

Difference in differences

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- 1 Effect of minimum wages
Card and Krueger (1994)
Addison, Blackburn, and Cotti (2009)
Clemens and Strain (2018)

References

- Angrist and Pischke (2014) chapter 5
- Stock and Watson (2009) chapter 13, especially 13.4
- Wooldridge (2013) chapter 13, especially 13.2

Difference in
differences

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References

Section 1

Effect of minimum wages

Introduction

- Effect of minimum wage on employment theoretically ambiguous
 - In competitive labor market, increasing binding minimum wage decreases employment
 - In monopsonistic labor market, increasing minimum wage, can increase employment

Even if direction not ambiguous, size of effect cannot be determined from theory alone

Policy change as a natural experiment

- Ideal experiment: randomly assign labor markets to a control group (minimum wage kept constant) and treatment group (minimum wage increased), compare outcomes
- Policy changes affecting some areas and not others create natural experiments
 - Unlike ideal experiment, control and treatment groups not randomly assigned

Card and Krueger (1994)

- In April 1992:
 - Minimum wage in New Jersey from \$4.25 to \$5.05
 - Minimum wage in Pennsylvania constant at \$4.25
- **Card and Krueger (1994)** surveyed 473 fast food restaurants in February/March 1992, and again in November/December 1992

Pennsylvania

Number
of Restaurants

- 1
- 2
- 3
- 4
- 5
- 6

New
Jersey

Difference in differences

Average employees

	PA	NJ
Before	23.33 (1.35)	20.44 (0.51)
After	21.17 (0.94)	21.03 (0.52)

Difference in differences

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- Is $\overline{NJ,after} - \overline{PA,after} = 21.03 - 21.17 = -0.14$ (1.07) a good estimate of the causal effect of the minimum wage difference on employment?

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- Is $\overline{NJ,after} - \overline{PA,after} = 21.03 - 21.17 = -0.14 (1.07)$ a good estimate of the causal effect of the minimum wage difference on employment?
- Is $\overline{NJ,after} - \overline{NJ,before} = 21.03 - 20.44 = 0.59 (0.54)$ a good estimate of the causal effect of the minimum wage difference on employment?

Difference in differences

	<i>All</i>	<i>Restaurants, by State</i>		<i>Difference NJ - PA</i>
		<i>PA</i>	<i>NJ</i>	
	<i>(1)</i>	<i>(2)</i>	<i>(3)</i>	<i>(4)</i>
1. FTE Employment Before, All Available Observations	21.00 (0.49)	23.33 (1.35)	20.44 (0.51)	-2.89 (1.44)
2. FTE Employment After, All Available Observations	21.05 (0.46)	21.17 (0.94)	21.03 (0.52)	-0.14 (1.07)
3. Change in Mean FTE Employment	0.05 (0.50)	-2.16 (1.25)	0.59 (0.54)	2.76 (1.36)

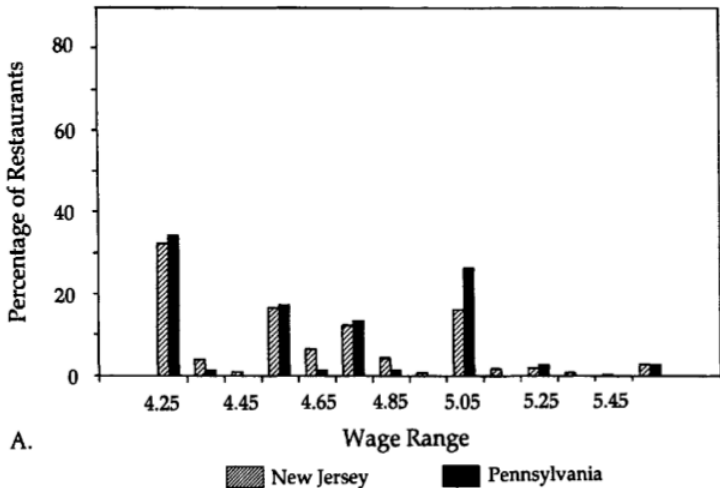
⁰This table and other figure and tables in this section from Card and Krueger (1997).

