

# The labor market consequences of electricity adoption: concrete evidence from the Great Depression

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# Motivation: the technological unemployment debate

- Technological unemployment:
  - ▶ direct replacement of workers with technology
  - ▶ short- to medium-term unemployment (up to 10 years)
- Revival of debate with new wave of technology:
  - ▶ water power: “employment of machinery is frequently detrimental to [the] interests [of the labouring class]” (Ricardo, 1817)
  - ▶ steam engine: “demand for commodities is not demand for labour” (Mill, 1871)
  - ▶ electricity: “technological unemployment ... due to our discovery of means of economising the use of labour” (Keynes, 1933)
  - ▶ computers: “the second machine age ... and the workless economy” (Brynjolfsson et al., 2014)
- Luddite fallacy (Easterly, 2001)
  - ▶ labor-saving = productivity-enhancing
  - ▶ adjustment on output margin, not employment

# This paper: testing the theory of technological unemployment with electricity adoption

- Choice of period and technology:
  - ▶ variation in electricity prices (not computers)
  - ▶ labor market data: Census of Manufactures 1929-1935
- Causal effect of cheaper electricity on labor market outcomes and output
- Identification strategy:
  - ▶ geography as an instrument for electricity prices
  - ▶ concrete industry ideal to study electricity adoption
  - ▶ newly digitized plant-level dataset, 1929-1935

# Literature review of economic history and electrification

- first paper to use Instrumental Variables to test the margin of adjustment in technological unemployment:
  - ▶ plant-level data with employment, wages, quantity, electric capital,
  - ▶ instrument for change in price of electricity
  - ▶ disentangles technology from offshoring and unionization

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- existing historical studies with Ordinary Least Squares and without plant-level data:
  - ▶ productivity growth (Field, 2000)
  - ▶ decline in labor share (Woolf, 1994)
  - ▶ routinization of production (Gray, 2013)

# Outline

- 1 Data
- 2 Model
- 3 Empirics
- 4 Conclusion

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- manual labor / electric power from the grid:
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  - ▶ test of technological unemployment
- competitive industry:
  - ▶ <5% of plants have less than 5 competitors
  - ▶ rules out strategic adoption

## Examples of labor-saving machinery:

- “the power-driven concrete mixer has practically displaced hand mixing” (Jerome, 1934)
- conveyor systems, power shovels, machinery for crushing, grinding



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  - ▶ housing boom, bank deposit suspensions, and unionization from Fishback et al. (2012) and Kimborough and Snowden (2007)

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# Model: technology to produce output

- Production function:

$$Y_{i,t} = A_{i,t} K_{NE,i,t}^{\alpha} L_{NR,i,t}^{\beta} M_{i,t}^{1-\alpha-\beta}$$

plant  $i$ , Total Factor Productivity  $A_{i,t}$ , non-electric capital  $K_{NE,i,t}$ , labor in nonroutine occupations  $L_{NR,i,t}$

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- Third factor:

$$M_{i,t} = \left( K_{E,i,t}^{\frac{\sigma-1}{\sigma}} + L_{R,i,t}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

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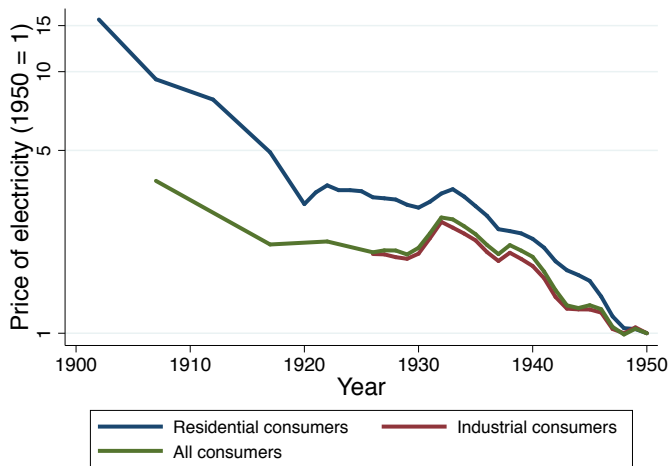
$$M_{i,t} = \left( K_{E,i,t}^{\frac{\sigma-1}{\sigma}} + L_{R,i,t}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

electric capital  $K_{E,i,t}$ , labor in routine occupations  $L_{R,i,t}$

- Crucial assumptions:

