

# Increasing Public Spending in Health Improves Health: Lessons from Constitutional Reform in Brazil

Michel Szklo    Damian Clarke    Rudi Rocha

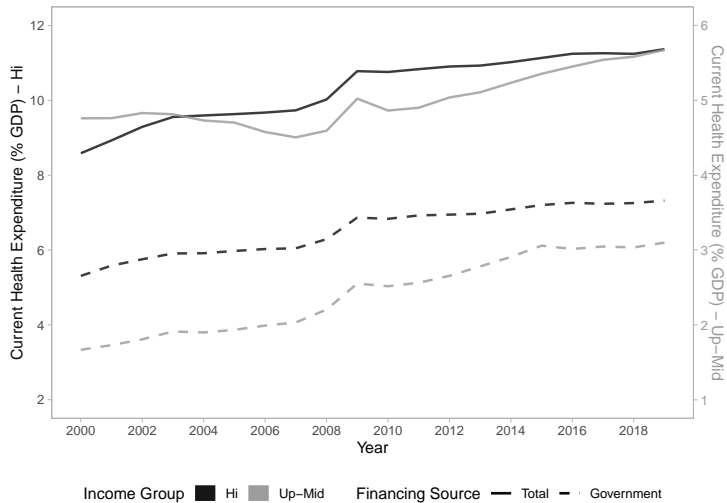
FGV EAESP    U. de Chile    FGV EAESP

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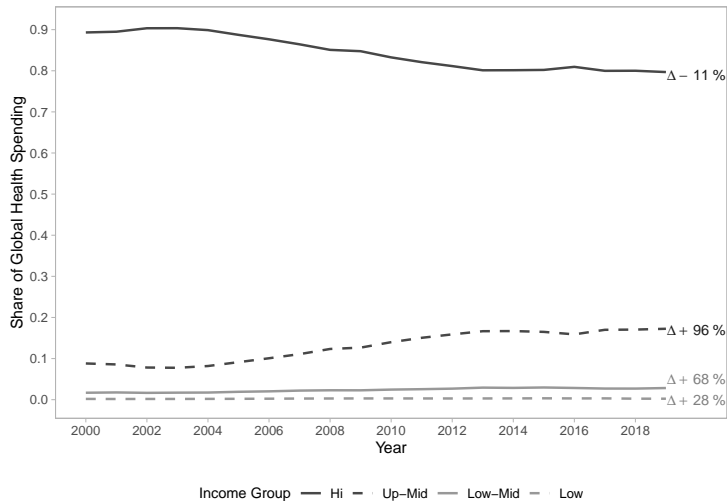
## Motivation

- Global spending on health more than doubled in real terms since the turn of the century, reaching US\$ 8.5 trillion in 2019, or 9.8% of global GDP, and is estimated to reach over US\$24 trillion by 2040 ([World Health Organization, 2021](#); [Dieleman et al., 2017](#)).
  - ▶ Global concerns about health spending trends with aging and medical costs.
  - ▶ Most of this growth has been funded by public sources, especially in high-income countries.

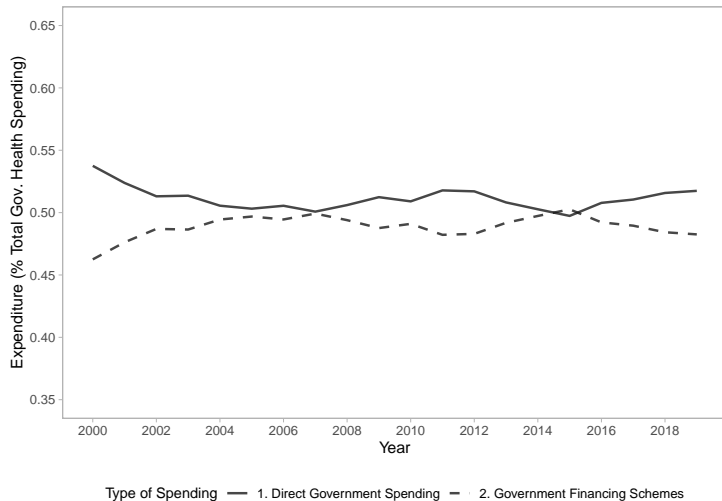
## Motivation



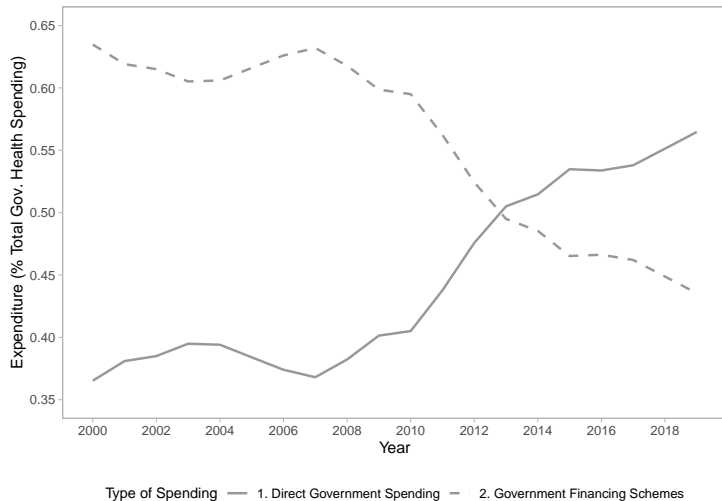
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  - ▶ Global concerns about health spending trends with aging and medical costs.
  - ▶ Most of this growth has been funded by public sources, especially in high-income countries.
- Yet, despite well-documented correlations, surprisingly scarce evidence on how effective public health expenditure is in improving health outcomes.
  - ▶ There is micro evidence on cost-effectiveness related to specific treatments and returns to specific medical resources (e.g. [Cutler, 2007](#); [Doyle et al., 2015](#)).
  - ▶ But very scant on public spending, although a majority of health spending is financed by taxes and administered by governments. None on mechanisms.

