Unintended Consequences of Health Care Reform in South Korea: Evidence from a Regression Discontinuity in Time Design

Moon Joon Kim[1]

[1]Duke Kunshan University

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Outpatient healthcare utilization

OECD Health Statistics 2007

Year	Rank	Country	# per capita
2005	1	Japan	13.7
	2	Czech Republic	13.2
	3	Hungary	11.8
		South Korea	11.8
	5	Slovak Republic	11.3

Outpatient healthcare utilization

OECD Health Statistics 2017

Year	Rank	Country	# per capita
2015	1	South Korea	16.6
	2	Japan	12.8
	3	Slovak Republic	11.4
	4	Hungary	11.1
	5	Russia	10

Motivation and contribution

- South Korea has become the country with the **highest** per capita utilization of outpatient health services worldwide since 2012.
- Why is it important?
  - Demand side
  - Supply side

Motivation and contribution

- There may be many different reasons for that.
- This is the **first** paper arguing that the abolition of copayment program in 2007 is the one of those main reasons.

Background 1: Korean healthcare system

- National Health Insurance Service (NHIS)
- Single compulsory health insurance
- Available to everyone living in South Korea
  - National health insurance (97.1% as of 2018)
  - Medical aid (2.9% as of 2018)
- Advantages
  - Low healthcare cost
  - Easy accessibility

$\rightarrow$ "Perhaps the biggest challenge facing Korea's health-care system is the rapid increase in spending" (Randall Jones, 2010)

Background 2: Copayment program in Korea

What is the copayment in South Korea?

Example)

Medical bill $\leq$ US\$15 $\rightarrow$ You pay US\$3

Medical bill $>$ US\$15 $\rightarrow$ You pay coinsurance (20-30% of medical bill)

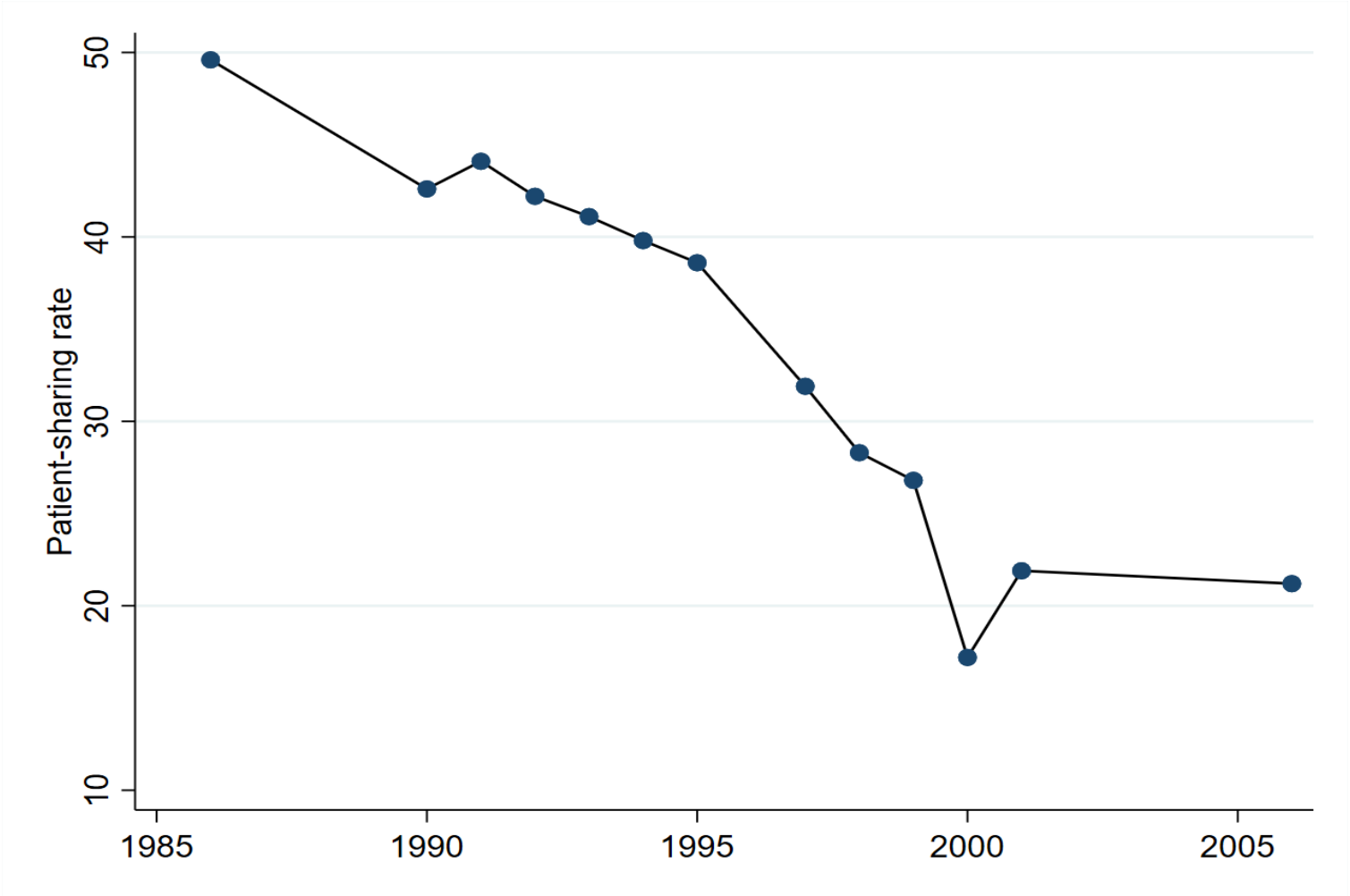
Background 2: Copayment program in Korea