- ▶ elasticity of substitution  $\sigma > 1$
- ▶ trend in rental rate  $r_{E,t} \searrow$

## Assumption: price of electricity decreases exponentially



Source: Historical Statistics of the United States, adjusted for inflation

## Model's predictions

- Labor share, labor productivity, capital intensity:

$$\frac{w_{i,t}L_{i,t}}{p_{i,t}Y_{i,t}} = \beta + \gamma \left( 1 + \left( \frac{r_{E,i,t}}{w_{R,i,t}} \right)^{1-\sigma} \right)^{-1} \nearrow \text{ in } r_{E,i,t}$$

$$\frac{Y_{i,t}}{L_{i,t}} = \frac{w_{i,t}}{p_{i,t}} \left( \beta + \gamma \left( 1 + \left( \frac{r_{E,i,t}}{w_{i,t}} \right)^{1-\sigma} \right)^{-1} \right)^{-1} \searrow \text{ in } r_{E,i,t}$$

$$\frac{K_{E,i,t}}{L_{i,t}} = \left( \frac{r_{E,i,t}}{w_{R,i,t}} \right)^{-1} \left( \frac{\beta}{\gamma} \frac{w_{R,i,t}}{w_{NR,i,t}} + \left( 1 + \frac{\beta}{\gamma} \frac{w_{R,i,t}}{w_{NR,i,t}} \right) \left( \frac{r_{E,i,t}}{w_{R,i,t}} \right)^{\sigma-1} \right)^{-1} \searrow \text{ in } r_{E,i,t},$$

wages by occupation  $w_{R,i,t}$  and  $w_{NR,i,t}$ , average wage  $w_{i,t}$ , rental rate of electric capital  $r_{E,i,t}$ .

## Model's predictions as regression equations:

- Labor share, labor productivity, capital intensity:

$$\Delta \log \frac{w_{i,t} L_{i,t}}{p_{i,t} Y_{i,t}} = \text{constant} + a \Delta \log (p_{E,k,t}) + \text{error},$$

$$\Delta \log \frac{Y_{i,t}}{L_{i,t}} = \text{constant} + b \Delta \log (p_{E,k,t}) + \text{error},$$

$$\Delta \log \frac{K_{E,i,t}}{L_{i,t}} = \text{constant} + c \Delta \log (p_{E,k,t}) + \text{error},$$

state-level price of electricity  $p_{E,k,t}$

- Predictions:  $a > 0$ ,  $b < 0$ ,  $c < 0$
- firm-level variation within state  $\Rightarrow$  attenuation bias
- plant-level outcome on state-level variation  $\Rightarrow$  state-level clustering of standard errors



## Additional regressions:

- Prices, output, revenue, and employment

$$\Delta \log p_{i,t} = \text{constant} + a' \Delta \log (p_{E,k,t}) + \text{error}$$

$$\Delta \log Y_{i,t} = \text{constant} + b' \Delta \log (p_{E,k,t}) + \text{error}$$

$$\Delta \log p_{i,t} Y_{i,t} = \text{constant} + c' \Delta \log (p_{E,k,t}) + \text{error}$$

$$\Delta \log L_{i,t} = \text{constant} + d' \Delta \log (p_{E,k,t}) + \text{error}$$

- Technological unemployment:

$$a' = ?, \quad b' = 0, \quad c' = 0, \quad d' > 0$$

- Luddite fallacy:

$$a' > 0, \quad b' > 0, \quad c' > 0, \quad d' = 0$$

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  - ▶ ready-mix concrete has a few hours to reach destination
  - ▶ concrete is 6th most dispersed industry