Assessing natural experiment

- NJ and PA minimum wage not randomly assigned
 - NJ could have chosen higher minimum because e.g. it was growing faster than PA
- Can check pre-period balance
 - If treatment and control group were randomly assigned, then there would be no differences between them before the experiment

Means of Key Variables

	All (1)	Restaurants, by State		t-test for NJ - PA ^a (4)
		New Jersey (2)	Pennsylvania (3)	
1. Distribution of Restaurant Types (%)				
a. Burger King	41.7	41.1	44.3	-0.5
b. KFC	19.5	20.5	15.2	1.2
c. Roy Rogers	24.2	24.8	21.5	0.6
d. Wendy's	14.6	13.6	19.0	-1.1
e. Company Owned	34.4	34.1	35.4	-0.2
2. Means in Wave 1				
a. FTE Employment	21.0 (0.49)	20.4 (0.51)	23.3 (1.35)	-2.0
b. Percent Full-Time Employees	33.3 (1.2)	32.8 (1.3)	35.0 (2.7)	-0.7
c. Starting Wage (\$/hr)	4.62 (0.02)	4.61 (0.02)	4.63 (0.04)	-0.4
d. Wage = \$4.25 (%)	31.0 (2.3)	30.5 (2.5)	32.9 (5.3)	-0.4
e. Price of Full Meal (\$)	3.29 (0.03)	3.35 (0.04)	3.04 (0.07)	4.0
f. Hours Open (weekday)	14.4 (0.1)	14.4 (0.2)	14.5 (0.3)	-0.3
g. Recruiting Bonus	24.6 (2.1)	23.6 (2.3)	29.1 (5.1)	-1.0



A.
 Figure 2.2 Distribution of starting wage rates. A. February–March 1992.
 B. November–December 1992.

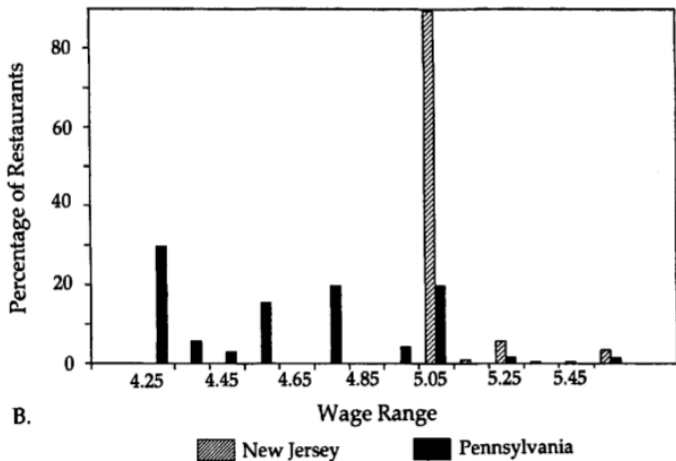


Figure 2.2 Distribution of starting wage rates. A. February–March 1992. B. November–December 1992.

- $\Delta y_i = \beta_0 + \beta_1 NJ_i + \epsilon_i$
 - Δy_i = change in employees at restaurant i
 - $NJ_i = 1$ if in NJ, 0 if in PA
 - $\hat{\beta}_1$ = difference in differences

Diff-in-diffs regression

- $\Delta y_i = \beta_0 + \beta_1 NJ_i + \epsilon_i$
 - Δy_i = change in employees at restaurant i
 - $NJ_i = 1$ if in NJ, 0 if in PA
 - $\hat{\beta}_1$ = difference in differences
- Can estimate multiple regression to hold restaurant characteristics fixed

$$\Delta y_i = \beta_0 + \beta_1 NJ_i + \text{other controls} + \epsilon_i$$

*Dependent Variable:
Change in Employment^a*

	(1)	(2)	(3)	(4)	(5)
1. New Jersey Dummy	2.33 (1.19)	2.30 (1.20)	—	—	—
2. Initial Wage Gap ^d	—	—	15.65 (6.08)	14.92 (6.21)	11.98 (7.42)
3. Controls for Chain and Ownership ^e	No	Yes	No	Yes	Yes
4. Controls for Region ^f	No	No	No	No	Yes
5. Standard Error of Regression	8.79	8.78	8.76	8.76	8.75
6. Probability Value for Controls ^g	—	0.34	—	0.44	0.40

Addison, Blackburn, and Cotti (2009)

- Minimum wage and employment in retail
- US data 1990-2005
- Model

$$\log(E_{ist}) = \beta \log(MW_{st}) + \text{controls}_{ist} + \mu_i + \lambda_i t + \tau_t + \epsilon_{ist}$$

county i , state s , year t

Table 4

Regression estimates with county-level trends: food and beverage store sector.