- First introduced in Jan, 1986
- Objective: Increase an economic burden of insured
- Only applied to outpatient (20% co-insurance for inpatient)

Year	Copay limit	Copay (KRW)	Patient-sharing
1986	10,000	2,000 (First exam)	49.6%
		1,500 (After first)	
2001	15,000	3,000	21.9%
		1,500 (age 65+)	

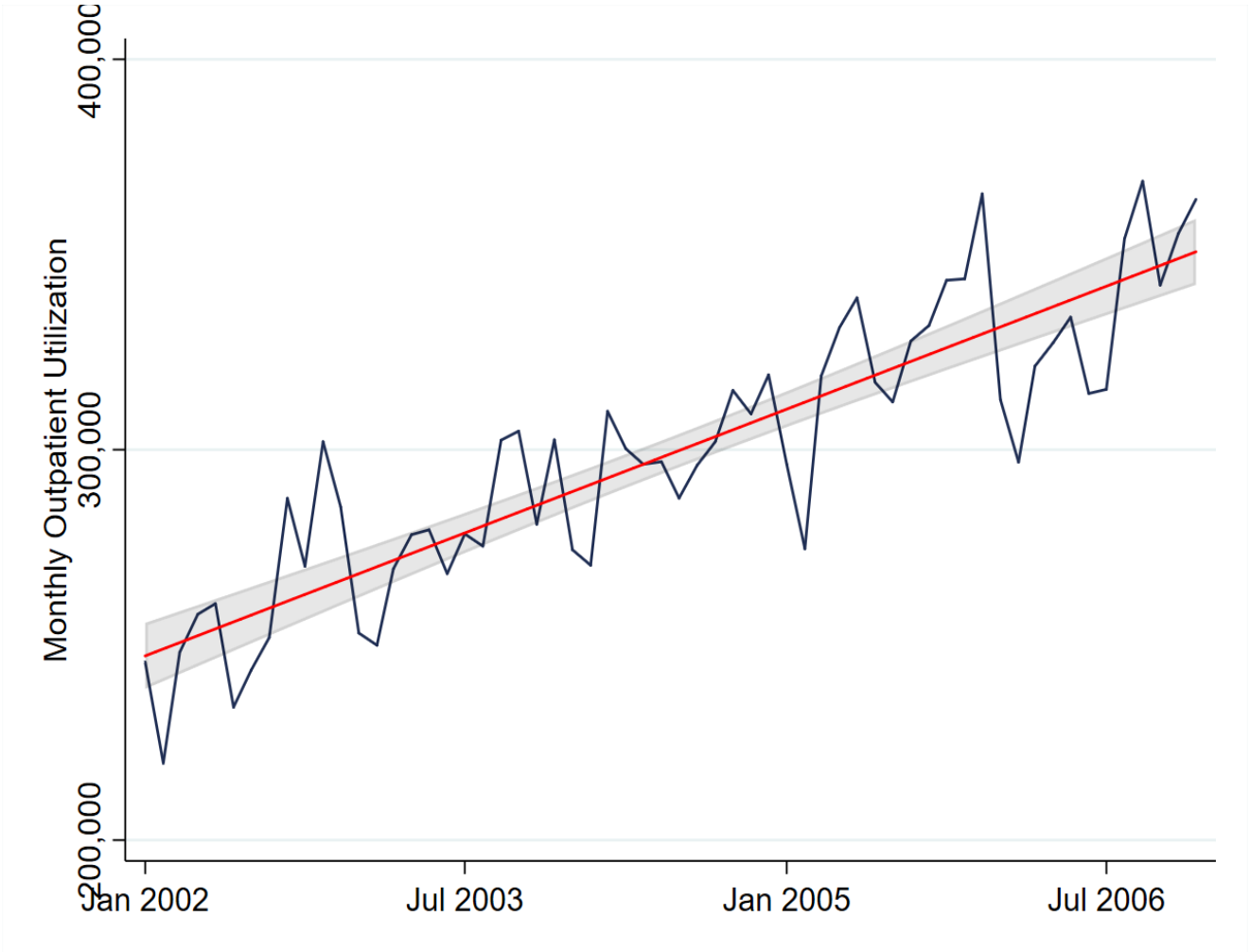
- However, NHIC fixed the copayment since 2001