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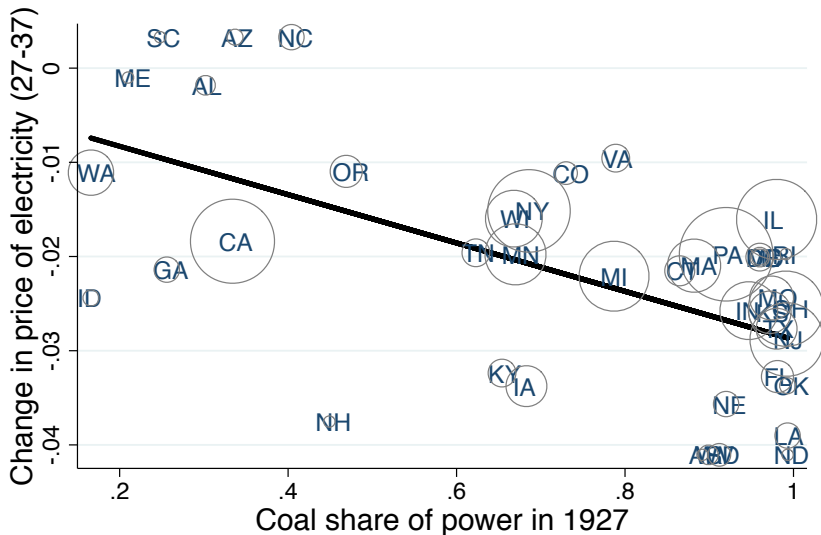
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- $$outcome = cst + b \times treatment$$

- $$\Delta \log L = cst + b \times \Delta \log p_E$$

## “First-stage regression”



Slope: -0.03 t-statistic: -4.59 F-statistic: 21.1  
R2: 0.35 Observations: 42

## Validity of the instrument

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  - ▶ State-level and plant-level fixed effects differenced out
- Plant-level shocks (e.g., Total Factor Productivity) absent from ratios
- More robustness checks later

# Cheaper electricity $\Rightarrow$ labor share of revenue $\searrow$

| Dependent variable              | (1)                | (2)                   | (3)                  | (4)                    | (5)                     |
|---------------------------------|--------------------|-----------------------|----------------------|------------------------|-------------------------|
|                                 |                    |                       | $\Delta$ labor share |                        |                         |
| $\Delta$ price of electricity   | 1.969**<br>(0.947) | 2.949**<br>(1.348)    | 1.883**<br>(0.850)   | 2.277**<br>(0.982)     | 1.714**<br>(0.856)      |
| $\Delta$ price of cement        |                    | -0.0205<br>(0.0316)   |                      |                        |                         |
| Farm share in 1920              |                    | -0.143**<br>(0.0581)  |                      |                        |                         |
| Log-personal income in 1929     |                    | -0.102***<br>(0.0389) |                      |                        |                         |
| $\Delta$ housing in 1920s       |                    |                       | -0.00671<br>(0.0153) |                        |                         |
| bank suspensions                |                    |                       | 0.00114<br>(0.0462)  |                        |                         |
| initial size (plant)            |                    |                       |                      | 0.00562*<br>(0.00325)  |                         |
| initial productivity (plant)    |                    |                       |                      | 0.0654***<br>(0.00550) |                         |
| unionization                    |                    |                       |                      |                        | -0.00164*<br>(0.000937) |
| Herfindahl index                |                    |                       |                      |                        | -0.00862<br>(0.0465)    |
| Observations                    | 621                | 576                   | 621                  | 621                    | 618                     |
| First-stage <i>F</i> -statistic | 11.14              | 9.771                 | 12.51                | 11.19                  | 11.90                   |
| Number of states/clusters       | 42                 | 32                    | 42                   | 42                     | 41                      |

Clustered standard errors in parentheses. Significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$