Industry	Food and beverage stores	Supermarkets and other grocery stores	Convenience stores	Specialty food stores	Beer, wine, and liquor stores
NAICS code	445	44511	44512	4452	4453
<i>Dep. variable</i>	<i>(b) Employment</i>				
Minimum wage	0.225** (0.114)	0.210* (0.128)	0.227** (0.116)	0.067 (0.110)	0.101** (0.048)
Population	0.414** (0.154)	0.526** (0.231)	0.821 (0.581)	-0.693 (0.521)	-0.035 (0.273)
Total employment	0.468** (0.053)	0.520** (0.090)	0.509** (0.138)	0.903** (0.176)	0.468** (0.112)
Total average weekly earnings	-0.052 (0.032)	-0.043 (0.056)	-0.122** (0.060)	-0.179** (0.058)	-0.036 (0.033)
Unemployment rate	-0.002 (0.003)	-0.003 (0.004)	-0.006 (0.008)	-0.005 (0.008)	-0.000 (0.005)
Enrollment rate	-0.052 (0.032)	-0.057 (0.056)	0.050 (0.067)	-0.219** (0.064)	-0.032 (0.038)

Clemens and Strain (2018)

“The short-run employment effects of recent minimum wage changes: evidence from the American Community Survey”

Recent minimum wage changes in US

- July 2009 federal minimum wage to \$7.25
- Great recession
- 2012 - 1 state increases minimum wage
- 2013 - 4 states increases minimum wage
- 2014 - 17 states increases minimum wage
- Average increase \$0.92 (12%)

TABLE 1**List of States with Statutory Minimum Wage
Increases and Inflation-Indexed Increases**

Statutory Increase of \$1 or More	Statutory Increase Under \$1
Alaska	Arkansas
California	Connecticut
District of Columbia	Delaware
Massachusetts	Hawaii
New Jersey	Maryland
New York	Michigan
Rhode Island	Minnesota
South Dakota	Nebraska
	West Virginia
Indexers	
Arizona	
Colorado	
Florida	
Missouri	
Montana	
Ohio	
Oregon	
Vermont	
Washington	

Notes: Data on minimum wage indexing provisions come from the National Council of State Legislatures. The states labeled as Indexers link annual updates to their effective minimum wage rates to a measure of inflation. Data on minimum wage changes come from the U.S. DOL. States are counted as statutory increase of under \$1 if the combined statutory increase in the minimum wage from January 2013 through January 2015 was under \$1. States are counted as statutory increase of \$1 or more if the combined statutory increase in the minimum wage was \$1 or more.

FIGURE 1

Average Minimum Wage across Policy Regimes

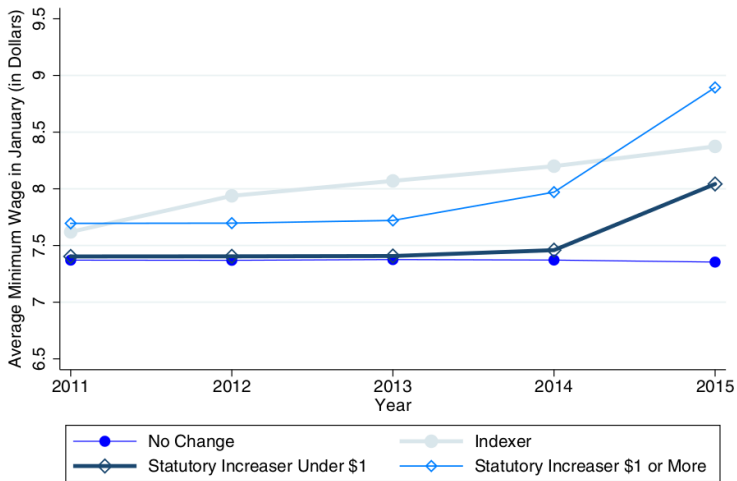
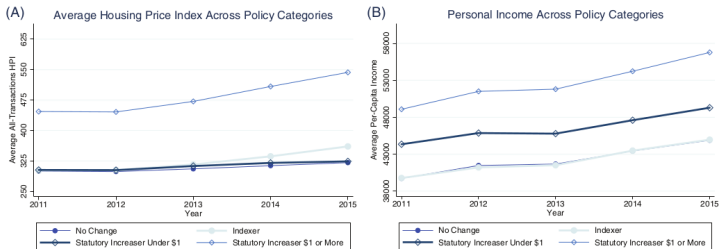
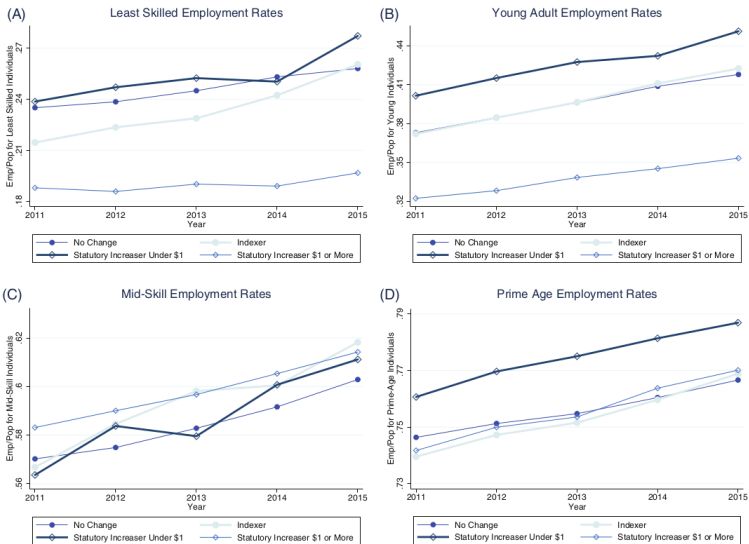