Background 2: Copayment program in Korea



Patient-sharing rate (Kim, 2007)

Background 2: Copayment program in Korea



Monthly outpatient utilization (2002-2006)

Background 3: Medical amendment in 2007

Abolition of copayment program

- Converted into coinsurance (30–40 %), except patients aged 65 or above

New healthcare policy

- Medical amendment passed: Jun 7, 2007
- Effective: Aug 1, 2007

Research question

Q. How did the abolition of copayment program impact outpatient healthcare utilization?

Data: Data sources

Korean National Health Insurance Service

- Random sample of 1 million beneficiaries of NHI (not including medical aid)
- Covered period: Jan 1, 2002 - Dec 31, 2015
- Data type: Repeated cross-sectional
- Data cleaning
  - Only for outpatient healthcare services
  - Panel with 120 million observations

Data: Summary statistics

Summary statistics

Variable	Obs	Mean	SD	Min	Max
Monthly hospitalization	2,688	39,193	43,926	2,796	228,693
Age	2,688	42.86	3.75	31.64	55.49
Sex	2,688	0.58	0.01	0.53	0.61
Cost per visit	2,688	19,839	3,260	14,821	29,815
		($18)	($2.96)	($13.47)	($27.11)
- Patient-sharing	2,688	6,011	888	4,176	8,993
		($5.47)	($0.81)	($3.80)	($8.18)
- NHI-sharing	2,688	13,804	2,454	10,108	21,267
		($12.55)	($2.23)	($9.18)	($19.33)

Empirical strategy: Non-parametric sharp RD

Following Calonico et al. (2014, 2017)