# Cheaper electricity $\Rightarrow$ labor productivity $\nearrow$

| Dependent variable            | (1)                  | (2)                  | (3)                  | (4)                    | (5)                  |
|-------------------------------|----------------------|----------------------|----------------------|------------------------|----------------------|
| $\Delta$ price of electricity | -5.648***<br>(2.047) | -7.343***<br>(2.086) | -5.224***<br>(1.882) | -5.827***<br>(1.996)   | -5.531***<br>(1.934) |
| $\Delta$ price of cement      |                      | 0.0775<br>(0.0559)   |                      |                        |                      |
| Farm share in 1920            |                      | 0.283**<br>(0.135)   |                      |                        |                      |
| Log-personal income in 1929   |                      | 0.159*<br>(0.0836)   |                      |                        |                      |
| $\Delta$ housing in 1920s     |                      |                      | 0.0368<br>(0.0299)   |                        |                      |
| bank suspensions              |                      |                      | -0.00460<br>(0.0797) |                        |                      |
| initial size (plant)          |                      |                      |                      | 0.00682<br>(0.00595)   |                      |
| initial productivity (plant)  |                      |                      |                      | -0.0845***<br>(0.0108) |                      |
| unionization                  |                      |                      |                      |                        | 0.00134<br>(0.00119) |
| Herfindahl index              |                      |                      |                      |                        | 0.0760<br>(0.0750)   |
| Observations                  | 483                  | 445                  | 483                  | 483                    | 481                  |
| First-stage $F$ -statistic    | 12.01                | 12.00                | 13.24                | 12.09                  | 12.54                |
| Number of states/clusters     | 40                   | 31                   | 40                   | 40                     | 39                   |

# Cheaper electricity $\Rightarrow$ electric capital intensity $\nearrow$

| Dependent variable            | (1)                  | (2)                                 | (3)                  | (4)                    | (5)                    |
|-------------------------------|----------------------|-------------------------------------|----------------------|------------------------|------------------------|
|                               |                      | $\Delta$ electric capital intensity |                      |                        |                        |
| $\Delta$ price of electricity | -6.959***<br>(2.114) | -6.623***<br>(1.587)                | -5.585***<br>(1.424) | -6.692***<br>(2.185)   | -5.838***<br>(1.544)   |
| $\Delta$ price of cement      |                      | 0.0627*<br>(0.0374)                 |                      |                        |                        |
| Farm share in 1920            |                      | 0.0465<br>(0.139)                   |                      |                        |                        |
| Log-personal income in 1929   |                      | 0.164**<br>(0.0681)                 |                      |                        |                        |
| $\Delta$ housing in 1920s     |                      |                                     | 0.113***<br>(0.0325) |                        |                        |
| bank suspensions              |                      |                                     | -0.0638<br>(0.0893)  |                        |                        |
| initial size (plant)          |                      |                                     |                      | 0.0535***<br>(0.00568) |                        |
| initial productivity (plant)  |                      |                                     |                      | -0.0365**<br>(0.0154)  |                        |
| unionization                  |                      |                                     |                      |                        | 0.00378**<br>(0.00149) |
| Herfindahl index              |                      |                                     |                      |                        | -0.314***<br>(0.107)   |
| Observations                  | 475                  | 444                                 | 475                  | 475                    | 472                    |
| First-stage $F$ -statistic    | 11.85                | 10.53                               | 13.32                | 11.88                  | 12.77                  |
| Number of states/clusters     | 39                   | 32                                  | 39                   | 39                     | 38                     |

# Summary 1: electricity was a labor-saving technology

- Technological convergence caused:
  - ▶ labor share ↘ 19%
  - ▶ productivity ↗ 35%
  - ▶ electrical intensity ↗ 41%

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- Technological convergence caused:
  - ▶ labor share ↘ 19%
  - ▶ productivity ↗ 35%
  - ▶ electrical intensity ↗ 41%
- Magnitudes:
  - ▶ similar to actual changes
  - ▶ about 0.5 s.d. of distribution