FIGURE 2
Evolution of Macroeconomic Covariates across Minimum Wage Policy Regimes



Notes: Panel A plots the average housing price index variable for each of our four policy categories from 2011 to 2015. Housing price index data come from the Federal Housing Finance Agency. Panel B plots average per-capita income for each of our four policy categories from 2011 to 2015. Data on average per-capita income come from the BEA. States are defined as statutory increasers under \$1 if the combined statutory increase in their minimum wage between January 2013 and January 2015 was under \$1. States are defined as statutory increasers of \$1 or more if the combined statutory increase in their minimum wage was \$1 or greater. Indexers are states that index their minimum wage to inflation. Averages are weighted by state population.

FIGURE 3
Evolution of Employment across Minimum Wage Policy Regimes



Model

$$y_{ist} = \sum_p \beta_p Policy_s \times Post_t + \alpha_{1s} + \alpha_{2t} + X_{ist}\gamma + \epsilon_{ist}$$

TABLE 4

Relationship between Minimum Wage Increases and Employment of Individuals 25 and under with Less than a High School Education (D-in-D Estimates)

	(1)	(2)	(3)	(4)	(5)	(6)
Large statutory increaser × post	-0.0106 (0.008)	-0.0137 (0.008)	-0.0104 (0.011)	-0.0105 (0.007)	-0.0098 (0.007)	-0.0118 (0.009)
Small statutory increaser × post	0.0113 (0.013)	0.0123 (0.012)	0.0113 (0.013)	0.0108 (0.012)	0.0091 (0.012)	0.0094 (0.010)
Indexer × post	0.0203** (0.008)	0.0199** (0.009)	0.0204** (0.009)	0.0180** (0.008)	0.0161** (0.008)	0.0137* (0.008)
Ln(income per capita)		0.1477 (0.101)				0.1223 (0.099)
Housing price index divided by 1,000			-0.0044 (0.086)			-0.0072 (0.087)
State mid-skill employment-to-population ratio				0.2521** (0.125)		0.2443** (0.121)
Age and education controls	No	No	No	No	Yes	Yes
Observations	453,956	453,956	453,956	453,956	453,956	453,956
R ²	.015	.015	.015	.015	.101	.102

Notes: This table reports difference-in-differences estimates for which the policy indicator variables distinguish between states in which the minimum wage was increased by less than \$1 and states that increased their minimum wage by \$1 or more. The sample is from the ACS and includes individuals ages 25 and younger with less than a completed high school education. Variable definitions and sources are discussed in the note to Table 2 (and in the paper). All specifications include year and state fixed effects. Age and education controls consist of a dummy variable for each education group and age (included in columns 5 and 6 as indicated within the table). Standard errors are clustered at the state level.

* $p < .1$; ** $p < .05$; *** $p < .01$.

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