# Empirical Methods for Policy Evaluation
# Homework

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## 1 Introduction

Gentzkow et al. (2011) use new data on entries and exits of US daily newspapers from 1869 to 2004 to estimate effects on political participation, party vote shares and electoral competitiveness. In fact, the paper narrow down the period under investigation to years 1968-1928 and find that with a robust positive effect on political participation, one addition newspaper entry increase presidential and congressional turnout by 0.3%.

The estimation strategy or identification strategy by Gentzkow et al. (2011) follows the similar logic as the conventional DID method; setting the precise timing of these events and treatment is the entry or exit of newspaper. The distinctive feature is that the intensity or magnitude of treatment is heterogeneous; the first newspaper in a market explain most of the effect while the contribution of successors are much smaller. Therefore, we are motivated to investigate the heterogeneity of treatment rate. For example, as raised in Chaisemartin and D'Haultfoeuile (2019), the treatment rate may only increase more in the treatment group. In addition, Chaisemartin and D'Haultfoeuile (2019) propose weaker assumptions that standard Wald-DID estimand, which assume the homogeneity of treatment effect over time.

Specifically, Chaisemartin and D'Haultfoeuile (2019) assume conditional common trend

**Assumption 1.** For all $d \in \mathcal{S}(D)$ and all $t \in \{1, \ldots, \bar{t}\}, E(Y(d) \mid G, T = t, D(t-1) = d) - E(Y(d) \mid G, T = t-1, D(t-1) = d\ )$ does not depend on $G$.

which regulate that mean of $Y(0), Y(1)$ follow the same evolution over time among treatment and control group units that were untreated or treated at $T = 0$.

In next section, we start our replication by reproducing the fundamental main result of the effect of newspaper entry/exit on voter turnout.

In the last section, we further elaborate our estimation strategy and discuss the empirical results.

## 2 Replication

The original empirical setting of Gentzkow et al (2011) is presented as followed:

$$y_{ct} = \rho_c + \beta n_{ct} + \gamma_{st} + \delta \mathbf{x}_{ct} + \lambda z_{ct} + \varepsilon_{ct} \tag{1}$$

where $\rho_c$ is a county effect, $\gamma_{st}$ is a state-year effect, $\mathbf{x}_{ct}$ is a vector of observable characteristics, $\delta$ is a vector of parameters, and $\varepsilon_{ct}$ is a county-year shock. The parameter $\beta$ is the causal effect of $n_{ct}$ on $y_{ct}$.

The index $z_{ct}$ denotes newspaper profitability. The parameter $\lambda$ encodes the extent to which newspaper profitability is related to the political outcome $y_{ct}$ conditional on $n_{ct}, \mathbf{x}_{ct}, \rho_c$, and $\gamma_{st}$.

However, due to the property of highly persistent shock, we extend the original empirical setting to

$$\Delta y_{ct} = \beta \Delta n_{ct} + \Delta \gamma_{st} + \delta \Delta \mathbf{x}_{ct} + \lambda \Delta z_{ct} + \Delta \varepsilon_{ct}, \tag{2}$$

which means we estimate the model in first differences.

The estimation reproduced is presented as below.

| | Readership (C) | Presidential Turnout (NC) | Presidential Turnout (C) | Congressional Turnout (Pres. C) | Congressional Turnout (Off C) |
|---|---|---|---|---|---|
| Number of newspapers | 0.1314 | 0.0026 | 0.0034 | 0.0031 | 0.0032 |
| | (0.0044) | (0.0009) | (0.0009) | (0.0011) | (0.0012) |
| $R^2$ | 0.435 | 0.569 | 0.579 | 0.521 | 0.531 |
| Number of counties | 1,181 | 1,195 | 1,195 | 1,195 | 1,192 |
| Number of county-years | 11,281 | 15,627 | 15,627 | 14,634 | 13,869 |

Table 1: The Effect of Newspaper Entry/Exit on Voter Turnout

# 3 Robustness

We proceed our discussion of fuzzy DID in two steps. First, we introduce the estimands and estimators in the simplest set-up with two groups, two periods, a binary treatment and no co-variates. Second, we extend the application to a case with multiple periods and groups.

We assume treatment $D$ is binary, where $Y(1), Y(0)$ represents the potential outcomes of being treated or not.

The time periods are defined as $T \in \{0,1\}$ while groups are represented by $G \in \{0,1\}$. In other words, if a unit is in treatment group, $G = 1$.

We keep Assumptions 2-5 as

**Assumption 2.** $\mathrm{E}(D_{11}) > E(D_{10})$, and $E(D_{11}) - E(D_{10}) > E(D_{01}) - E(D_{00})$

**Assumption 3.** For all $\mathrm{d} \in \mathcal{S}(D), P(D_{01} = d) = P(D_{00} = d) \in (0,1)$

**Assumption 4.** There exist $D(0), D(1)$ such that $D = D(T), D(t)T \mid G(t \in \{0,1\})$ and

$$P(D(1) \geq D(0) \mid G) = 1 \quad \text{or } P(D(1) \leq D(0) \mid G) = 1.$$

**Assumption 5.** For all $d \in \mathcal{S}(D)$ and all $t \in \{1, \ldots, \bar{t}\}, E(Y(d) - Y(0) \mid G, T = t, D(t-1) = d) = E(Y(d) - Y(0) \mid G, T = t-1, D(t-1) = d)$.