# Cheaper electricity $\Rightarrow$ output prices $\searrow$

| Dependent variable            | (1)                | (2)                    | (3)   | (4)                    | (5)                     |
|-------------------------------|--------------------|------------------------|---|------------------------|-------------------------|
| $\Delta$ price of electricity | 3.540**<br>(1.502) | 3.704**<br>(1.550)     | $\Delta$ output price<br>3.275**<br>(1.509) | 3.500**<br>(1.499)     | 3.448**<br>(1.456)      |
| $\Delta$ price of cement      |                    | -0.0774***<br>(0.0274) |   |                        |                         |
| Farm share in 1920            |                    | -0.0789<br>(0.0893)    |   |                        |                         |
| Log-personal income in 1929   |                    | -0.0660<br>(0.0580)    |   |                        |                         |
| $\Delta$ housing in 1920s     |                    |                        | -0.0414**<br>(0.0184)                       |                        |                         |
| bank suspensions              |                    |                        | 0.0879*<br>(0.0516)                         |                        |                         |
| initial size (plant)          |                    |                        |   | -0.00756*<br>(0.00406) |                         |
| initial productivity (plant)  |                    |                        |   | -0.0116*<br>(0.00686)  |                         |
| unionization                  |                    |                        |   |                        | -0.000385<br>(0.000958) |
| Herfindahl index              |                    |                        |   |                        | 0.00673<br>(0.0554)     |
| Observations                  | 454                | 421                    | 454   | 453                    | 452                     |
| First-stage $F$ -statistic    | 10.11              | 9.615                  | 10.90                                       | 10.29                  | 10.60                   |
| Number of states/clusters     | 40                 | 31                     | 40  | 40                     | 39                      |

# Cheaper electricity $\Rightarrow$ revenue unchanged

| Dependent variable            | (1)              | (2)                 | (3)                                  | (4)                     | (5)                  |
|-------------------------------|------------------|---------------------|--------------------------------------|-------------------------|----------------------|
| $\Delta$ price of electricity | 2.160<br>(1.467) | 2.779<br>(2.119)    | $\Delta$ revenue<br>0.904<br>(1.347) | 1.553<br>(1.081)        | 2.349<br>(1.448)     |
| $\Delta$ price of cement      |                  | -0.0360<br>(0.0502) |                                      |                         |                      |
| Farm share in 1920            |                  | -0.0647<br>(0.119)  |                                      |                         |                      |
| Log-personal income in 1929   |                  | -0.0654<br>(0.0727) |                                      |                         |                      |
| $\Delta$ housing in 1920s     |                  |                     | -0.0867***<br>(0.0180)               |                         |                      |
| bank suspensions              |                  |                     | -0.0257<br>(0.0579)                  |                         |                      |
| initial size (plant)          |                  |                     |                                      | -0.0682***<br>(0.00410) |                      |
| initial productivity (plant)  |                  |                     |                                      | -0.0780***<br>(0.0140)  |                      |
| unionization                  |                  |                     |                                      |                         | 0.00189<br>(0.00160) |
| Herfindahl index              |                  |                     |                                      |                         | 0.112<br>(0.0695)    |
| Observations                  | 630              | 585                 | 630                                  | 628                     | 627                  |
| First-stage $F$ -statistic    | 11.19            | 9.699               | 12.50                                | 11.25                   | 11.98                |
| Number of states/clusters     | 42               | 32                  | 42                                   | 42                      | 41                   |