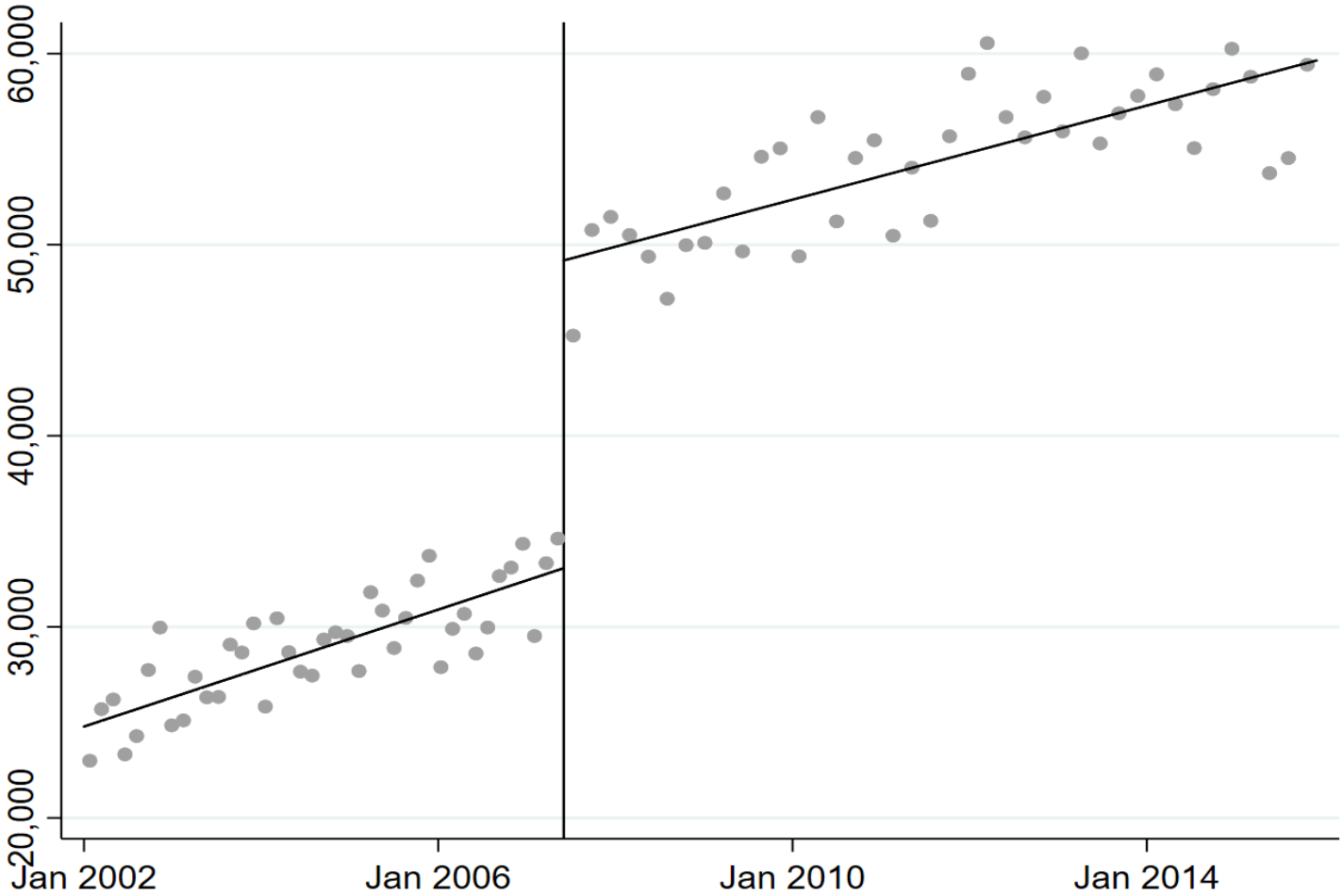
$$\hat{\beta}_{RD} = \hat{\mu}_+ - \hat{\mu}_- \tag{1}$$

where $\hat{\mu}_+, \hat{\mu}_-$ are defined through

$$\hat{\phi}_y = \underset{\hat{\mu}_+, \hat{\mu}_-, \hat{\lambda}}{\text{argmin}} \sum \{y_{it} - 1(t \geq \bar{t}) \cdot \eta(T)\mu_+ - 1(t < \bar{t}) \cdot \eta(T)\mu_- - Z_{it}\lambda\}^2 \cdot K_h T \tag{2}$$

where
$\hat{\phi}_Y = [\hat{\mu}_+, \hat{\mu}_-, \hat{\lambda}]$
$\eta(\cdot)$: $(1, x, ..., x^p); p = 1$ (Gelman and Imbens, 2017)
K_h: triangular kernel function
h: data-driven MSE-optimal bandwith

Regression discontinuity plot



Why?

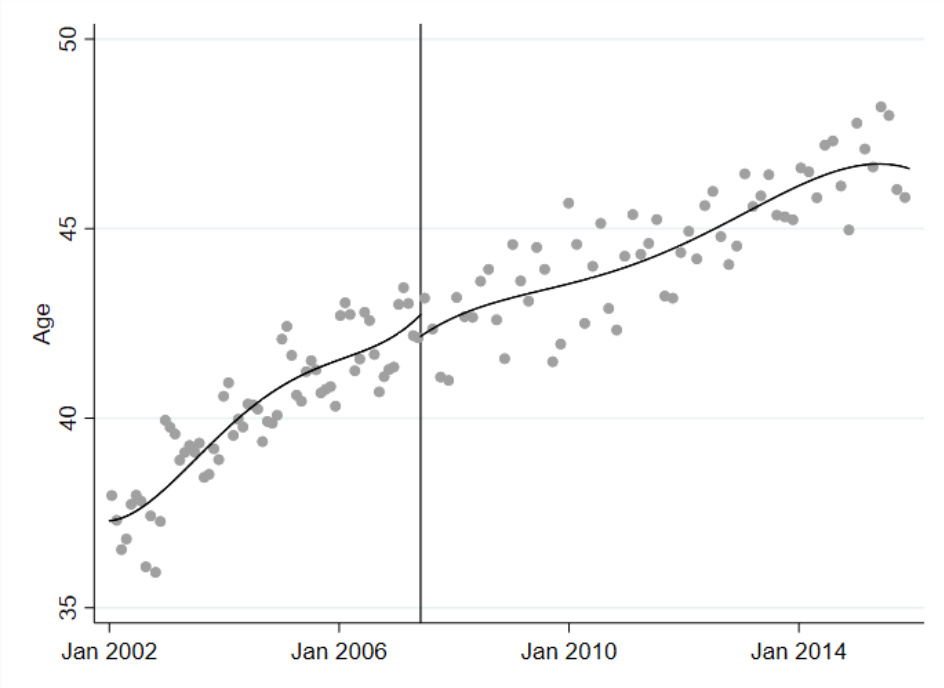
Q. Why did people use more healthcare services despite the patient-sharing increased?