## Motivation

- A common thread in the literature is that health spending **may** be sufficient to impact health outcomes at certain margins but this is certainly not a foretold conclusion.
  - ▶ In principle, chain of causation depends on many interlinked steps: from inputs to outcomes.
  - ▶ And involves state capacity in designing/implementation/management, inputs complementarities, diversion due to corruption etc.
- **This paper** assesses whether and how a public spending reform which increased health spending in Brazilian municipalities translates into micro-level improvements in health.
  - ▶ EC29/2000 as source of exogenous variation.
  - ▶ We examine several questions along the chain connecting public health spending to health outcomes in Brazil, across municipalities and over time.



- **This paper**, more specifically:
  - ▶ Explore variation in spending along the baseline distribution of spending.
  - ▶ Rely on the richness of data from information systems on spending (Finbra/SIOPS) and health (Datusus) to deliver a comprehensive analysis.
  - ▶ This includes: allocation of resources, hiring/investment in HR and infrastructure, medical production, health outcomes, distributional effects and impacts on the private sector.
- Related streams of literature, in brief:
  - ▶ Public spending and development impacts: FPM, oil revenues etc.
  - ▶ CEA of specific procedures, hospital resources etc.
  - ▶ Variation in public spending and health outcomes: mostly correlational, scant causal evidence, no mechanisms (e.g. Crémieux et al. 1999, Bhalotra 2007, Castro 2019).

# Outline

Background and Data

Empirical Strategy

Results

Final Remarks

## Background

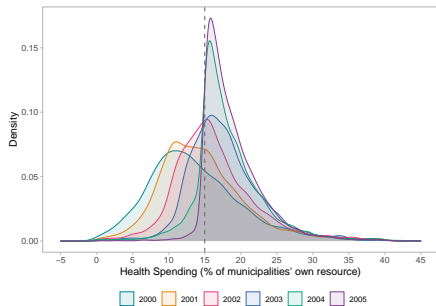
- A little bit of SUS and the role of municipalities: autonomous entities.
- In the 1990s, most of the spending was centralized at the Federal Government, period marked by budget disputes and crisis in the financing of health care.
- Attempts to solve financing issues:
  - ▶ CPMF (1996): financial operations tax. EC/22 defined that revenues from this instrument should be used to finance the provision of public health.
  - ▶ PEC/169 (1992): secure 30% of the federal Social Security budget and 10% of state and municipalities tax income to the provision of public health.
  - ▶ PEC/82 (1995): secure all tax income from profits and revenues, originally financing Social Security, to the provision of public health.
- Both PECs were merged into new PEC that in 2000 was approved as the 29th Constitutional Amendment.

## Background: the EC29/2000

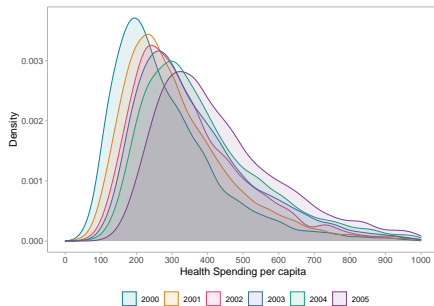
- EC/29 determined the minimum amount of resources that the federal, state and local governments need to spend on public health services.
  - ▶ Federal Government: 2000 – 5% of 1999 spending; 2001-2004 corrected by GDP.
  - ▶ States: 12% of tax income net of transfers.
  - ▶ Municipalities: 15% of tax income.
- EC/29 induced an increase in resources for health and in the participation of states and municipalities in the financing of health care.
- States and municipalities own resources were responsible for about two thirds of the increase in health spending between 2000 and 2011 (Piola, 2013).

## Background: descriptive statistics

(a) Health Spending (% of own resource spending)

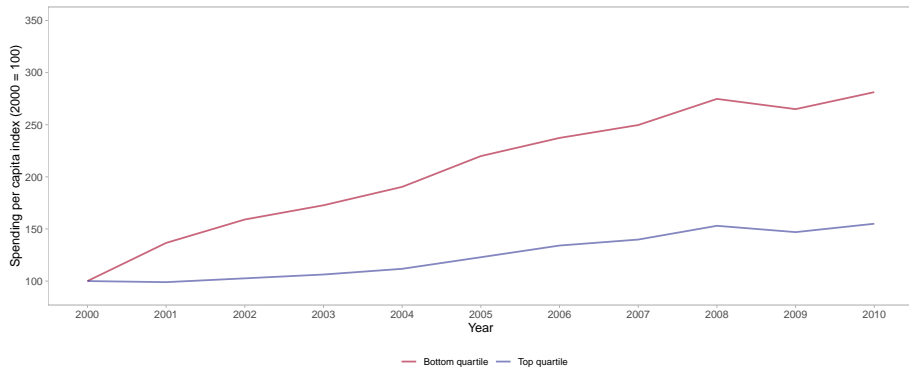


(b) Health Spending per capita (2010 R\$)



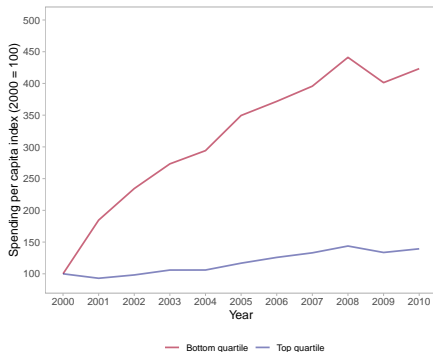
## Background: descriptive statistics

(a) Total Health Spending (2000 = 100)

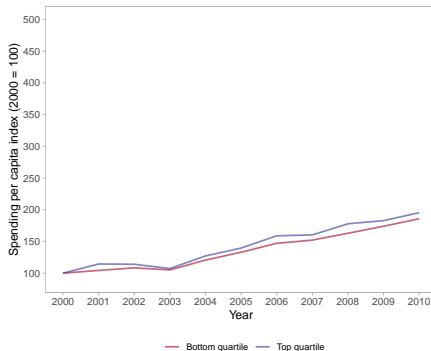


## Background: descriptive statistics

(b) Health Spending from Own Resources (2000 = 100)

