# Does Increasing Public Spending in Health Improve Health? Lessons from Constitutional Reform in Brazil

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XVII RIDGE FORUM - LACEAs Health Economics Network
6th Annual Workshop
May 15, 2023

# Motivation

- Global spending on health more than doubled in real terms since the turn of the century.
- Currently stands at 9.8% of global GDP and is projected to increase substantially (World Health Organization, 2021; Dieleman et al., 2017).
- Most of the growth has been from public sources, especially in high-income countries.
- Perhaps surprisingly, little evidence on how effective public health expenditure is in improving health outcomes.
  - Micro evidence on cost-effectiveness related to specific treatments/resources (e.g. Cutler, 2007; Doyle et al., 2015).
  - Very scant on public spending, although majority of health spending is financed by taxes and administered by governments. None on mechanisms.
- Little evidence generally on health spending and health outcomes in developing world.

# Motivation

- A common thread in the literature is that health spending **may** be sufficient to impact health.
- But this is certainly not a foretold conclusion.
  - For example, consider the RAND Health Insurance Experiment, Oregan HIE
  - "States that spend more per Medicare beneficiary are not states that provide higher quality care." Baicker and Chandra (2004)
- In principle, chain of causation depends on many interlinked steps: from inputs to outcomes.
- Involves state capacity in design/implementation/management, input complementarities, diversion due to corruption etc.
- Understanding how health spending propagates through this chain, and which (if any) steps break down is important given the magnitude of health spending.

# This paper

We assess whether and how a public spending reform designed to increase health spending translates into micro-level improvements in health.

- The setting is Brazil, 1998-2010.
- 29$^{th}$ Constitutional Amendment enshrined municipal health spending of *at least* 15% of budget.
- Depending on health spending at baseline, municipalities are more or less exposed to the reform.
- We collect a remarkably rich set of data allowing us to understand the full chain of reform impacts:
  1. How does the reform affect spending patterns?

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  1. How does the reform affect spending patterns?
  2. How does the reform affect municipal investments in health?
  3. How does the reform affect individual access to health?
  4. How does the reform affect hard health outcomes?

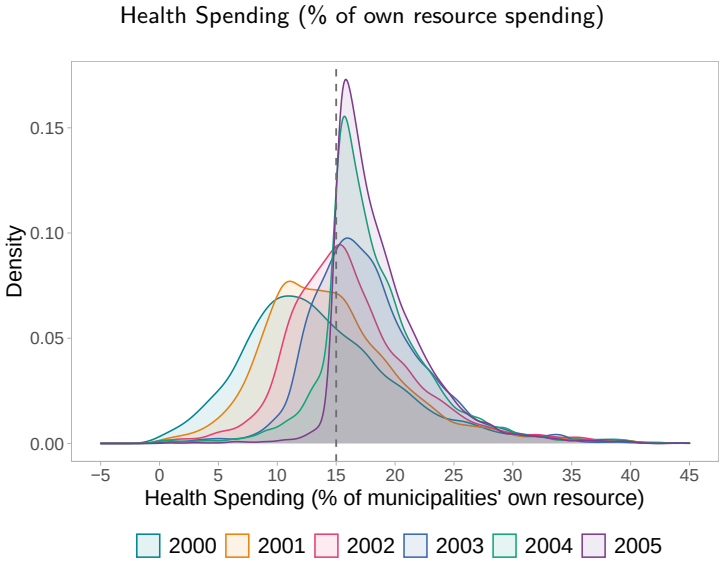
◂ Further literature

# Outline

# Background: Health Spending and the EC29/2000

- In Brazil in the '90s, most spending was centralised at level of Federal Government.
- Period of budget disputes and crises in health care financing.
- Reform efforts during the '90's resulted in the passage of the 29$^{th}$ Constitutional Amendment.
- In practice, enshrined a series of minimum spending floors for 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.

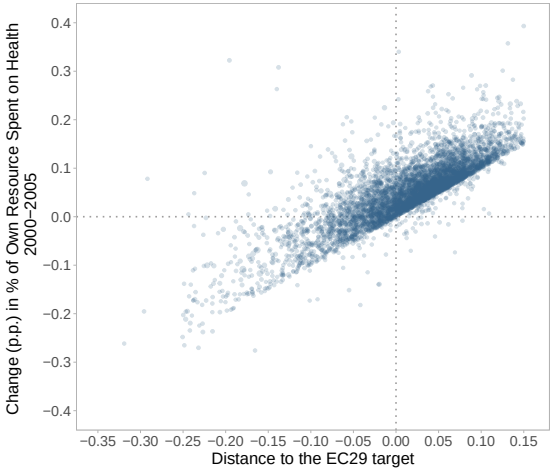
# Descriptive Impact: Compression of the Spending Distribution I



