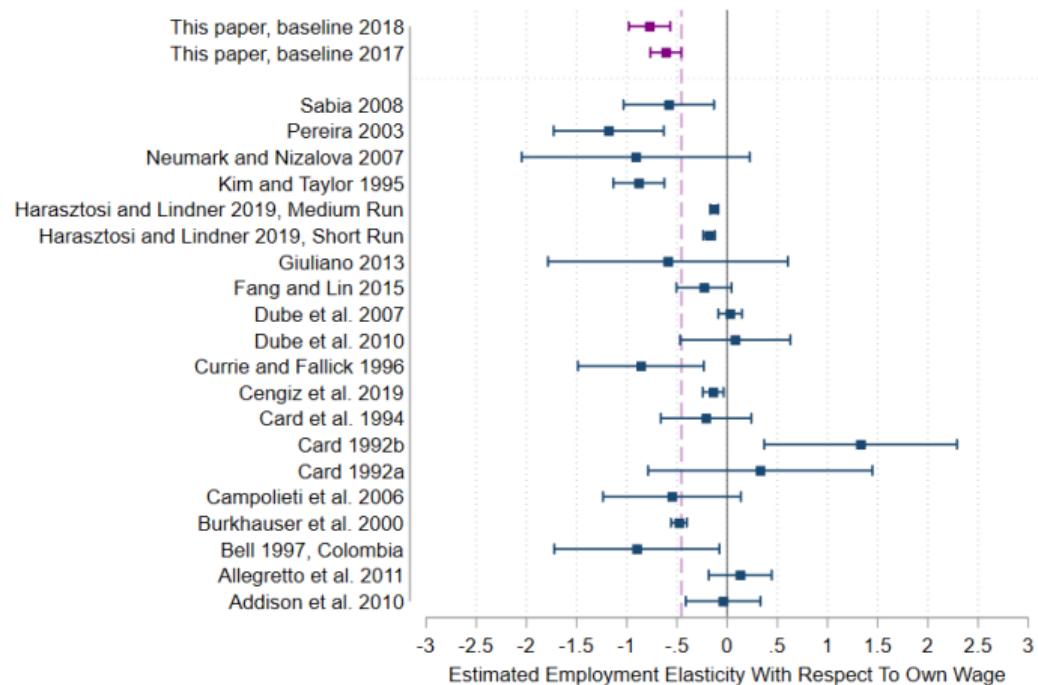
# Is the relationship approx. linear?



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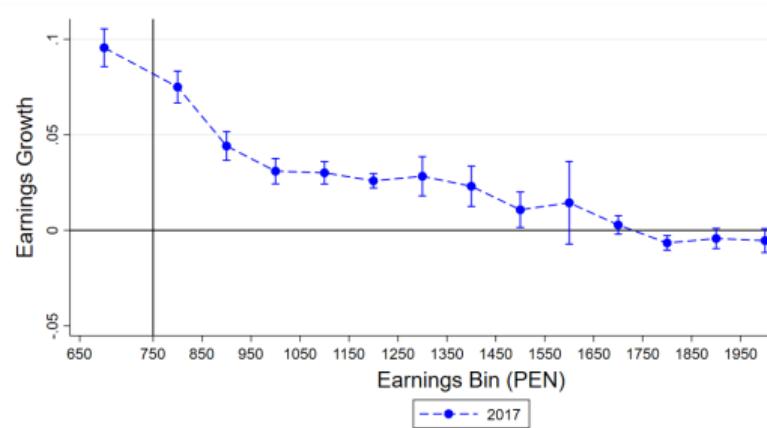


# Own-wage elasticity in recent literature

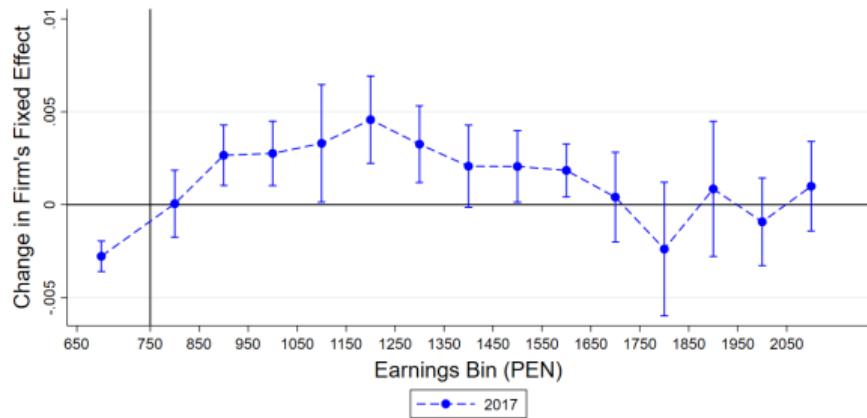


# Minimal gains from reallocation

Wage Effects

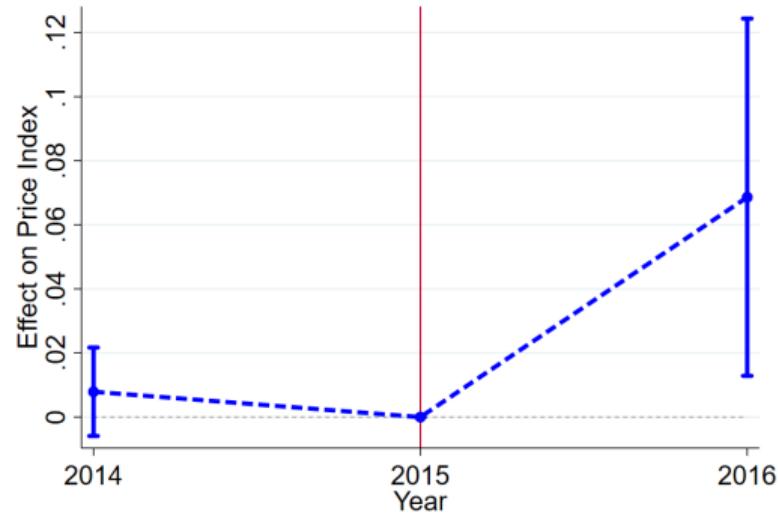


Reallocation Effects



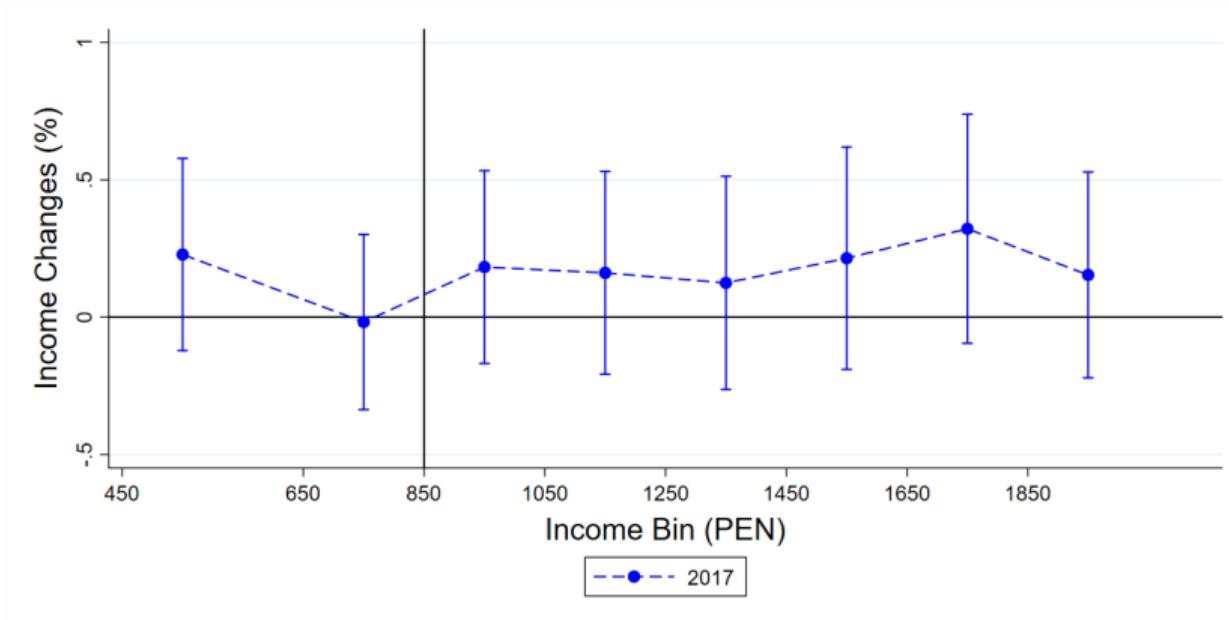
# Evidence on Laspeyres index

Change in food price index



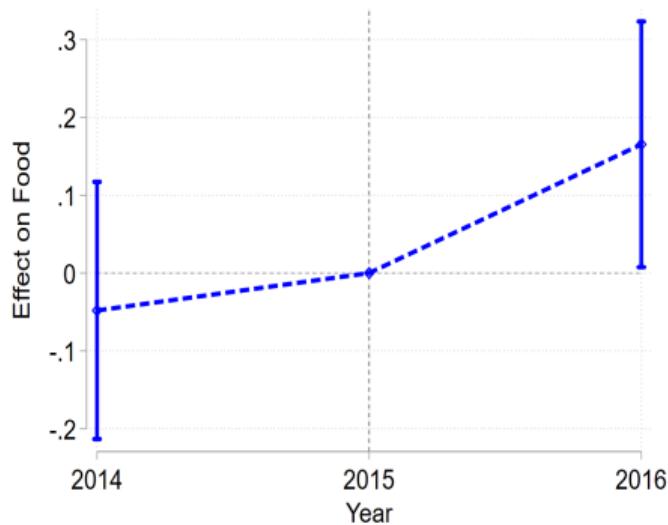
# Income in the Informal Sector

Changes in Income for Informal Workers

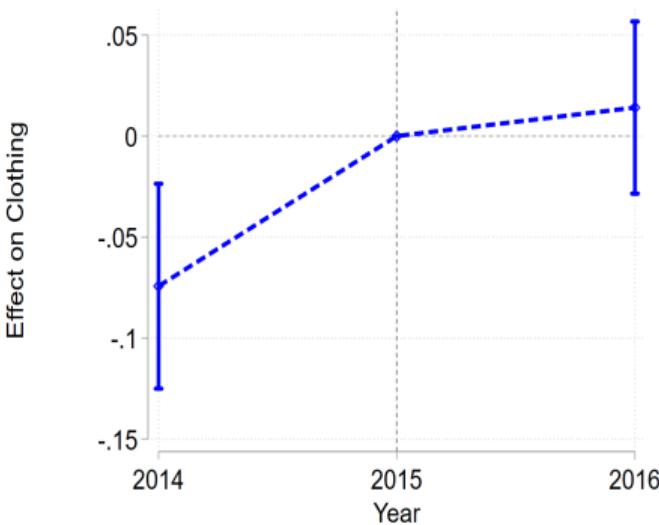


# Changes in Expense Shares

Food

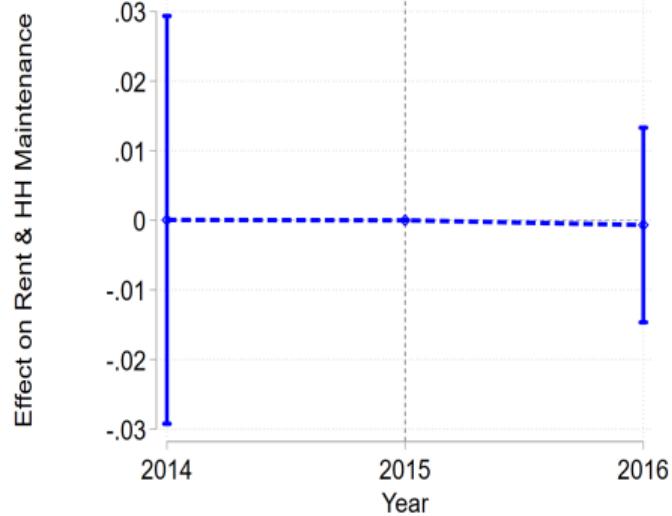


Clothing

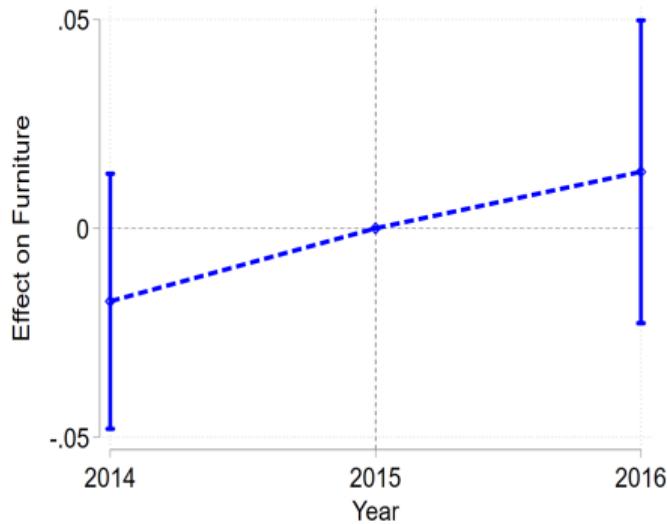


# Changes in Expense Shares

HH Maintenance

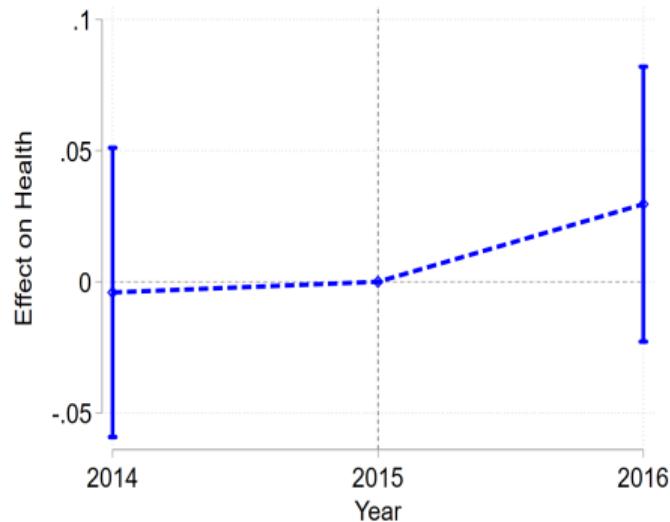


Furniture

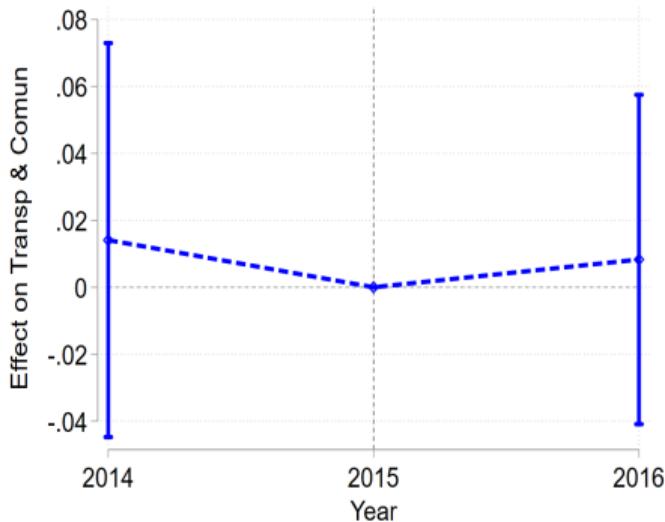


# Changes in Expense Shares

Health

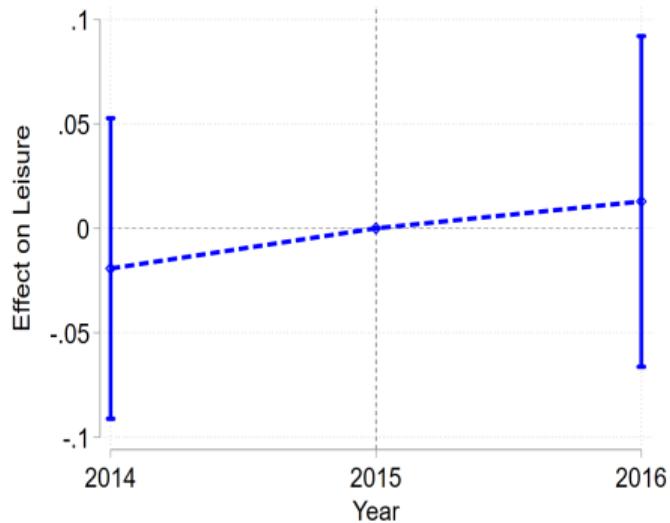


Transportation & Communication

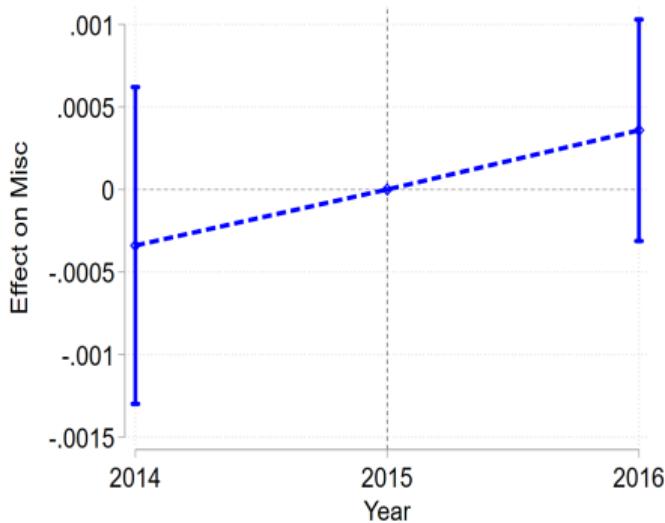


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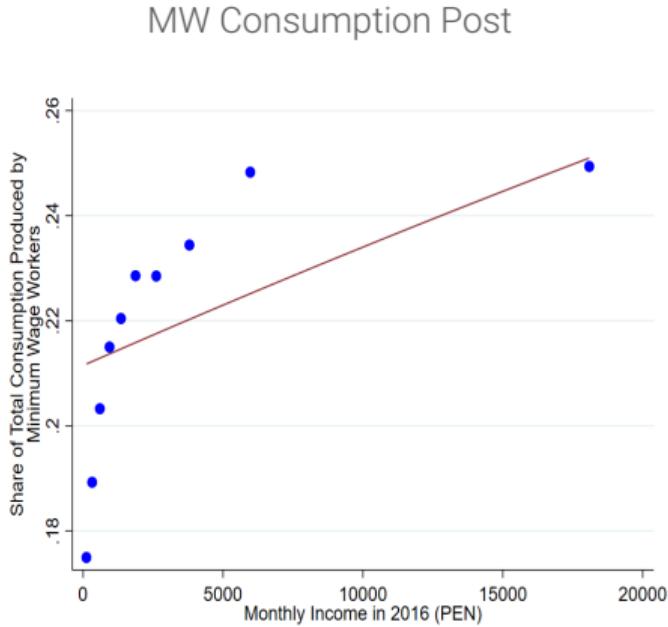
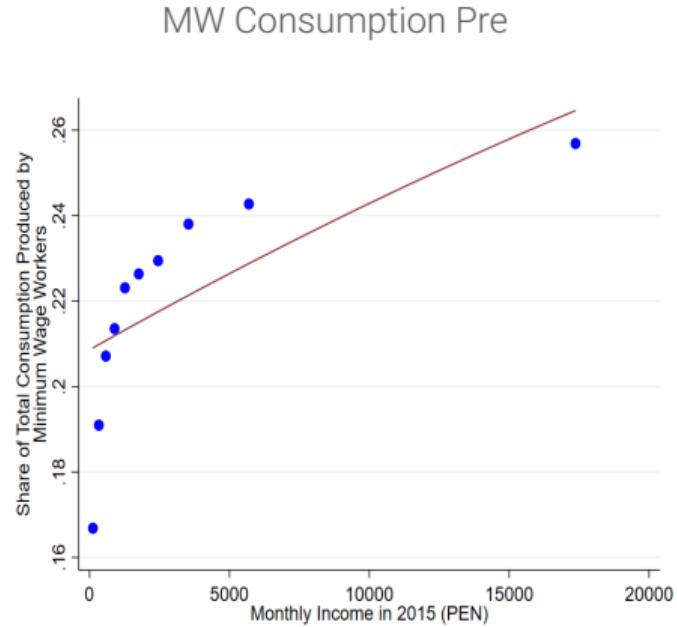
Leisure



Miscellaneous Expenses



# MW Consumption Post-Policy



## Imputation of Earnings

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

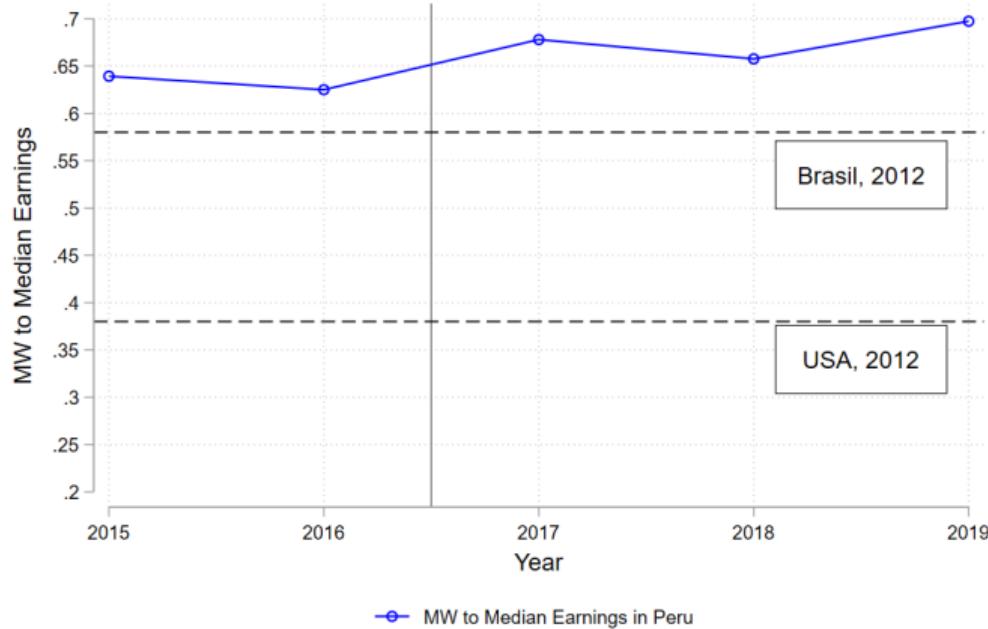
- ▶ I create 10-year age cells (20 to 29, 30 to 39, ..., 50 to 59), and 6 education cells (missing, no qualifications, secondary, some post sec, univ graduate, post graduate).
- ▶ I construct the mean log-earnings of individual  $i$  in all other periods, and for all their coworkers. For singleton workers 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  $k = \Phi[(c - X'\beta)/\sigma]$ , where  $\Phi(\cdot)$  is the standard normal CDF. Let  $u \sim U[0, 1]$ , then