# Cheaper electricity $\Rightarrow$ output unchanged

| Dependent variable            | (1)               | (2)                | (3)                                  | (4)                     | (5)                   |
|-------------------------------|-------------------|--------------------|--------------------------------------|-------------------------|-----------------------|
| $\Delta$ price of electricity | -1.936<br>(2.806) | -3.035<br>(2.743)  | $\Delta$ output<br>-2.417<br>(2.487) | -1.997<br>(2.435)       | -1.823<br>(2.841)     |
| $\Delta$ price of cement      |                   | 0.0427<br>(0.0554) |                                      |                         |                       |
| Farm share in 1920            |                   | 0.104<br>(0.103)   |                                      |                         |                       |
| Log-personal income in 1929   |                   | 0.0329<br>(0.0723) |                                      |                         |                       |
| $\Delta$ housing in 1920s     |                   |                    | -0.0393<br>(0.0252)                  |                         |                       |
| bank suspensions              |                   |                    | 0.0129<br>(0.0911)                   |                         |                       |
| initial size (plant)          |                   |                    |                                      | -0.0599***<br>(0.00581) |                       |
| initial productivity (plant)  |                   |                    |                                      | -0.0847***<br>(0.0134)  |                       |
| unionization                  |                   |                    |                                      |                         | 0.00289*<br>(0.00160) |
| Herfindahl index              |                   |                    |                                      |                         | 0.146<br>(0.0994)     |
| Observations                  | 454               | 421                | 454                                  | 453                     | 452                   |
| First-stage $F$ -statistic    | 10.11             | 9.615              | 10.90                                | 10.29                   | 10.60                 |
| Number of states/clusters     | 40                | 31                 | 40                                   | 40                      | 39                    |

# Cheaper electricity $\Rightarrow$ employment ↘

| Dependent variable            | (1)                 | (2)                  | (3)                   | (4)                     | (5)                   |
|-------------------------------|---------------------|----------------------|-----------------------|-------------------------|-----------------------|
|                               |                     |                      | $\Delta$ employment   |                         |                       |
| $\Delta$ price of electricity | 3.405***<br>(1.226) | 4.307***<br>(1.601)  | 2.688***<br>(0.958)   | 3.005**<br>(1.187)      | 3.276***<br>(1.174)   |
| $\Delta$ price of cement      |                     | -0.0567*<br>(0.0321) |                       |                         |                       |
| Farm share in 1920            |                     | -0.162<br>(0.109)    |                       |                         |                       |
| Log-personal income in 1929   |                     | -0.131**<br>(0.0582) |                       |                         |                       |
| $\Delta$ housing in 1920s     |                     |                      | -0.0574**<br>(0.0242) |                         |                       |
| bank suspensions              |                     |                      | 0.0170<br>(0.0614)    |                         |                       |
| initial size (plant)          |                     |                      |                       | -0.0618***<br>(0.00339) |                       |
| initial productivity (plant)  |                     |                      |                       | 0.0135<br>(0.0110)      |                       |
| unionization                  |                     |                      |                       |                         | 9.21e-05<br>(0.00173) |
| Herfindahl index              |                     |                      |                       |                         | 0.113**<br>(0.0476)   |
| Observations                  | 621                 | 576                  | 621                   | 621                     | 618                   |
| First-stage $F$ -statistic    | 11.14               | 9.771                | 12.51                 | 11.19                   | 11.90                 |
| Number of states/clusters     | 42                  | 32                   | 42                    | 42                      | 41                    |



## Summary 2: electricity caused job losses

- Technological convergence caused:
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  - ▶ no effect on output
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- Results also robust to:
  - ▶ using the relative price of electricity  $p_{E,k,t}/w_{k,t}$
  - ▶ dropping counties near dam construction

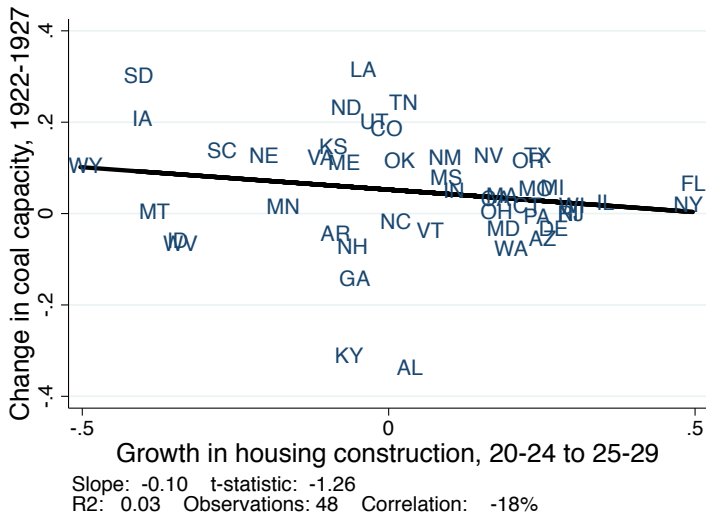
# Falsification tests: cheaper electricity and materials share

| Dependent variable            | (1)              | (2)                  | (3)  | (4)                     | (5)                      |
|-------------------------------|------------------|----------------------|--|-------------------------|--------------------------|
| $\Delta$ price of electricity | 1.085<br>(0.773) | 0.640<br>(1.000)     | $\Delta$ materials share<br>1.178<br>(0.822) | 1.156<br>(0.795)        | 0.854<br>(0.670)         |
| $\Delta$ price of cement      |                  | -0.0132<br>(0.0123)  |  |                         |                          |
| Farm share in 1920            |                  | 0.0338<br>(0.0504)   |  |                         |                          |
| Log-personal income in 1929   |                  | -0.00411<br>(0.0298) |  |                         |                          |
| $\Delta$ housing in 1920s     |                  |                      | -0.00163<br>(0.0118)                         |                         |                          |
| bank suspensions              |                  |                      | 0.0326<br>(0.0465)                           |                         |                          |
| initial size (plant)          |                  |                      |  | 0.00933***<br>(0.00285) |                          |
| initial productivity (plant)  |                  |                      |  | 0.00422<br>(0.00535)    |                          |
| unionization                  |                  |                      |  |                         | -0.00102**<br>(0.000468) |
| Herfindahl index              |                  |                      |  |                         | 0.0302<br>(0.0247)       |
| Observations                  | 599              | 557                  | 599  | 598                     | 596                      |
| First-stage $F$ -statistic    | 10.61            | 9.318                | 11.91  | 10.73                   | 11.40                    |
| Number of states/clusters     | 42               | 32                   | 42   | 42                      | 41                       |

## Validity: the sample seems balanced on observables

| Dependent variable<br>in 1929 | (1)                 | (2)                 | (3)                 | (4)                        | (5)                  |
|-------------------------------|---------------------|---------------------|---------------------|----------------------------|----------------------|
|                               | productivity        | employment          | revenue             | electric cap.<br>intensity | labor<br>share       |
| coal share in 1927            | 0.197<br>(0.172)    | 0.0612<br>(0.183)   | 0.116<br>(0.208)    | -0.314*<br>(0.156)         | 0.00261<br>(0.0182)  |
| Constant                      | 5.746***<br>(0.133) | 1.859***<br>(0.130) | 10.33***<br>(0.160) | 1.307***<br>(0.134)        | 0.295***<br>(0.0146) |
| Observations                  | 569                 | 628                 | 630                 | 563                        | 630                  |
| R-squared                     | 0.003               | 0.000               | 0.001               | 0.007                      | 0.000                |

## Validity: change in coal share uncorrelated with change in demand



# Outline

- 1 Data
- 2 Model
- 3 Empirics
- 4 Conclusion**

## Conclusion:

# The labor market consequences of technological adoption

- Testing the theory of technological unemployment



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- Electricity adoption could explain up to 80% of job losses in the concrete industry
- Future research: what do these workers become?

Any comments?

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# Additional slides

## Extension: results are more precise for continuing plants

- With entry and exit, similar point estimates, lower precision
- Plant exit due to reasons uncorrelated with electricity:

|                                 | Dependent variable  | exit = 1, continuing = 0 |
|---------------------------------|---|--------------------------|
| plant-level                     | $\log\left(\frac{P_{i,t} Y_{i,t}}{L_{i,t}}\right)  _{1929}$ | -0.176***                |
|                                 | $\log(L_{i,1929})$  | -0.152***                |
|                                 | $\log(K_{E,i,t}/L_{i,t})  _{1929}$                          | -0.000139                |
| 50 miles around county with GIS | housing boom  | 0.188***                 |
|                                 | bank suspensions  | 0.181                    |
|                                 | Constant  | 2.386***                 |
|                                 | Observations  | 1,963                    |
|                                 | R-squared   | 0.116                    |



## Model: firm's objective

- Representative firm, perfect competition, maximizes intertemporal profits:

$$\text{profits}_t = Y_t - w_t (L_{NR,t} + L_{R,t}) - r_{NE,t} K_{NE,t} - r_{E,t} K_{E,t}$$

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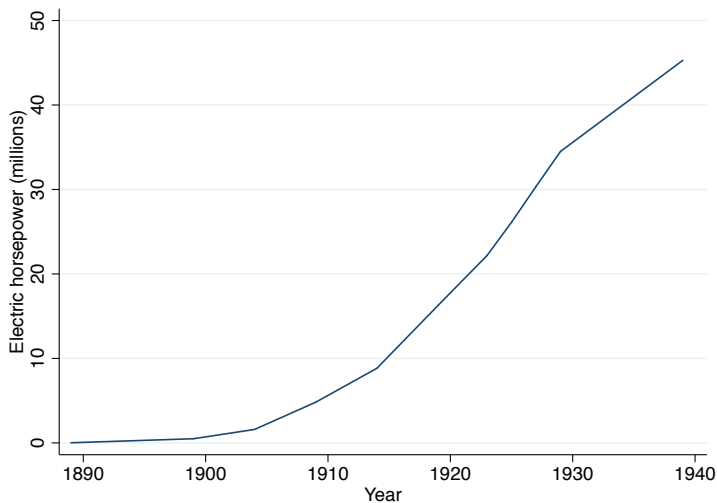
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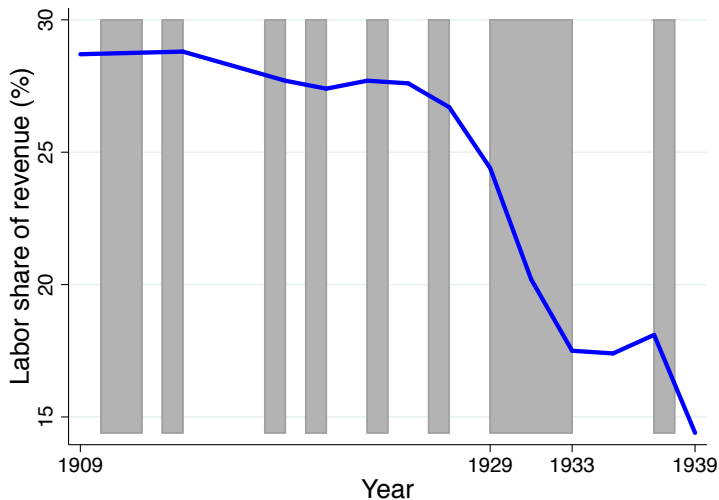
- $\Rightarrow r_{C,t} = \exp(-b_t)$ ,  $r_{NC,t} = 1$



# Manufacturing was still adopting electricity in 1930s



## The Great Depression accelerated the decline in the labor share of income of concrete



## Endogeneity: OLS < IV

- Supply-and-demand:

$$\Delta \log \left( \frac{K_{E,i,t}}{L_{i,t}} \right) = c - d \Delta \log \left( \frac{p_{E,i,t}}{w_{i,t}} \right) + demand_{i,t}$$

$$\Delta \log \left( \frac{K_{E,i,t}}{L_{i,t}} \right) = c' + d' \Delta \log \left( \frac{p_{E,i,t}}{w_{i,t}} \right) + supply_{i,t}$$

- Then:

$$\Delta \log \left( \frac{p_{E,i,t}}{w_{i,t}} \right) = \frac{1}{d + d'} (c - c' + demand_{i,t} - supply_{i,t})$$

- Positive correlation between regressor and error term biases  $-d$  toward 0
- Similar for labor share of income (in the paper)