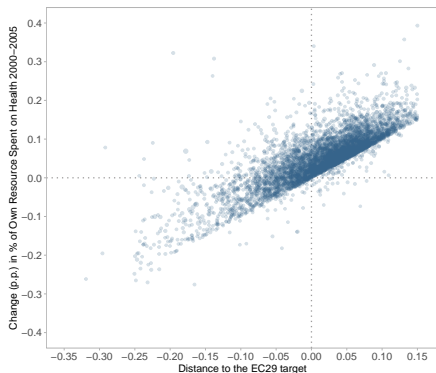


(c) Health Spending from Transfers (2000 = 100)



## Background: descriptive statistics

(a) Scatter Plot: Shifts in % of Own Resource Spent on Health



(b) Binscatter Plot: Shifts in % of Own Resource Spent on Health

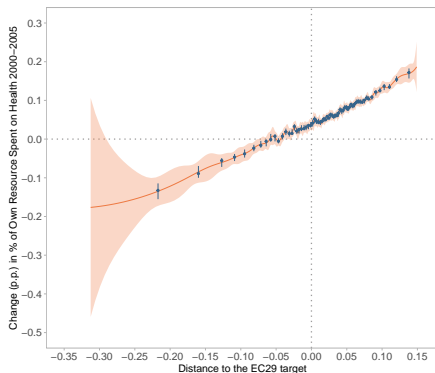
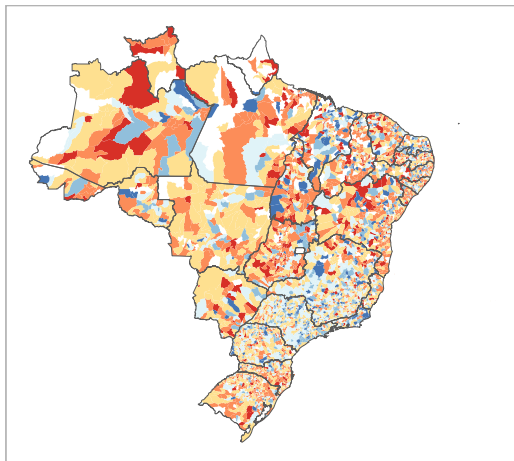




Figure: EC/29 Compliance Geographic Variation



## Data

- Spending:
  - ▶ FINBRA: 1998 - 2010
  - ▶ SIOPS: 2000 - 2010
- Health Inputs, Access, System:
  - ▶ Datasus/SIA and SIAB: 1998 - 2010
  - ▶ Datasus/SINASC: 1998 - 2010
  - ▶ MS/DAB: 1998 - 2010
  - ▶ IBGE/AMS: 1999, 2002, 2005, 2009; ANS: 2000 - 2010
- Health Outcomes:
  - ▶ Datasus/SIH and SIM: 1998 - 2010

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## Empirical Strategy

We estimate a difference-in-difference (DiD) model with a continuous intention-to-treat variable of interest, exploiting within-municipality variation:

$$Y_{mts} = \beta Dist_{m,pre} \times Post_t + \delta_{st} + \delta_j + \theta Z_{m,pre} \times \delta_t + X'_{mts} \gamma + \varepsilon_{mts} \quad (1)$$

Where  $Y_{mts}$  is an outcome in municipality  $m$ , state  $s$ , year  $t$ ;  $Dist_{m,pre}$  is the baseline percentage points distance to EC/29 target in municipality  $m$ ;  $Post_t$  is a dummy that equals one if the year is 2001 or later;  $\delta_{st}$  and  $\delta_j$  are fixed effects;  $Z_{m,pre} \times \delta_t$  is an interaction between socioeconomic baseline controls and time, and  $X_{mts}$  are controls.

Additionally, we estimate a variation of equation 1, which allows for more flexible coefficient estimates:

$$Y_{mts} = \sum_{i=1}^I \beta_{pre,i} Dist_{m,pre} \times EC29_{t+i} + \dots + \varepsilon_{mts} \quad (2)$$

## Validity of the Research Design

- Potential drawbacks in the TWFE regressions frequently used in empirical research based on DiD style designs.
- Callaway et al. (2021) highlight that DiD models with continuous treatment require stronger parallel trends assumptions.
- We argue that our setting is quasi-random and that is unlikely that municipalities chose their distance to the spending target based on expected increases in health spending per capita.
- Moreover, there is a strong relationship between baseline distance to the target and changes in health spending per capita; no pre-trends in observables.

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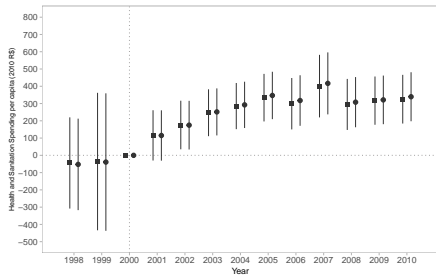
Results

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# Results: Fiscal Response

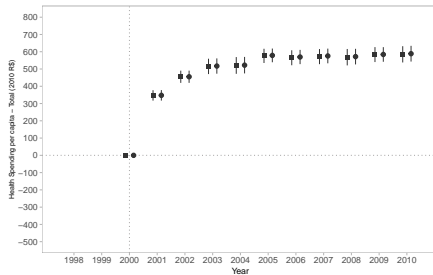
## Effects on Public Health Spending per capita