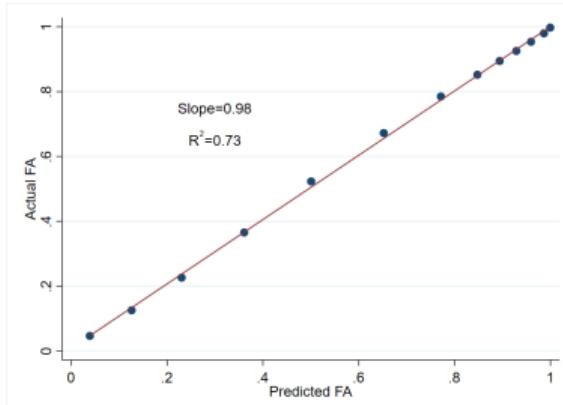
$$y^u = X'\beta + \sigma\Phi^{-1}[k + u(1 - k)]$$

# Increase in the Minimum Wage in Perú



## 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



## Who pays for the MW?

- ▶ Compute how much is industry  $s$  exposed to the MW

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

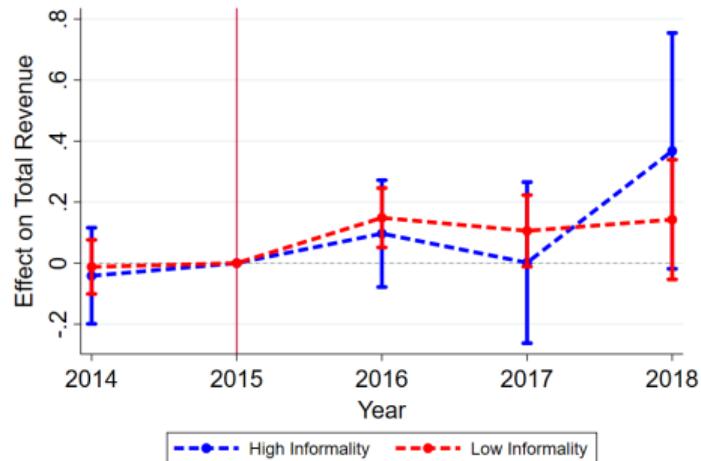
- $B(i, j)$ : share of commodity  $j$  produced by industry  $s$
- $U(i, j)$ : share of commodity  $j$  used by industry  $s$
- ▶ Using budget information in ENAHO, I match every product to a particular industry that produces it
- ▶ Compute the following measure

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

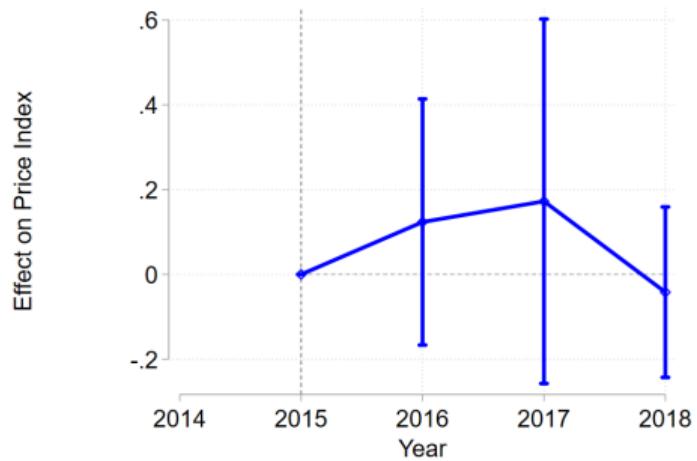
# Revenues and the informal sector

Compare provinces with high vs low presence of informality

Effects on Revenue



Effects on Output Price (Manufacture)



► Price changes using HH survey