The parameter of interest is Local Average Treatment Effect as

$$\Delta = E(Y(1) - Y(0) \mid S, T = 1) \tag{3}$$

Then three estimands of $\Delta$ are respectively Wald-DID, time-corrected Wald ratio and change-in-change Wald ratio:

$$\begin{aligned} W_{DID} &= \frac{E(Y_{11}) - E(Y_{10}) - (E(Y_{01}) - E(Y_{00}))}{E(D_{11}) - E(D_{10}) - (E(D_{01}) - E(D_{00}))} \\ W_{TC} &= \frac{E(Y_{11}) - E(Y_{10} + \delta_{D_{10}})}{E(D_{11}) - E(D_{10})} \\ W_{CIC} &= \frac{E(Y_{11}) - E(Q_{D_{10}}(Y_{10}))}{E(D_{11}) - E(D_{10})} \end{aligned} \tag{4}$$

## 3.1 Simplest set-up

We will compute $\widehat{W}^*_{DID}, \widehat{W}^*_{TC}$ with the first two time periods in the data set, 1868 and 1872 elections. Since we don't allow co-variate in CIC, estimates for $\widehat{W}^*_{CIC}$ will be given without any controls. However, given the fact that stata command *fuzzydid* does not contain option including state-specific trends, in order to keep in line with the definition of no controls in Gentzkow et al. (2011), we manually add state indicators as controls, which is equivalent to containing state-specific trends.

| | Readership (C) | Presidential Turnout (NC) | Presidential Turnout (C) | Congressional Turnout (Pres. C) | Congressional Turnout (Off C) |
|---|---|---|---|---|---|
| Number of newspapers | 0.0482 | 0.0257 | 0.0447 | 0.0385 | 0.0059 |
| | (0.1004) | (0.0097)* | (0.0597) | (0.0374)* | (0.0341) |
| Number of counties | 1424 | 1424 | 1424 | 1363 | 916 |

Table 2: The Effect of Newspaper Entry/Exit on Voter Turnout from 1868-1872 as $\widehat{W}^*_{DID}$

| | Readership (C) | Presidential Turnout (NC) | Presidential Turnout (C) | Congressional Turnout (Pres. C) | Congressional Turnout (Off C) |
|---|---|---|---|---|---|
| Number of newspapers | 0.0448 | 0.0315 | 0.0362 | -0.0422 | -0.0076 |
| | (7.9271) | (0.0122)* | (0.9237) | (0.2231) | (0.6054) |
| Number of counties | 1424 | 1424 | 1424 | 1363 | 916 |

Table 3: The Effect of Newspaper Entry/Exit on Voter Turnout from 1868-1872 as $\widehat{W}^*_{TC}$

| | Readership (NC) | Presidential Turnout (NC) | Congressional Turnout (Pres. NC) | Congressional Turnout (Off NC) |
|---|---|---|---|---|
| Number of newspapers | 0.0699 | 0.0133 | 0.0157 | 0.0175 |
| | (0.0279)* | (0.0142) | (0.0131) | (0.0244) |
| Number of counties | 1424 | 1424 | 1363 | 916 |

Table 4: The Effect of Newspaper Entry/Exit on Voter Turnout from 1868-1872 as $\widehat{W}^*_{CIC}$

Although we are surprised to find out that most point estimates are positive but only a few of them are significant, it can be explained by the fact that our samples are too restrictive in the sense that there is only 2 time periods.

## 3.2 Full Sample

| | Readership (C) | Presidential Turnout (NC) | Presidential Turnout (C) | Congressional Turnout (Pres. C) | Congressional Turnout (Off C) |
|---|---|---|---|---|---|
| Number of newspapers | 0.2827 | 0.0026 | 0.0025 | 0.0021 | 0.0032 |
| | (0.0201)* | (0.0010)* | (0.0029) | (0.0038) | (0.0066) |
| Number of counties | 16872 | 16872 | 16872 | 16149 | 14374 |

Table 5: The Effect of Newspaper Entry/Exit on Voter Turnout from 1868-1928 as $\widehat{W}^*_{DID}$

| | Readership (C) | Presidential Turnout (NC) | Presidential Turnout (C) | Congressional Turnout (Pres. C) | Congressional Turnout (Off C) |
|---|---|---|---|---|---|
| Number of newspapers | 0.3412 | 0.0043 | 0.0369 | 0.0347 | 0.0254 |
| | (9.9906) | (0.0013)* | (5.1442) | (2.6013) | (0.6546) |
| Number of counties | 16872 | 16872 | 16872 | 16149 | 14374 |

Table 6: The Effect of Newspaper Entry/Exit on Voter Turnout from 1868-1928 as $\widehat{W}^*_{TC}$

| | Readership (NC) | Presidential Turnout (NC) | Congressional Turnout (Pres. NC) | Congressional Turnout (Off NC) |
|---|---|---|---|---|
| Number of newspapers | 0.2789 | 0.0042 | 0.0029 | 0.0033 |
| | (0.0024)* | (0.0019)* | (0.0011) | (0.0048) |
| Number of counties | 16872 | 16872 | 16149 | 14374 |

Table 7: The Effect of Newspaper Entry/Exit on Voter Turnout from 1868-1928 as $\widehat{W}^*_{CIC}$

When we extend our analysis to the full sample, we find that all point estimates are positive but still only a few of them are significant. However, the number of estimates of statistical significance increase.

In addition, we also find that the estimate for presidential turnout with state specific trends (Column 2) is always significant. Therefore we focus our discussion on this variable.

We further conduct a placebo Wald-DID estimator, to assess if Assumption 1,5 are plausible. The result is that

| | LATE | Std | t | P value | lower ic | upper ic |
|---|---|---|---|---|---|---|
| $W_{DID}$ | -.00183 | .0018602 | -.9837909 | .3252183 | -.0060213 | .0012684 |

Table 8: Caption

The placebo Wald-DID is negative, indicating that the actual Wald-DID may be downward biased due to a violation of Assumption 1 and 5.