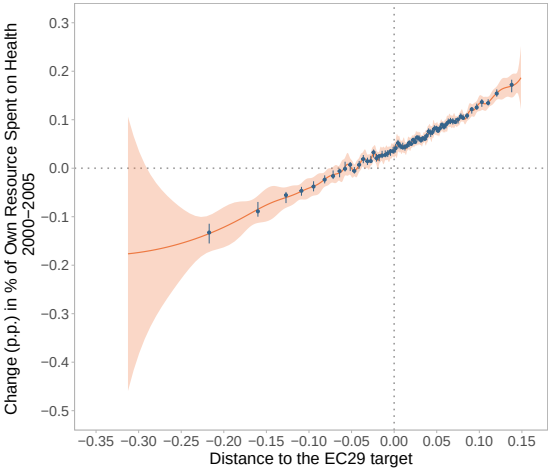

- Results in a large real increase in health spending ◂ Trends 1
- Mainly driven by own resources rather than federal transfers ◂ Trends 2
- Distance to the 15% threshold is geographically diverse ◂ Map

# Descriptive Impact: Compression of the Spending Distribution II

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




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



# Outline

# Data

We generate a municipality-by-year panel covering 5,507 Brazilian municipalities from 1998-2010. Generate municipal aggregates over a number of dimensions from a range of administrative sources:

- **Local spending and resources**: Brazilian Finance System (FINBRA), Brazilian National System of Public Health Budget (SIOPS).
- **Health Inputs**: Brazilian National System of Information on Primary Care (Datasus/SIAB), Censal Medical-Sanitary Assistance Survey (AMS).
- **Health Access**: Brazilian National System of Information on Ambulatory Care (Datasus/SIA), Brazilian National System of Birth Records (Datasus/SINASC), National System of Information on Hospitalizations (Datasus/SIH).
- **Health Outcomes**: Brazilian National System of Mortality Records (Datasus/SIM).
- **Other Measures**: Controls for baseline socioeconomic level (census), time-varying GDP per capita (IBGE), *Bolsa Familia* transfers.

◂ Time Periods

# Data

This data is rich, but high dimensional in nature. To focus on a common metric and avoid inflated rates of type I error we generate outcome indexes (Anderson, 2008).

- Four specific dimensions: spending, access, inputs, health outcomes. ◂ Definitions
- For further descriptive context, additionally separated into two further sub-indexes. ◂ Definitions
- Unless otherwise noted, effect sizes will be stated in terms of standard deviations of pre-reform measures.
- Full summary statistics. ◂ Link

# Outline

# Empirical Strategy

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

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

- $Y_{mts}$ 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
- Municipal and state×year fixed effects included as baseline (importance of within state variation)
- $Z_{m,pre} \times \delta_t$ is an interaction between socioeconomic baseline controls and time
- $X_{mts}$ are time-varying controls
- Consistently weight by population, and cluster standard errors at municipality level

# Empirical Strategy – Extensions

Two key extensions: (a) considering the dynamics of impacts over time and (b) potential differential results for above and below threshold municipalities.

**(a) Event Study Versions of (1)**

$$\begin{aligned} Y_{mts} = & \sum_{i=1}^{I} \beta_{pre,i}\, Dist_{m,pre} \times EC29_{t+i} + \sum_{j=0}^{J} \beta_{post,j}\, Dist_{m,pre} \times EC29_{t-j} \\ & + \delta_{st} + \delta_m + \theta\, Z_{m,pre} \times \delta_t + \gamma\, X_{mts} + \varepsilon_{mts}. \end{aligned} \tag{2}$$

**(b) Heterogeneity of (1) by Below vs Above Threshold Municipalities**

$$\begin{aligned} Y_{mts} = & \alpha(Dist_{m,pre} \times Post_t) \cdot Above_{m,pre} + \\ & \gamma(Dist_{m,pre} \times Post_t) \cdot Below_{m,pre} + \\ & \delta_{st} + \delta_m + \theta\, Z_{m,pre} \times \delta_t + \gamma\, X_{mts} + \varepsilon_{mts}. \end{aligned} \tag{3}$$

# Validity of the Research Design

- Identification is drawn from baseline distance to the (arbitrary) threshold.
- Adoption of EC29 is time-invariant (block adoption design).
- Time-invariant adoption means no concerned about bias owing to heterogenous effects over time.
- But, 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.
- Nevertheless, we estimate a binary version of (1), where 'Treatment' refers to below threshold municipalities.

# Outline

# What are the Fiscal Responses to Health Spending Reforms?

Table: Health Spending Reforms and Fiscal Outcomes (Part A)

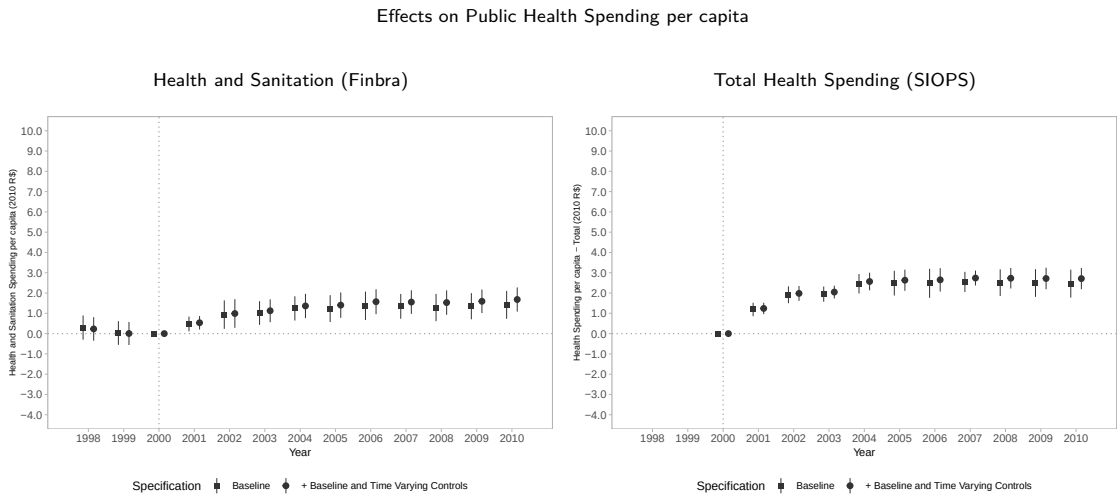
| | ln(per capita spending) | | | | Level |
|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** |
| **Panel A: Finbra** | | | | | |
| Total Revenues | -0.071 | 0.047 | 0.073 | 0.118 | 100.893 |
| | (0.135) | (0.114) | (0.114) | (0.115) | (183.364) |
| Total Spending | 0.002 | 0.112 | 0.137 | 0.133 | 171.998 |
| | (0.137) | (0.115) | (0.116) | (0.115) | (166.261) |
| Health Spending | 1.14*** | 1.249*** | 1.273*** | 1.273*** | 283.511*** |
| | (0.255) | (0.237) | (0.239) | (0.238) | (81.907) |
| Non-Health Spending | -0.198 | -0.093 | -0.067 | -0.08 | -106.625 |
| | (0.134) | (0.111) | (0.11) | (0.109) | (114.82) |
| Non-Health Social Spending | -0.128 | -0.075 | -0.054 | -0.062 | -38.931 |
| | (0.18) | (0.15) | (0.149) | (0.148) | (91.763) |
| Non-Social Spending | -0.212 | -0.061 | -0.031 | -0.042 | -56.209 |
| | (0.17) | (0.141) | (0.14) | (0.139) | (73.913) |
| Mun & Time-State FE | Y | Y | Y | Y | Y |
| Baseline Socioeconomic Controls×Time | N | Y | Y | Y | Y |
| Time-Varying Controls | N | N | Y | Y | Y |
| Fiscal Controls | N | N | N | Y | N |

# What are the Fiscal Responses to Health Spending Reforms?

Table: Health Spending Reforms and Fiscal Outcomes (Part B)

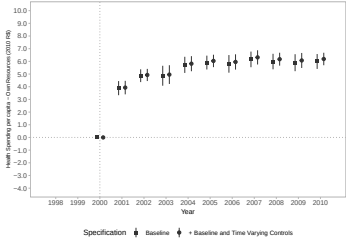
| | ln(per capita spending) | | | | Level |
|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** |
| **Panel B: Siops** | | | | | |
| Total Health Spending | 2.513*** | 2.586*** | 2.592*** | 2.605*** | 458.127*** |
| | (0.204) | (0.164) | (0.165) | (0.165) | (44.708) |
| From Own Resources | 5.799*** | 5.844*** | 5.851*** | 5.86*** | 420.212*** |
| | (0.256) | (0.244) | (0.239) | (0.237) | (16.682) |
| From Other Resources | 1.958 | 1.877 | 1.873 | 1.863 | 38.319 |
| | (1.596) | (1.349) | (1.341) | (1.315) | (44.899) |
| Personnel | 2.533*** | 2.559*** | 2.562*** | 2.467*** | 133.728*** |
| | (0.443) | (0.378) | (0.379) | (0.368) | (29.22) |
| Investment | 5.506*** | 5.249*** | 5.244*** | 5.301*** | 61.455*** |
| | (1.126) | (0.813) | (0.808) | (0.807) | (6.768) |
| Outsourced (3rd party services) | 1.534*** | 1.808*** | 1.815*** | 1.925*** | 48.837 |
| | (0.524) | (0.44) | (0.437) | (0.416) | (33.801) |
| Admin, Management and Others | 4.958*** | 4.793*** | 4.795*** | 4.847*** | 225.125*** |
| | (1.095) | (0.997) | (0.997) | (0.968) | (31.45) |
| Mun & Time-State FE | Y | Y | Y | Y | Y |
| Baseline Socioeconomic Controls×Time | N | Y | Y | Y | Y |
| Time-Varying Controls | N | N | Y | Y | Y |
| Fiscal Controls | N | N | N | Y | N |

# Temporal Dynamics in Health Spending Paths

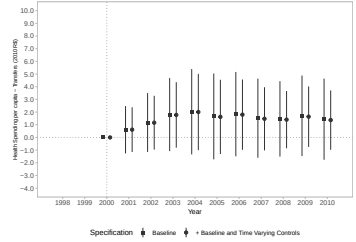


# How Are Spending Changes Directed?

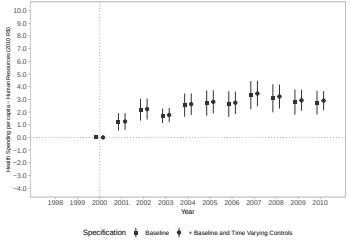
Health Spending - Own Resources



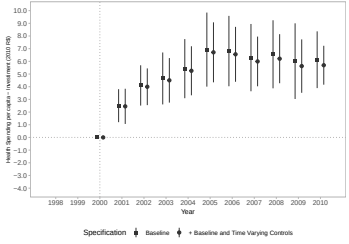

Health Spending - Transfers



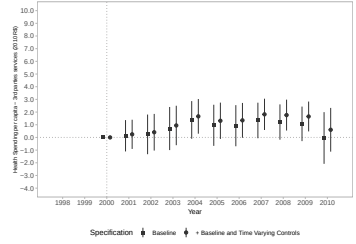

Human Resources



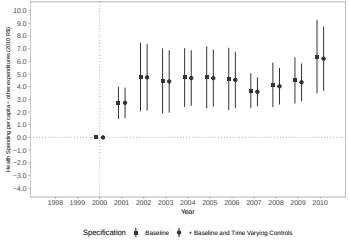

Investment




3rd parties services

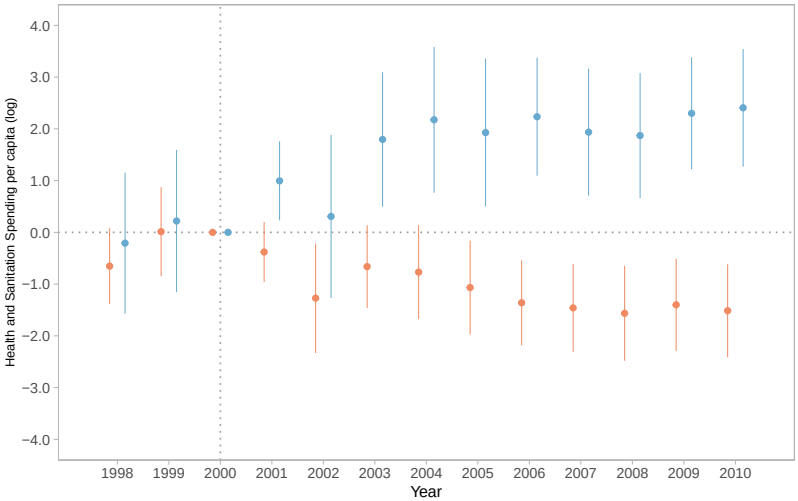



Other Expenditures



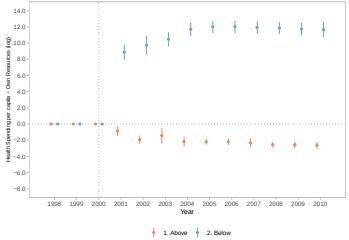
# How Does the Spending Threshold Alter Municipal Spending?

Figure: Health and Sanitation Spending per Capita (Finbra)

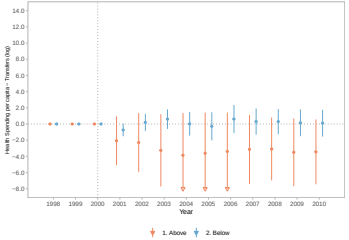


# How Are Spending Increases and Cuts Made?

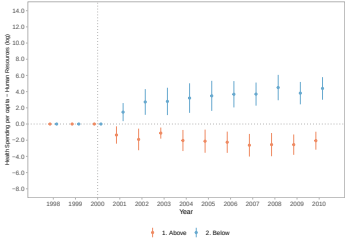
Health Spending - Own Resources



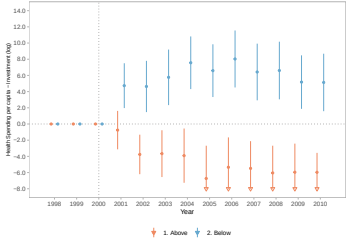

Health Spending - Transfers



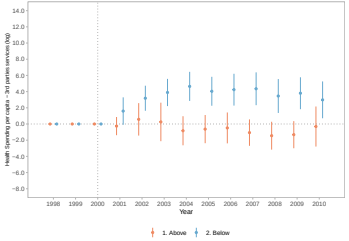

Human Resources



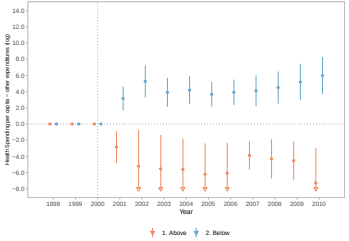

Investment




3rd parties services




Other Expenditures

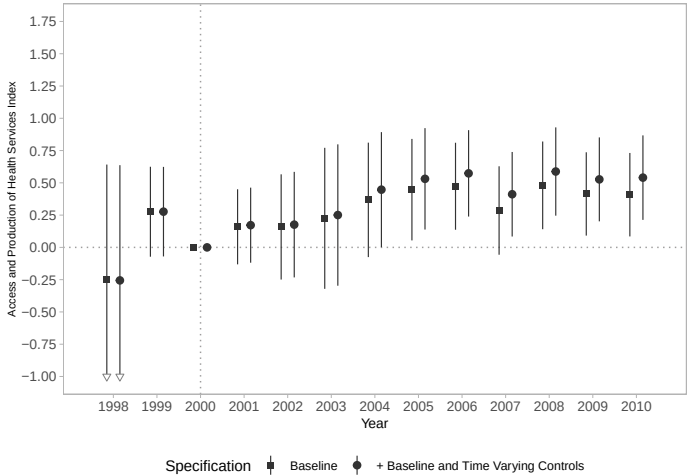


# Downstream Effects of Health Spending – Summary Indexes

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Access and Production of Health Services** | 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) |
| **Health Inputs** | 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) |
| **Birth Outcomes** | 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) |
| Municipalty & State× Year FEs | Y | Y | Y | Y |
| Socioeconomic controls | | Y | Y | Y |
| GDP p.c. & *Bolsa Familia* | | | Y | Y |
| Fiscal controls | | | | Y |

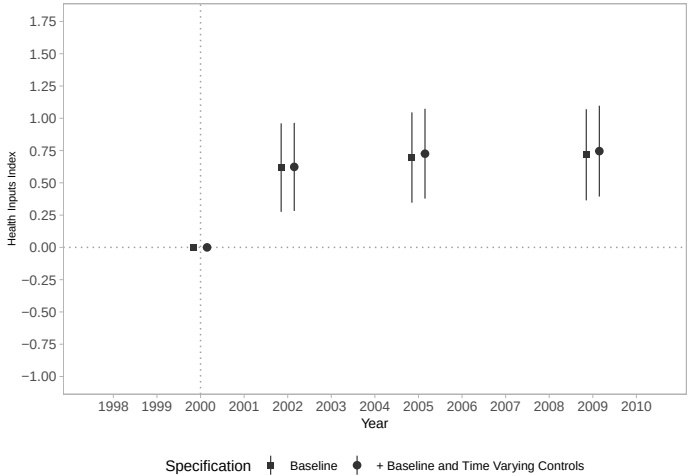
# Downstream Effects of Health Spending – Temporal Effects (Access)

Figure: Access and Production of Health Service



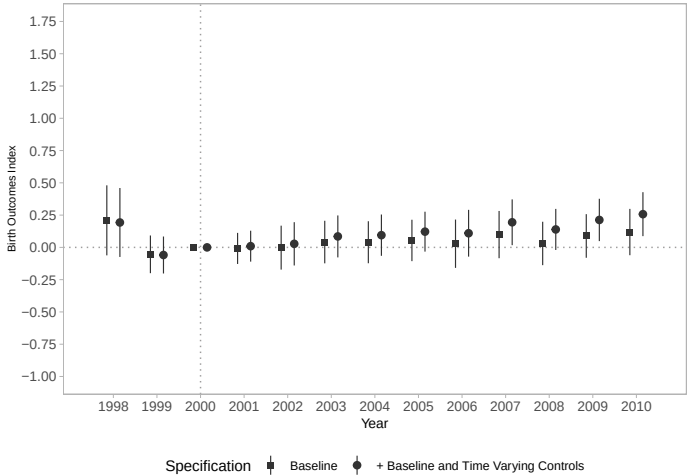
# Downstream Effects of Health Spending – Temporal Effects (Inputs)

Figure: Health Inputs



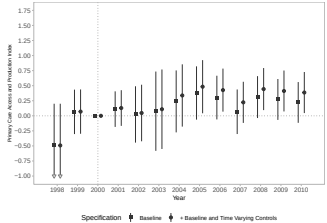
# Downstream Effects of Health Spending – Birth Outcomes

Figure: Birth outcomes

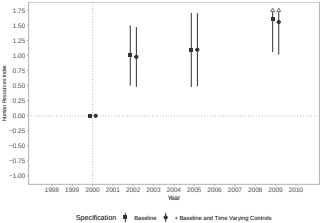


# Downstream Effects of Health Spending – Subindexes

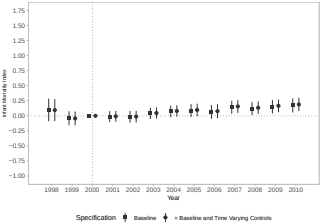
Primary Care



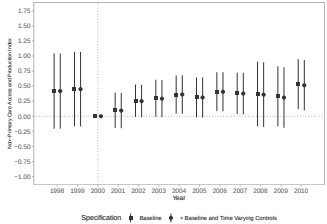

Human resources



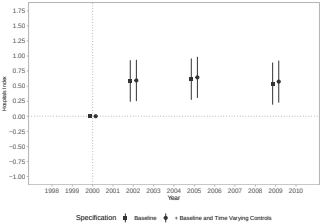

Infant mortality



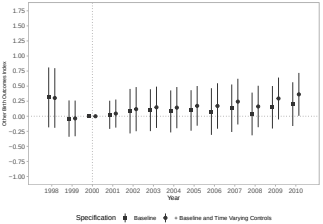

Non-Primary Care




Hospitals

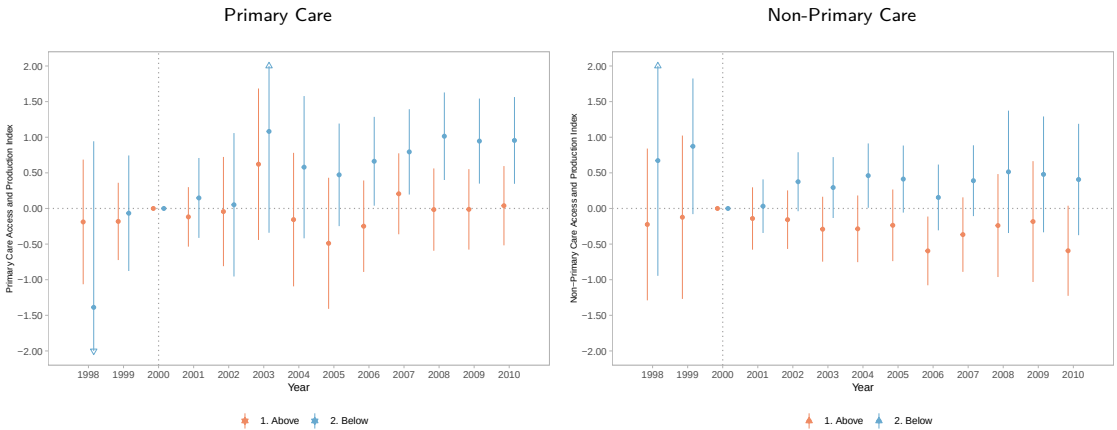



Other birth outcomes



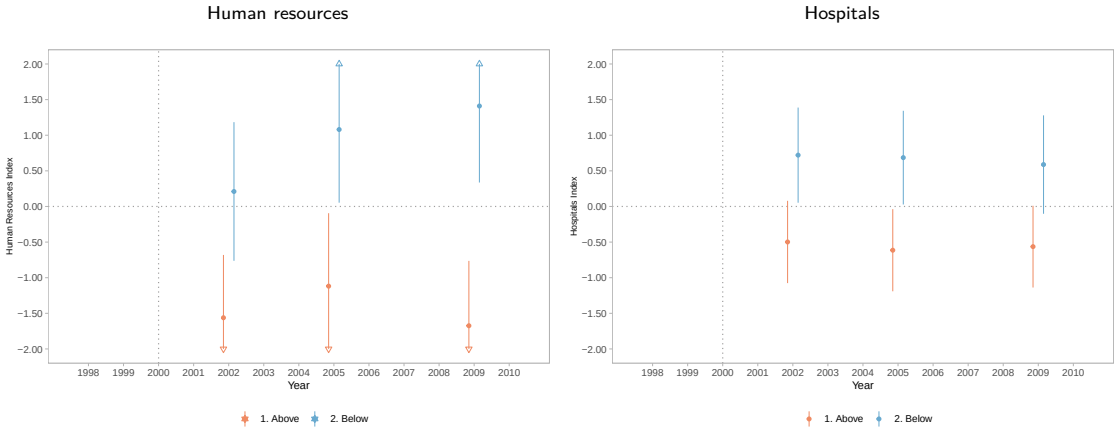
# Distributional Effects on Downstream Health Outcomes (A)

Figure: Access and Production of Health Service



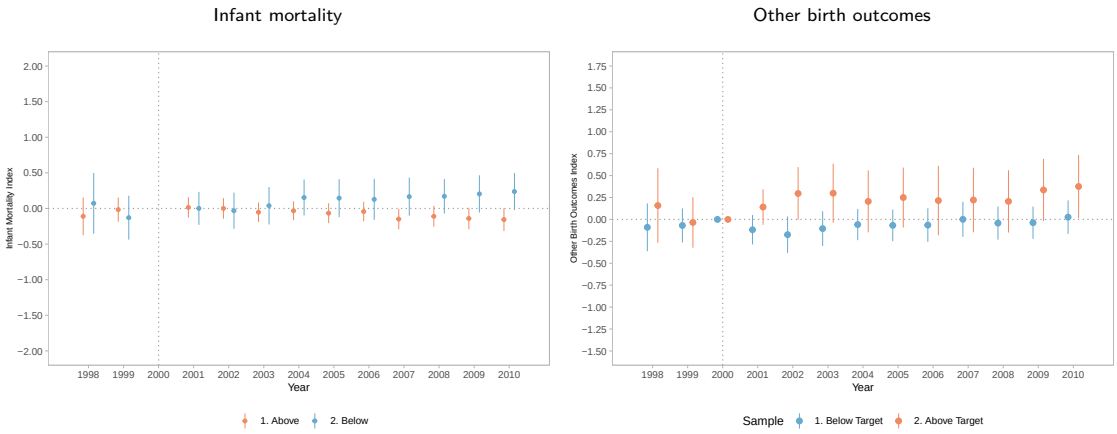
# Distributional Effects on Downstream Health Outcomes (B)

Figure: Health Inputs

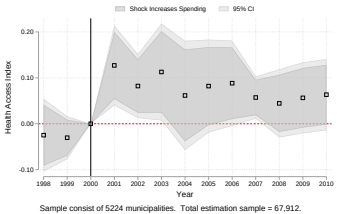


# Distributional Effects on Downstream Health Outcomes (C)

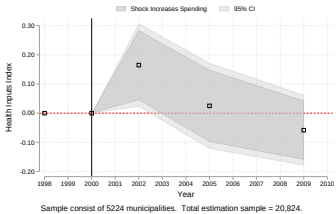
Figure: Birth Outcomes



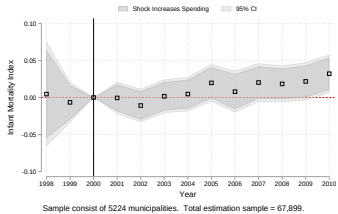
# A Binary "Treatment" Set-up




Access Index




Inputs Index

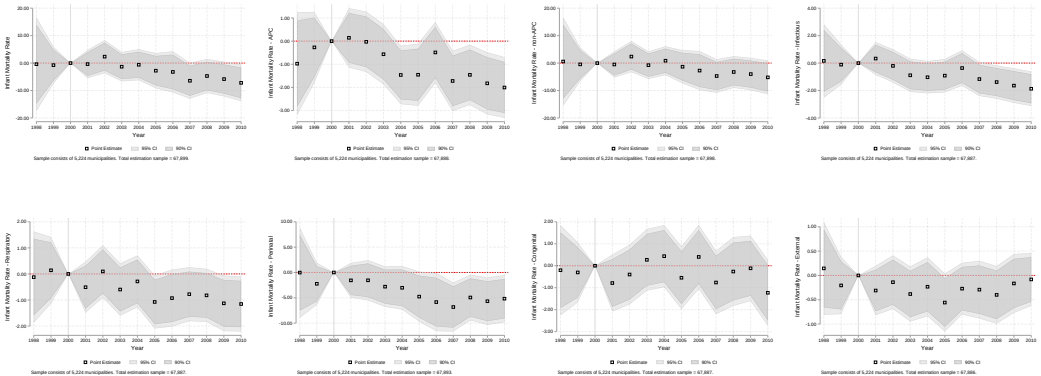



Infant Mortality

- Larger effects on access in outcomes classified as amenable to primary care
- Permanent effects observed in infrastructure inputs
- Temporary effects observed in human resources inputs
- Infant mortality changes observed in 'primary care-amenable' areas

# Where do Infant Mortality Declines Occur? I

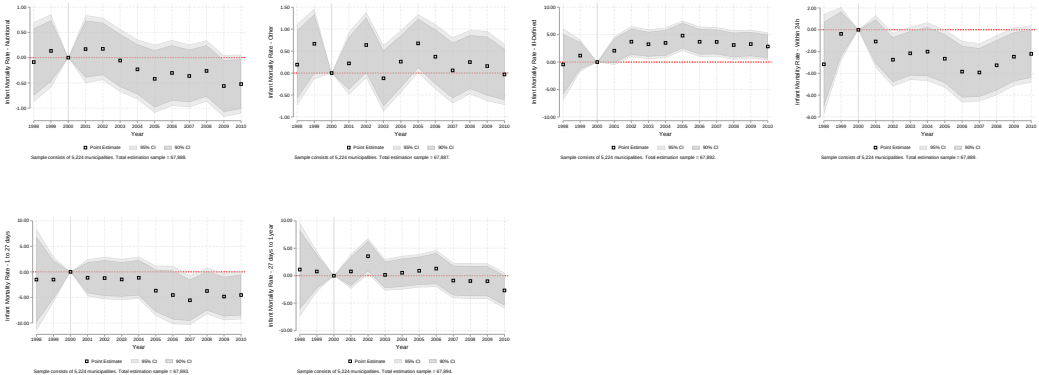
Figure: Continuous Event Studies, Variable by Variable – Infant Mortality




◂ Continuous

# Where do Infant Mortality Declines Occur? II

Figure: Continuous Event Studies, Variable by Variable – Infant Mortality




◂ Continuous

# Outline

# Final Remarks

- 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 increases in access and production of health services, health inputs, and moderate improvements in birth outcomes.
- Shifts in spending and inputs were associated with:
  - Greater number of administrative professionals, supply of municipal hospitals, and primary care coverage.
  - Small to moderate reductions in infant mortality rates, potentially related to improvements in primary care access and hospital care.
- 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).

# Final Remarks – Health Spending Implications

- Increases in spending are allocated to areas which are most important for targeting end-line health outcomes
- **Unintended spending consequences** given salience of 15% target
- Public spending cuts are potentially targeted to areas less influential for these types of health care outcomes

# Thank You!

Comments and queries are very welcome.

michel.szklo@fgv.br (or via coauthors)

# References I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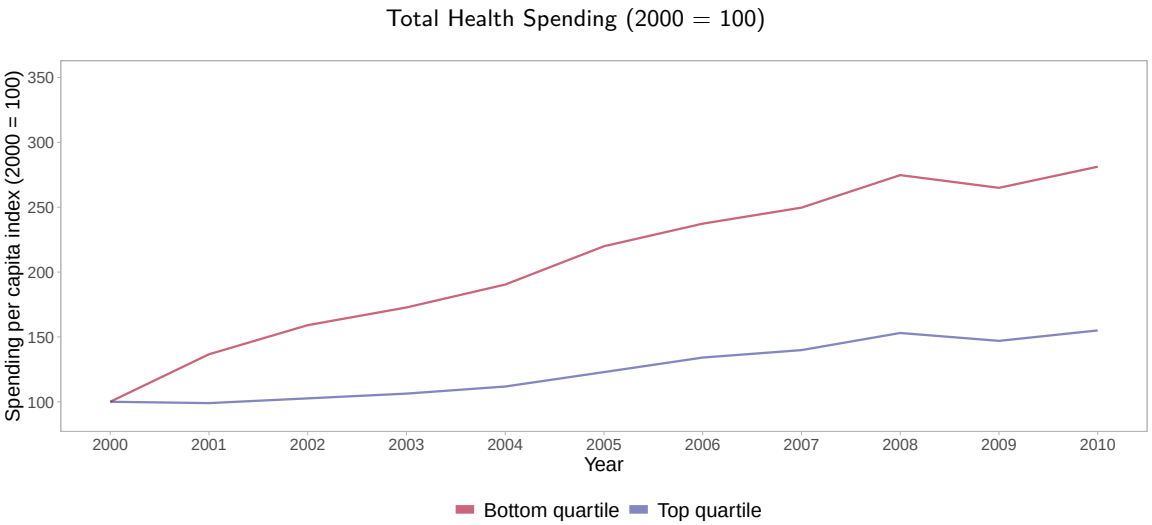
# Background: descriptive statistics

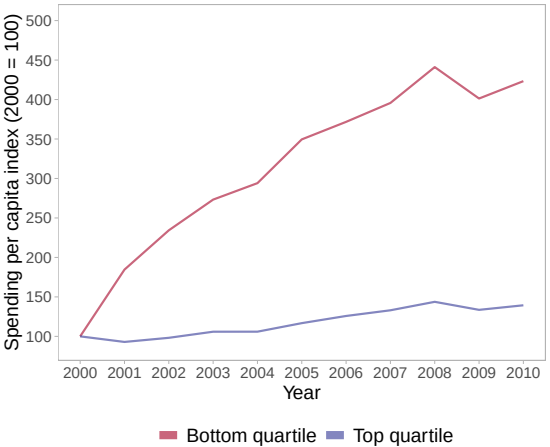
Back



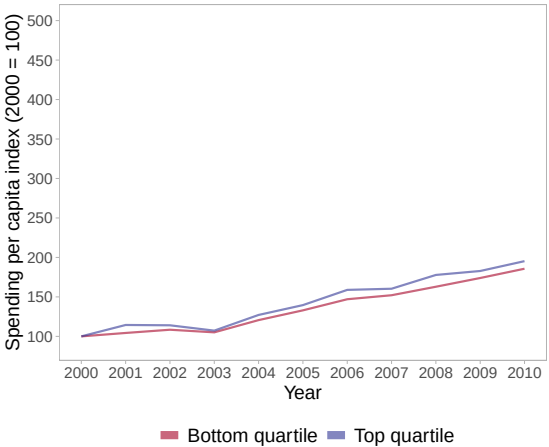
# Background: descriptive statistics

Back

Health Spending from Own Resources (2000 = 100)

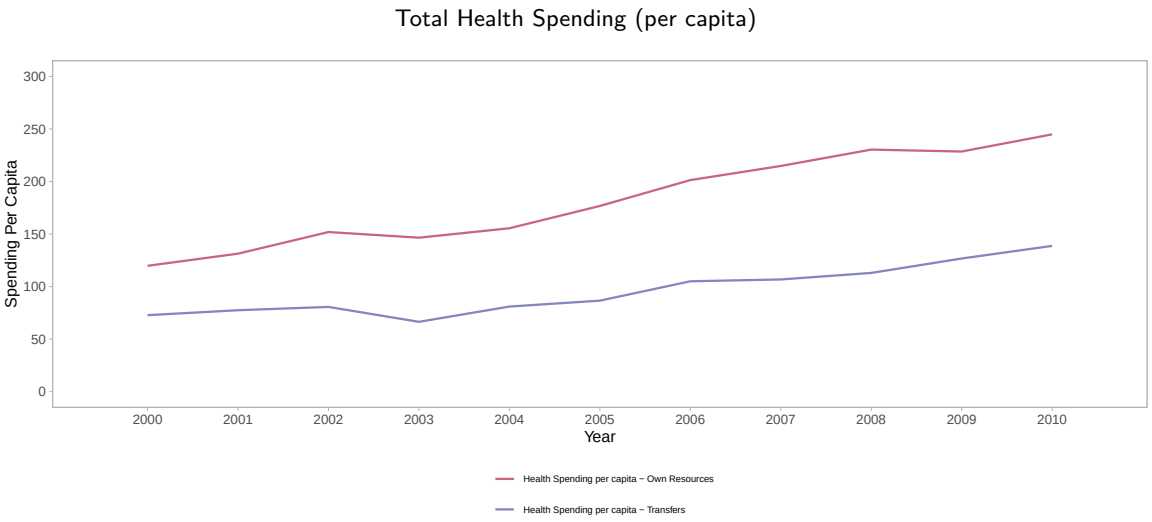



Health Spending from Transfers (2000 = 100)



# Background: descriptive statistics

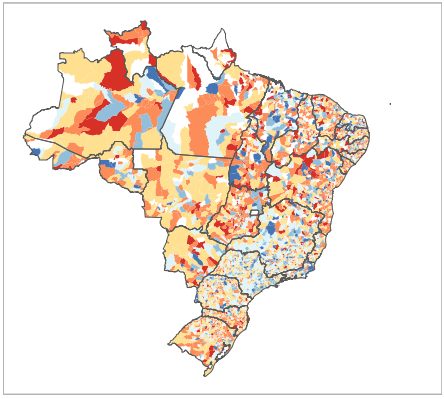
Back



# Background: descriptive statistics

Back

EC/29 Compliance Geographic Variation



## