Difference-in-discontinuities

with an application to fiscal policy

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Outline

Introduction

- Difference-in-discontinuities is a combination of difference-in-differences and regression discontinuity

- Use it when regression discontinuity is not "enough", e.g. when other policies jump discontinuously at the cut-off

- Example:
  - abolition of fiscal rules for Italian municipalities below 5,000 residents in 2001
  - same cut-off: jump in mayor's wage

Example

Fiscal rules relaxed for municipalities below 5,000 residents

TABLE 1—RULES OF THE DOMESTIC STABILITY PACT (DSP)

Year	Target of the DSP rules	Covered municipalities
1997	None	All
1998	None	All
1999	Fiscal gap: zero growth	All
2000	Fiscal gap: zero growth	All
2001	Fiscal gap: max 3 percent growth	Above 5,000
2002	Fiscal gap: max 2.5 percent growth	Above 5,000
2003	Fiscal gap: zero growth	Above 5,000
2004	Fiscal gap: zero growth	Above 5,000

Notes: The Domestic Stability Pact is a set of fiscal rules imposed by the central government to discipline the fiscal management of local governments. The main target is the *Fiscal gap* (see online Appendix Table A1 for details). The growth of the fiscal gap with respect to its value two years before is constrained to be either 0 or below 2.5 percent/3 percent depending on the year of the DSP.

Example

Wage of mayor (and executive committee) increases at the 5,000 cut-off

TABLE 2—LEGISLATIVE THRESHOLDS FOR ITALIAN MUNICIPALITIES, 1997–2004

Population	Wage of mayor	Wage of executive committee (%)	Size of executive committee	Size of city council	Electoral rule
Below 1,000	1,291	15	4	12	Single
1,000–3,000	1,446	20	4	12	Single
3,000–5,000	2,169	20	4	16	Single
5,000–10,000	2,789	50	4	16	Single
10,000–15,000	3,099	55	6	20	Single
15,000–30,000	3,099	55	6	20	Runoff
30,000–50,000	3,460	55	6	30	Runoff
50,000–100,000	4,132	75	6	30	Runoff
100,000–250,000	5,010	75	10	40	Runoff
250,000–500,000	5,784	75	12	46	Runoff
Above 500,000	7,798	75	14–16	50–60	Runoff

Intuition

- Wage of mayor is correlated with mayor's characteristics and policy decisions (Gagliarducci and Nannicini, 2013)

- Hence, canonical RD analysis at 5,000 cut-off is unable to credibly estimate effect of fiscal rules relaxation

- Intuition: exploit time variation in fiscal rules policy

  - "kill" variation in wage, which is fixed over time
  - take difference in regression discontinuity estimates

- More formally...

Identification

- The canonical cross-sectional RD regression

$$Y_{it} = \alpha + \beta D_i + \gamma P_i^* + \delta D_{it} P_i^* + \epsilon_{it}$$

where

- $D_i = 1[P_i^* > 0]$: assignment rule
- $P_i^* = P_i - P_c$: normalized population size
- P_i: population size
- $P_c = 5,000$

- In this case, $\hat{\beta} = \tau^{RDD} = \tau^W + \tau^R$
  $\rightarrow$ i.e., sum of the effect of mayor's wage (τ^W) **and** fiscal rules relaxation (τ^R)

Identification

- Exploit longitudinal data

$$Y_{it} = \omega + \nu D_{it} + \xi P_i^* + \eta A_t + \lambda A_t D_i + \theta D_i P_i^* + \mu A_t P_i^* + \chi A_t P_i^* D_i + \epsilon_{it}$$

where

- $A_t = 1[t \geq t_0]$
- $t_0 = 2001$

- In this case,

$$
\begin{aligned}
\hat{\lambda} = \tau^{DRD} &= \tau^{RDD,[t \geq t_0]} - \tau^{RDD,[t < t_0]} \\
&= \left(\tau^{R,[t \geq t_0]} + \tau^{W,[t \geq t_0]} \right) - \left(\tau^{R,[t < t_0]} + \tau^{W,[t < t_0]} \right) \\
&= \tau^R + \tau^W - \left(0 + \tau^W \right) \\
&= \tau^R
\end{aligned}
$$

Difference-in-discontinuities in practice

Validity of difference-in-discontinuities rests on same assumptions of RDD **and** DiD

- No change in **baseline covariates** at the cut-off, both before and after t_0

- No change in **density of running variable**, both before and after t_0

- **Parallel trends**

Application – Grembi, Nannicini, Troiano (2016)

Research question

- Study the effect of fiscal rules relaxation on municipalities' fiscal discipline

Data

- Municipalities' balance sheets and socio-demographic characteristics

Empirical strategy

- Difference-in-discontinuities

Application – Grembi, Nannicini, Troiano (2016)

Results – Fiscal gap & Deficit
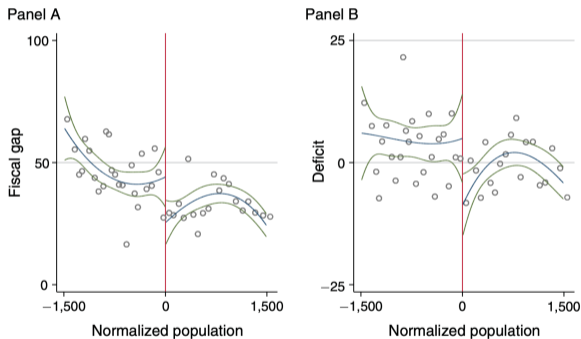
FIGURE 1. DIFFERENCE-IN-DISCONTINUITIES FOR DEFICIT AND FISCAL GAP (1)

Notes: Vertical axis: difference of each post-rule (i.e., 2001, 2002, 2003, and 2004) outcome value and each pre-rule (i.e., 1999 and 2000) outcome value. Horizontal axis: actual population size minus 5,000. The central line is a spline third-order polynomial fit; the lateral lines represent the 95 percent confidence interval. Scatter points are averaged over intervals of 50 inhabitants.

Application – Grembi, Nannicini, Troiano (2016)

Results – Revenues
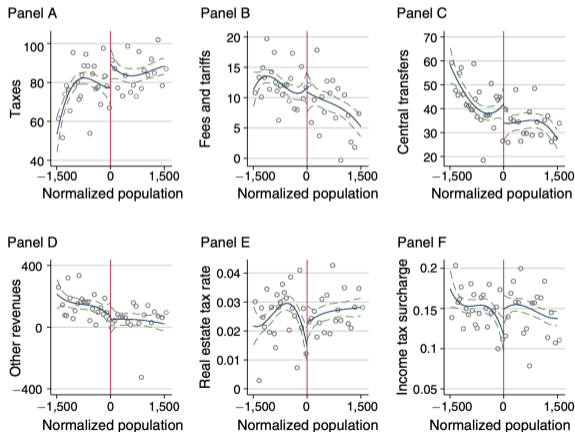
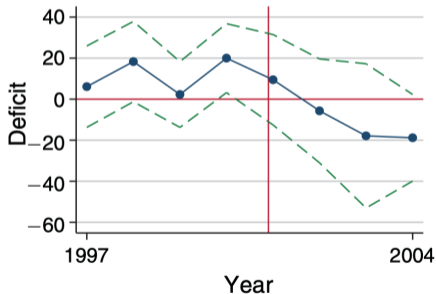FIGURE 3. DIFFERENCE-IN-DISCONTINUITIES FOR REVENUES OUTCOMES

Application – Grembi, Nannicini, Troiano (2016)
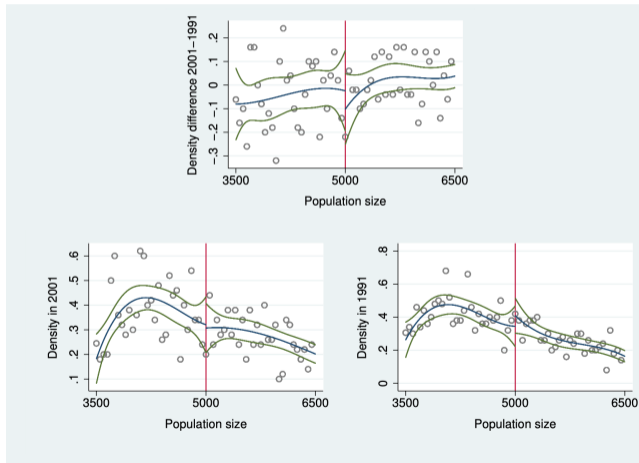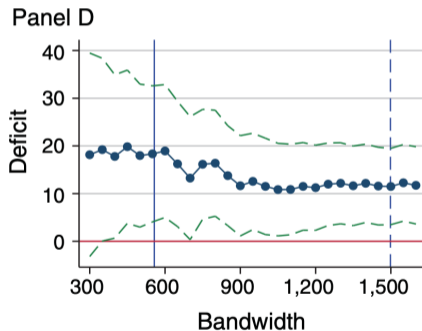
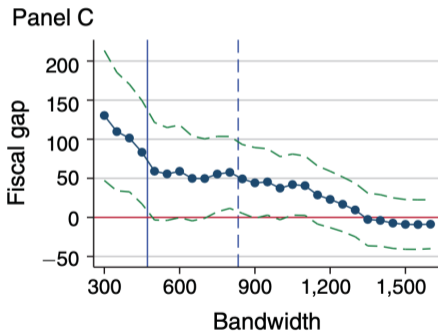**Validity checks – Parallel trends**
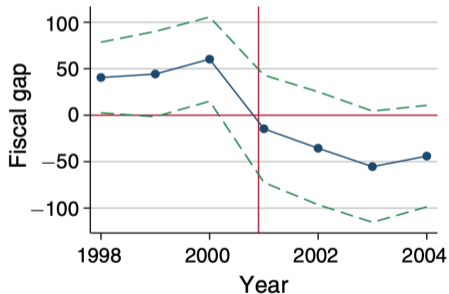
Application – Grembi, Nannicini, Troiano (2016)

Validity checks – Continuity of density of running variable

Application – Grembi, Nannicini, Troiano (2016)

Validity checks – Sensitivity to bandwidth

References and Materials

* = mandatory (only parts covered in class)

- (*) Grembi, V., Nannicini, T., and Troiano, U. (2016). Do Fiscal Rules Matter? *American Economic Journal: Applied Economics* 2016, 8(3): 1-30