1. Grace period (June 2007 – July 2007)

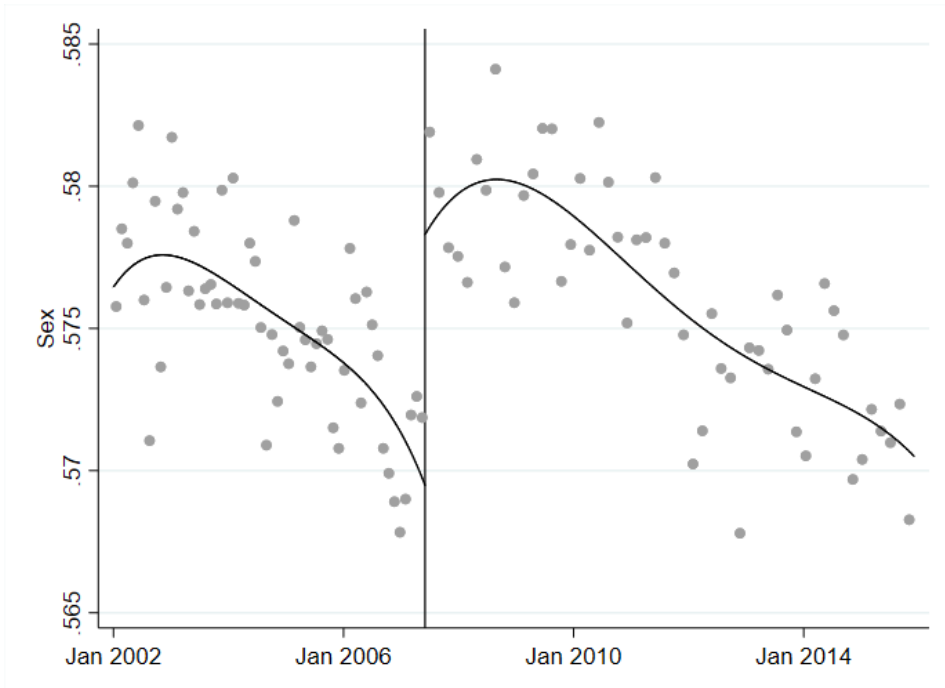
2. Supplementary private health insurance
   - monthly premium: US$7 (as of male aged 40 in 2007)
   - covers up to US$47,000 for inpatient and US$235 for outpatient

Fuzzy RD design

- Assignment to treatment and outcome do not have sharp binary relationship. (Not everyone had supplementary private insurance)
- Rather, it depends on the gender ratio.