### Health and Sanitation (Finbra)



Specification ■ Baseline ♦ + Baseline and Time Varying Controls

### Total Health Spending (SIOPS)

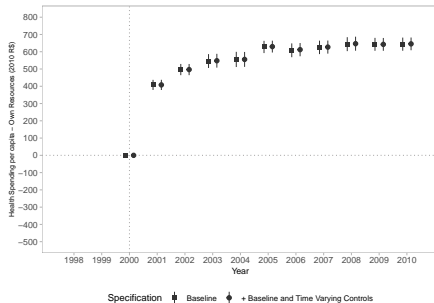


Specification ■ Baseline ♦ + Baseline and Time Varying Controls

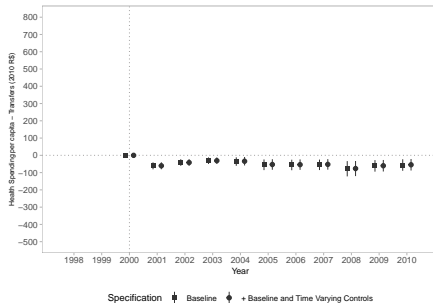
# Results: Fiscal Response

## Effects on Public Health Spending per capita - By Source

### Health Spending - Own Resources (SIOPS)



### Health Spending - Transfers (SIOPS)

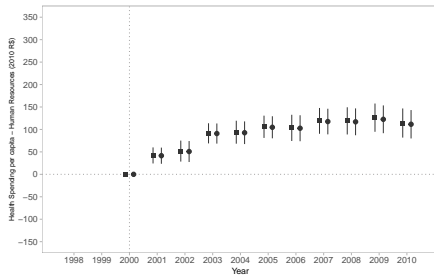




# Results: Fiscal Response

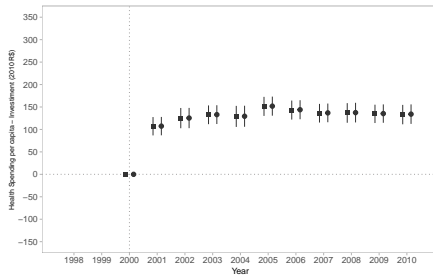
## Effects on Public Health Spending per capita - By Type

### Human Resources



Specification ■ Baseline ◆ + Baseline and Time Varying Controls

### Investment

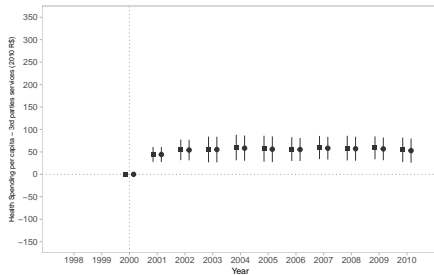


Specification ■ Baseline ◆ + Baseline and Time Varying Controls

## Results: Fiscal Response

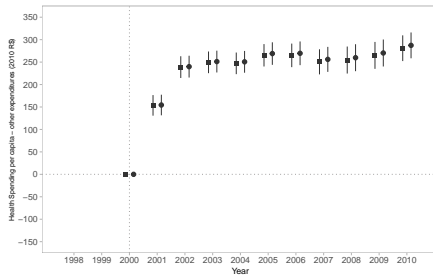
### Effects on Public Health Spending per capita - By Type

#### 3rd parties services



Specification  Baseline  + Baseline and Time Varying Controls

#### Other Expenditures



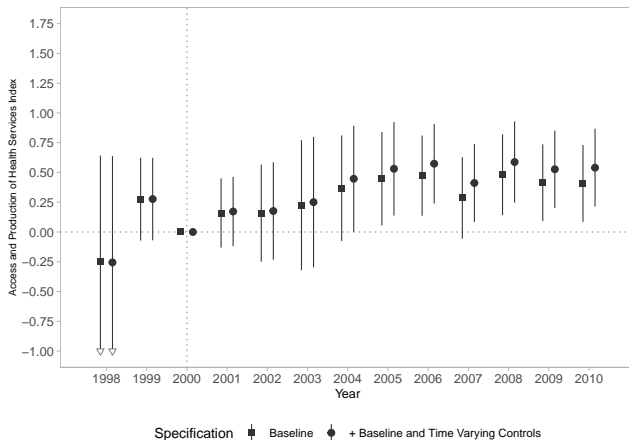
Specification  Baseline  + Baseline and Time Varying Controls

## Downstream Effects of Health Spending

	(1)	(2)	(3)	(4)
<b>Access and Production of Health Services</b>	0.329*	0.398**	0.410**	0.408**
	(0.169)	(0.175)	(0.175)	(0.175)
Primary Care Access and Production	0.320**	0.404**	0.418**	0.417**
	(0.159)	(0.163)	(0.163)	(0.163)
Non-Primary Care Access and Production	0.079	0.066	0.071	0.069
	(0.149)	(0.15)	(0.15)	(0.149)
<b>Health Inputs</b>	0.678***	0.694***	0.698***	0.697***
	(0.172)	(0.171)	(0.171)	(0.171)
Human Resources	1.239***	1.202***	1.214***	1.209***
	(0.245)	(0.243)	(0.243)	(0.243)
Hospitals	0.581***	0.601***	0.604***	0.604***
	(0.172)	(0.171)	(0.171)	(0.171)
<b>Birth Outcomes</b>	0.004	0.082	0.082	0.082
	(0.083)	(0.077)	(0.077)	(0.077)
Infant Mortality	0.066	0.072*	0.074*	0.075*
	(0.05)	(0.044)	(0.043)	(0.043)
Others	0.017	0.106	0.102	0.101
	(0.177)	(0.17)	(0.17)	(0.17)
Municipality & State× Year FEs	Y	Y	Y	Y
Socioeconomic controls		Y	Y	Y
GDP p.c. & <i>Bolsa Familia</i>			Y	Y
Fiscal controls				Y

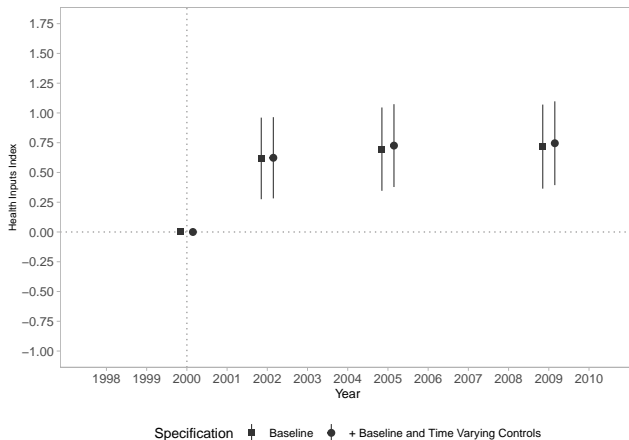
# Downstream Effects of Health Spending

Figure: Access and Production of Health Service



# Downstream Effects of Health Spending

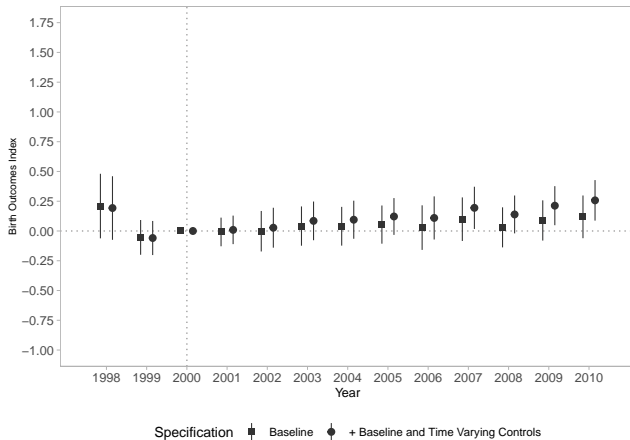
Figure: Health Inputs



(+)