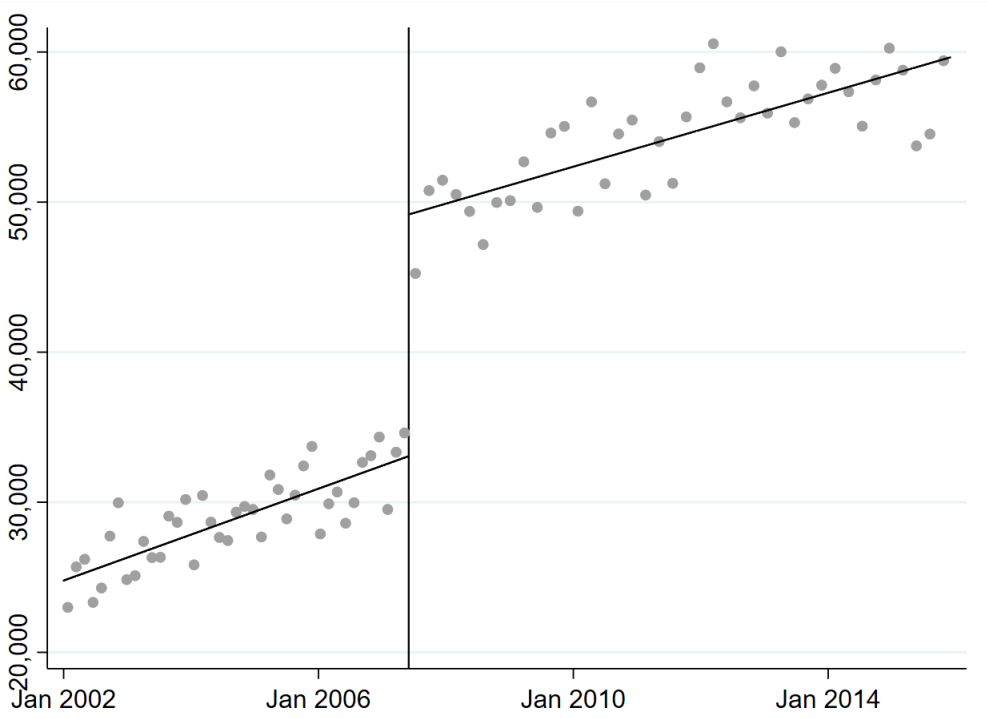
Age



Sex ratio

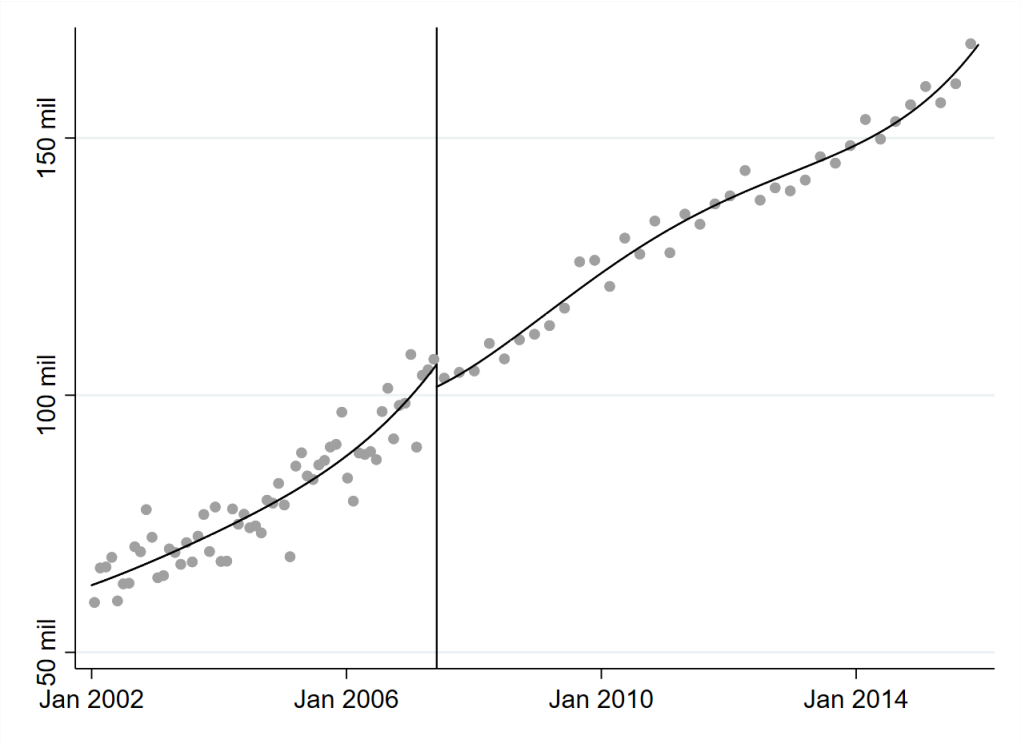
RDiT regression results

	Monthly hospitalization
Abolition	0.633
	(0.479)
	[88.30%]
RDD	Fuzzy
Covariate	Yes
Polynomial	1
Kernel	Triangular
Bandwidth	2 MSE-optimal
Observations	2,688