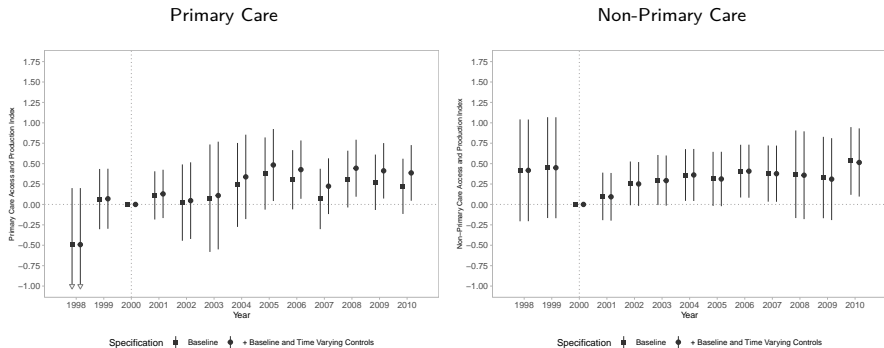
# Downstream Effects of Health Spending

Figure: Birth outcomes



# Downstream Effects of Health Spending

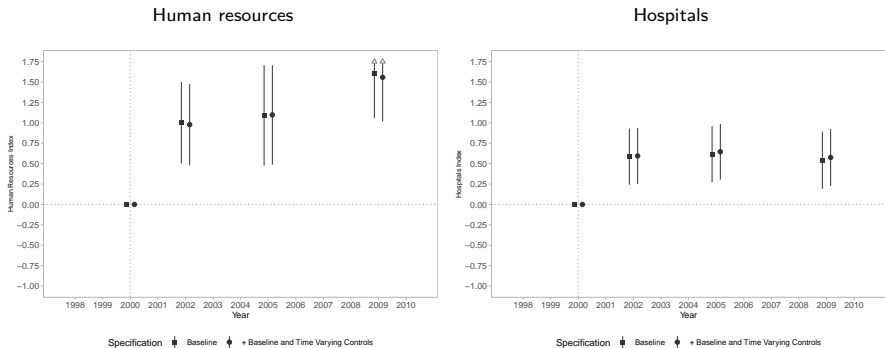
Figure: Access and Production of Health Service



(+)

# Downstream Effects of Health Spending

Figure: Health Inputs



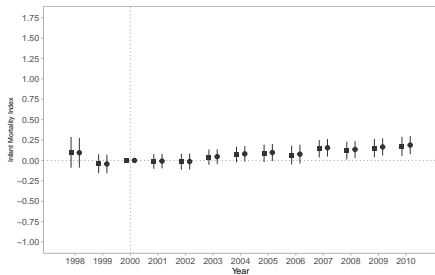
(+)



# Downstream Effects of Health Spending

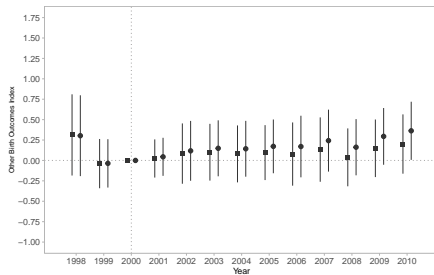
Figure: Birth Outcomes

Infant mortality



Specification ■ Baseline ♦ + Baseline and Time Varying Controls

Other birth outcomes



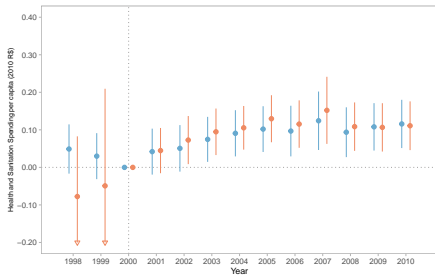
Specification ■ Baseline ♦ + Baseline and Time Varying Controls

(+)

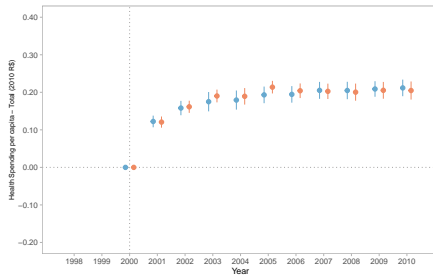
# Distributional Effects

## Effects on Public Health Spending per capita

### Health and Sanitation (Finbra)



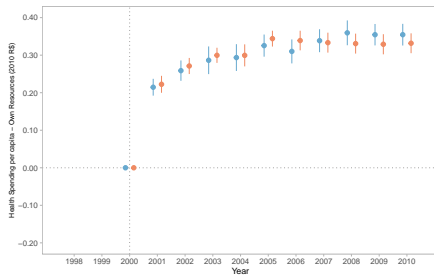
### Total Health Spending (SIOPS)



# Distributional Effects

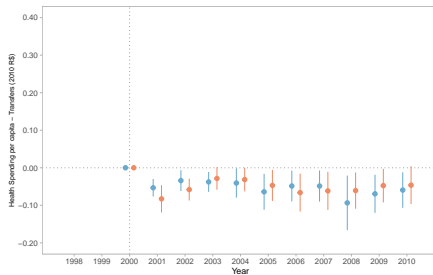
## Effects on Public Health Spending per capita - By Source

### Health Spending - Own Resources (SIOPS)



Sample 1. Below Target 2. Above Target

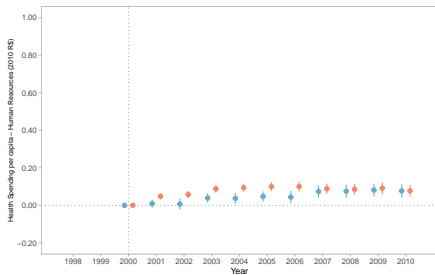
### Health Spending - Transfers (SIOPS)



Sample 1. Below Target 2. Above Target

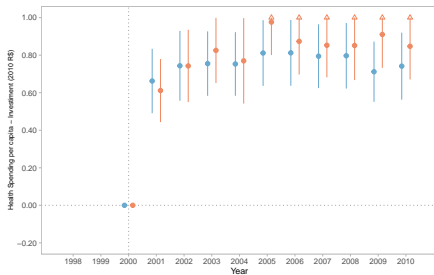
## Effects on Public Health Spending per capita - By Type

### Human Resources



Sample 1. Below Target 2. Above Target

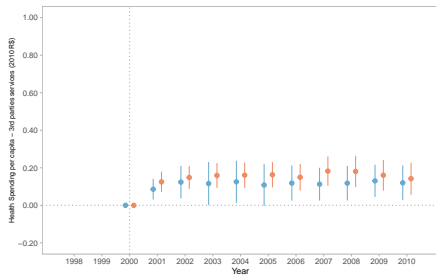
### Investment



Sample 1. Below Target 2. Above Target

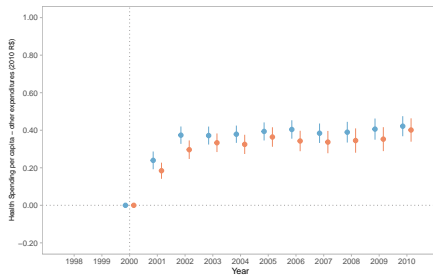
## Effects on Public Health Spending per capita - By Type

### 3rd parties services



Sample 1. Below Target 2. Above Target

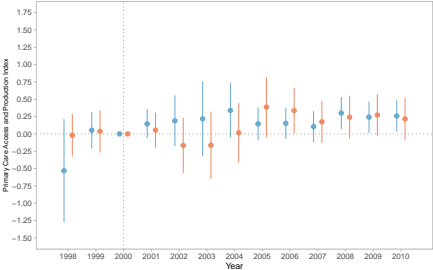
### Other Expenditures



Sample 1. Below Target 2. Above Target

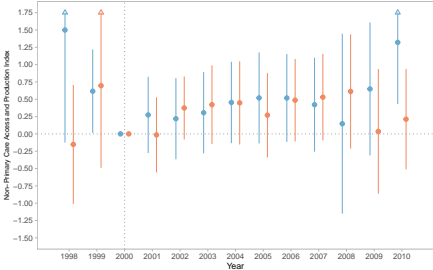
Figure: Access and Production of Health Service

Primary Care



Sample 1. Below Target 2. Above Target

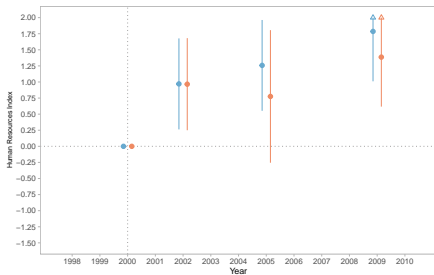
Non-Primary Care



Sample 1. Below Target 2. Above Target

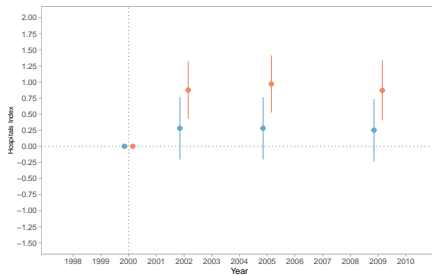
Figure: Health Inputs

## Human resources



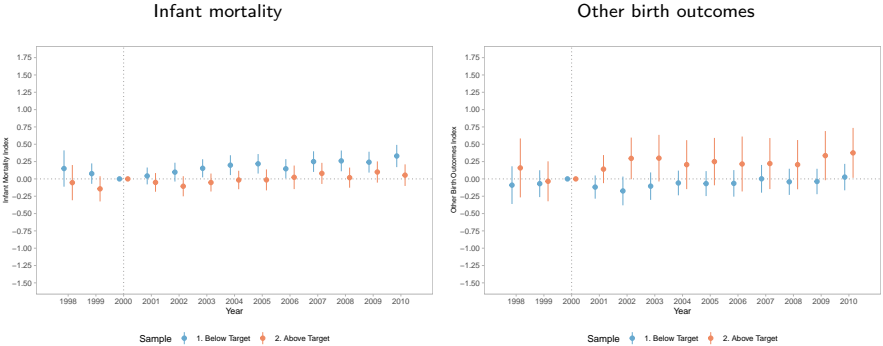
Sample 1. Below Target 2. Above Target

## Hospitals



Sample 1. Below Target 2. Above Target

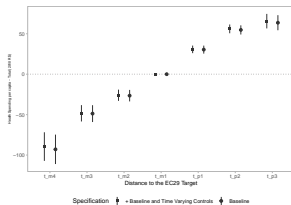
Figure: Birth Outcomes



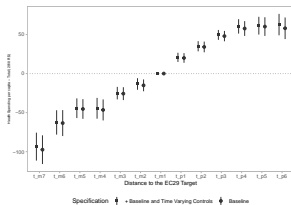


## Effects on Health Spending

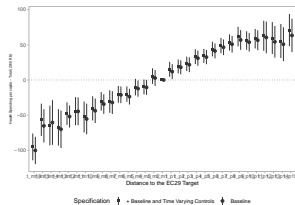
Bin size: 5% Agents



Bin size: 2.5%



Bin size: 1%



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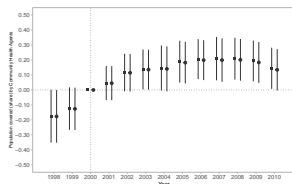
- When Brazilian municipalities were induced to increase health spending, they did so by increasing spending on admin, followed by human resources and investments.
- Spending translated into greater number of administrative professionals, supply of municipal hospitals, and primary care coverage.
- Shifts in spending and inputs were associated with:
  - ▶ Small to moderate reductions in infant mortality rates, potentially related to improvements in primary care access and hospital care.
  - ▶ Effects on health systems: private and coordination?
- Implied elasticity (infant mortality rate): total -0.06, amenable to primary care -0.14; but lower than what was found in previous studies (-0.3 to -1.1).

# Thank You !

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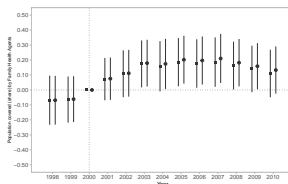
## Effects on Primary Care Coverage

Population Covered by Community Health Agents



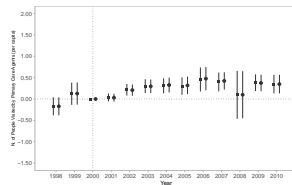
Specification  $\downarrow$  Baseline  $\downarrow$  + Baseline and Time Varying Controls

Population Covered by Family Health Agents



Specification  $\downarrow$  Baseline  $\downarrow$  + Baseline and Time Varying Controls

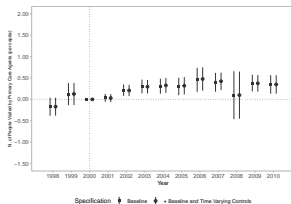
N. of People Visited



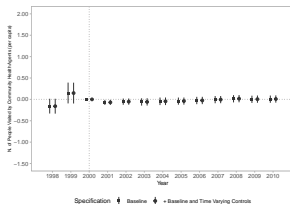
Specification  $\downarrow$  Baseline  $\downarrow$  + Baseline and Time Varying Controls

## Effects on Primary Care Coverage

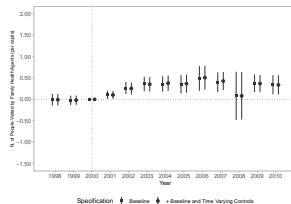
(a) N. of People Visited



(b) People Visited by CH Agents

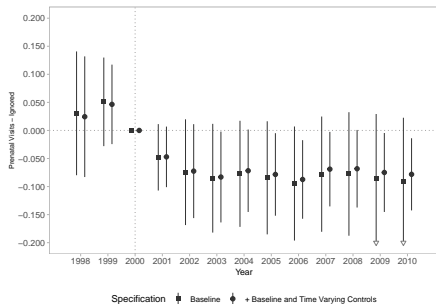


(c) People Visited by FH Agents

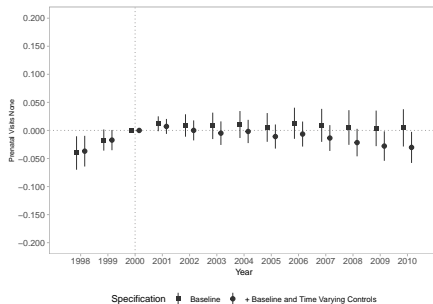


## Prenatal Visits

### Ignored

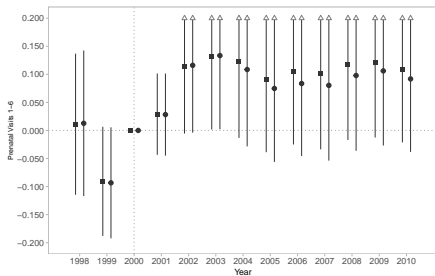


### None



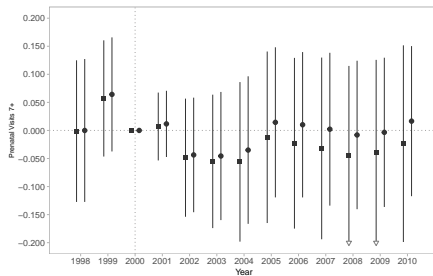
## Prenatal Visits

1 - 6



Specification ■ Baseline ● + Baseline and Time Varying Controls

7 +

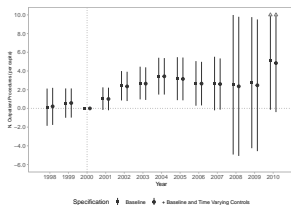


Specification ■ Baseline ● + Baseline and Time Varying Controls

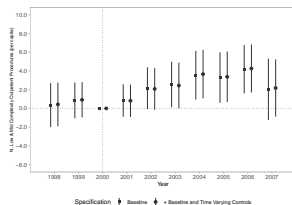


## Ambulatory Production

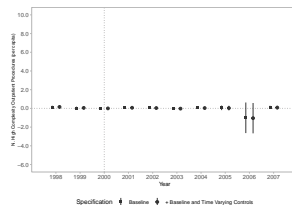
(a) Total



(b) Low and Mid Complexity

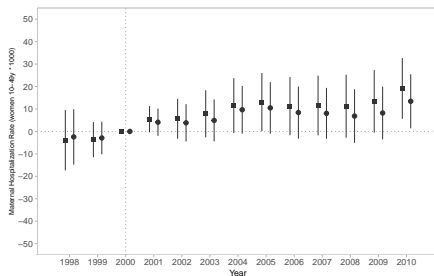


(c) High Complexity



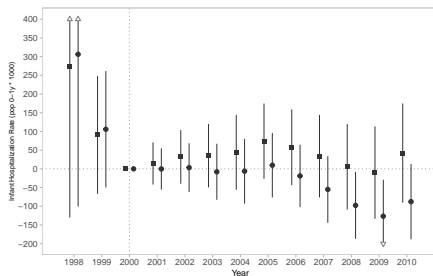
## Hospitalization Rates

Maternal (woman 10-49y \* 1000)



Specification ■ Baseline ● + Baseline and Time Varying Controls

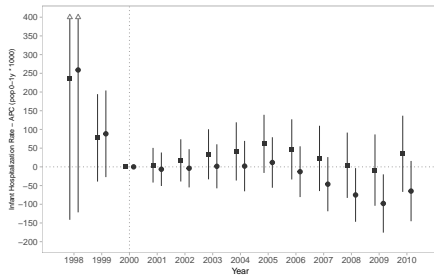
Infant (pop 0-1y \* 1000)



Specification ■ Baseline ● + Baseline and Time Varying Controls

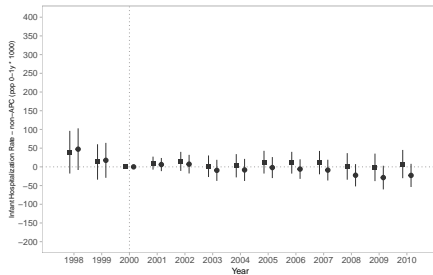
## Hospitalization Rates

Infant - APC (pop 0-1y \* 1000)



Specification ■ Baseline ● + Baseline and Time Varying Controls

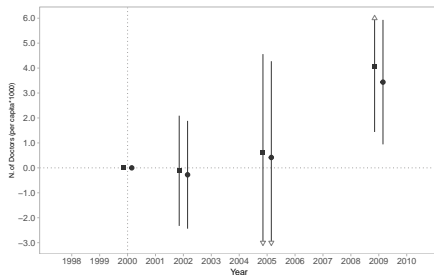
Infant - non-APC (pop 0-1y \* 1000)



Specification ■ Baseline ● + Baseline and Time Varying Controls

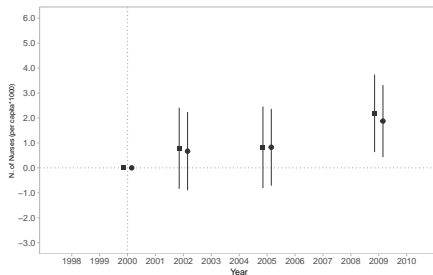
## Effects on Health Human Resources

### Number of Doctors (per capita\*1000)



Specification ■ Baseline ♦ + Baseline and Time Varying Controls

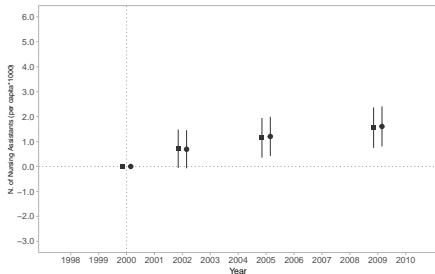
### Number of Nurses (per capita\*1000)



Specification ■ Baseline ♦ + Baseline and Time Varying Controls

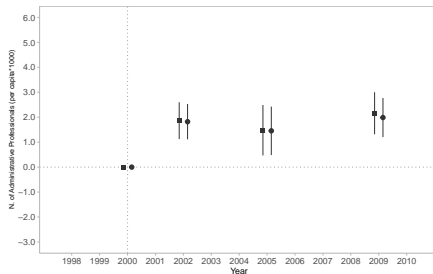
## Effects on Health Human Resources

Number of Nursing Assistants (per capita\*1000)



Specification    ■ Baseline    ● + Baseline and Time Varying Controls

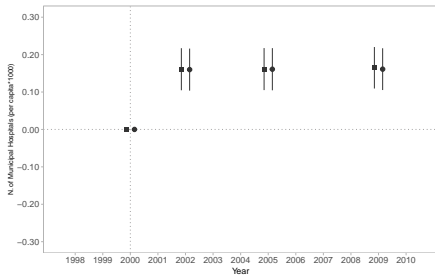
Number of Administrative Professionals (per capita\*1000)



Specification    ■ Baseline    ● + Baseline and Time Varying Controls

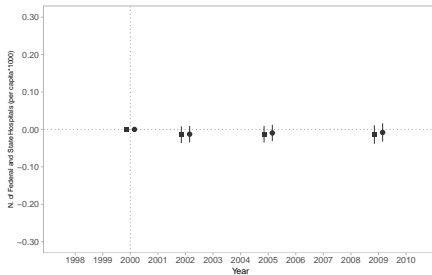
## Effects on Health Infrastructure

N. of Municipal Hospitals (per capita\*1000)



Specification ■ Baseline ● + Baseline and Time Varying Controls

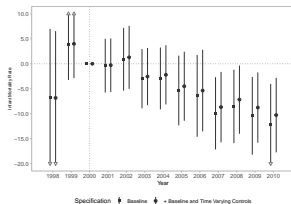
N. of Federal and State Hospitals (per capita\*1000)



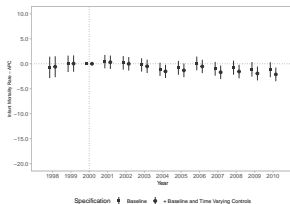
Specification ■ Baseline ● + Baseline and Time Varying Controls

## Effects on Infant Mortality Rates

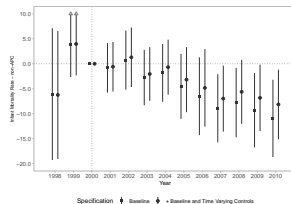
Total



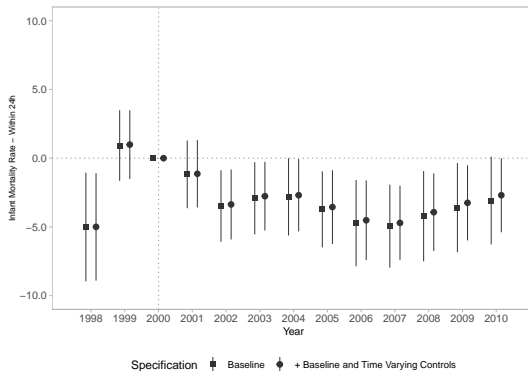
Amenable to Primary Care



Non-Amenable to Primary Care



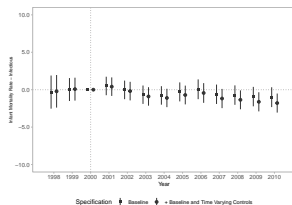
## Effects on Infant Mortality Rates - Within 24h



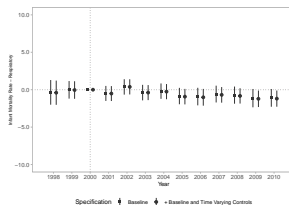


## Effects on Infant Mortality Rates

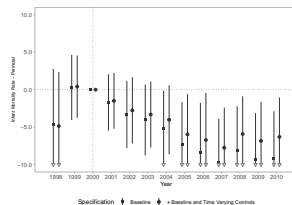
### Infectious



### Respiratory



### Perinatal



## References I

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