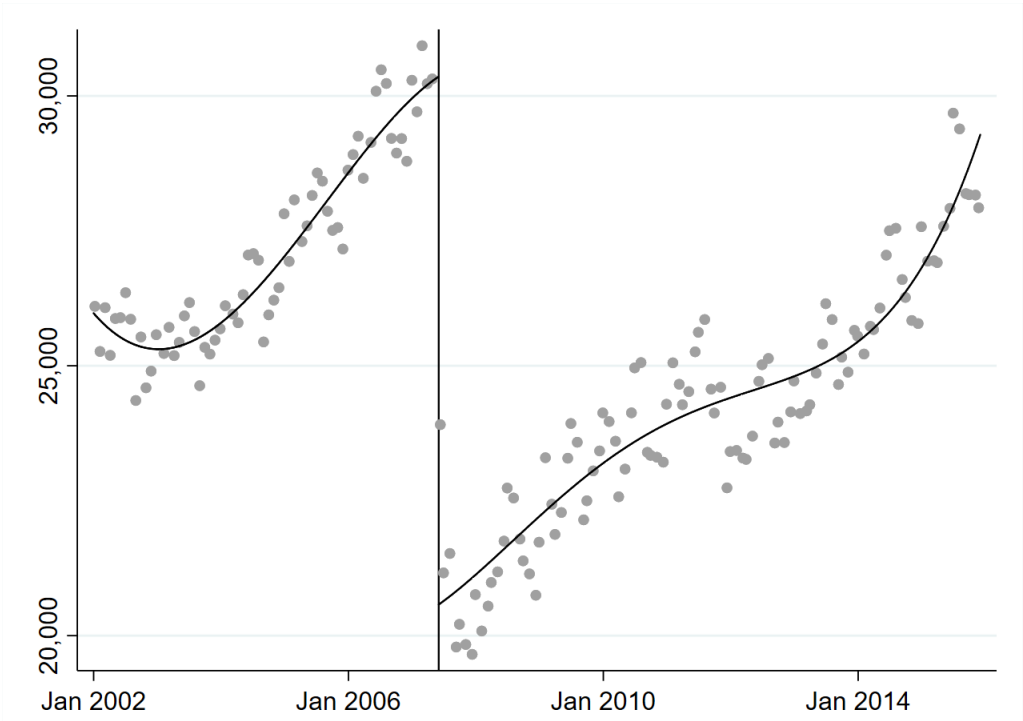
RDiT regression results

	Total healthcare spending
Abolition	-0.084
	(0.537)
	[-8.03%]
RDD	Fuzzy
Covariate	Yes
Polynomial	1
Kernel	Triangular
Bandwidth	2 MSE-optimal
Observations	2,688



RDiT regression results

	Per visit healthcare cost
Abolition	-0.272***
	(0.018)
	[-23.84 %]
RDD	Sharp
Covariate	Yes
Polynomial	1
Kernel	Triangular
Bandwidth	2 MSE-optimal
Observations	2,688

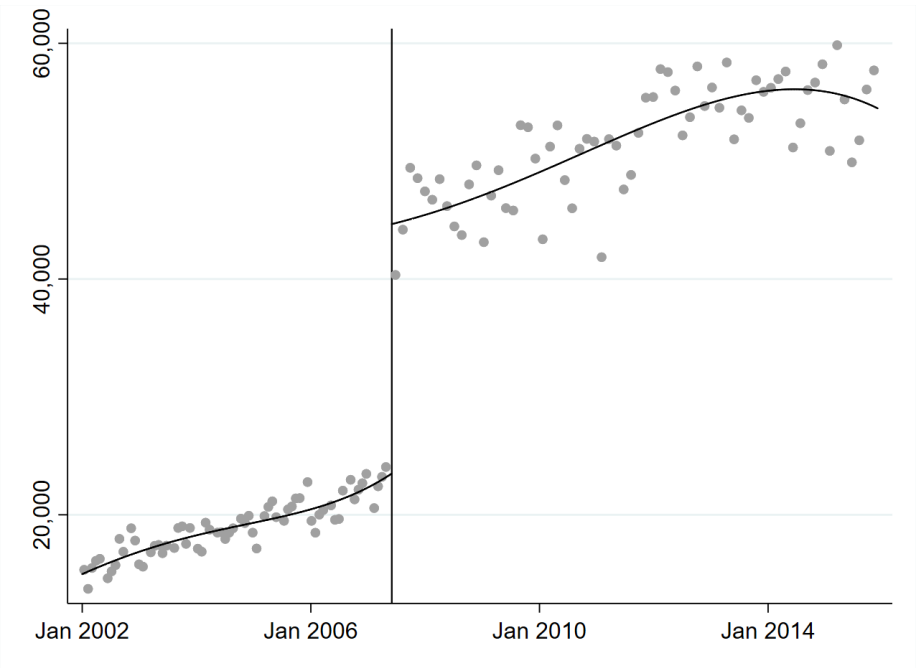


RDiT regression results

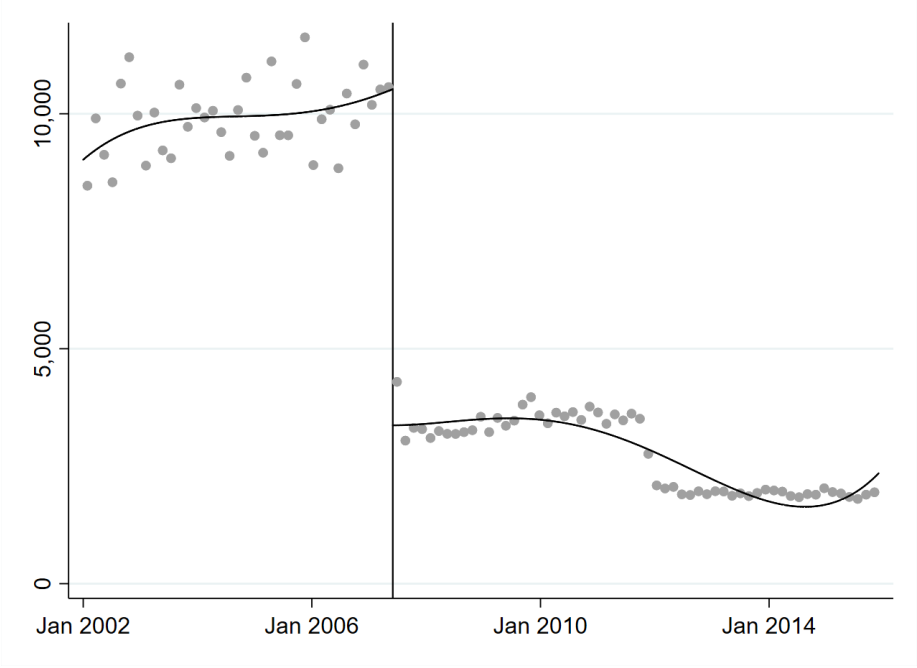
- Total hospitalization : Increase (not significant)
- Total healthcare spending: No change (not significant)
- Healthcare spending per visit: Decrease (significant)

What do these mean?

One-time visit vs. Multiple visits



One-time visit



Multiple visits

RD regression results

	1	2	3
	Total	One-time	Multiple visits
Abolition	0.633	0.744**	-0.816***
	(0.479)	(0.309)	(0.253)
	[88.30%]	[110.47%]	[-55.77%]
RDD	Fuzzy	Fuzzy	Fuzzy
Covariate	Yes	Yes	Yes
Polynomial	1	1	1
Kernel	Triangular	Triangular	Triangular
Bandwidth	2 MSE-optimal	2 MSE-optimal	2 MSE-optimal
Observations	2,688	2,688	2,688

Validity Tests of Regression Discontinuity in Time

- Conventional RD study requires validity tests (e.g., McCrary, 2008) to examine potential biases (ex. data sorting or anticipating effect)
- These tests are NOT applicable to RDiT
- Follows Hausman and Rapson (2018)'s checklist

Validity Tests of Regression Discontinuity in Time

Following Hausman and Rapson (2018),

- Unobservables correlated with time
  - Covariate and time fixed effects
  - Clustered robust standard error
- Time-varying treatment effects
- Autoregressive properties
  - Temporally aggregation
  - Clustered robust standard error
- Selection and strategic behavior
  - No events found that might impact health care utilization

Results summary

Healthcare utilization became more accessible:

- Marginal cost for health care service dropped to almost zero.

$\Longrightarrow$ Policy interaction and Moral hazard

- Waste their monthly premiums if not use
- Should see a doctor more than twice, at least

$\Longrightarrow$ Adverse selection

Policy implications

- If well adjusted, copayment works effectively to control the health care uses for low-value services.
- Supplementary private health insurance should be limited to serious diseases.
- Simple application of economic theory easily fails and causes unexpected results.

Future plan

- More research on "Supply" side
- Sensitivity analyses
  - Differentiated impacts on hospitalization for various diseases
  - Different age groups or gender inequality
  - Include more covariates (weather, air pollution, etc)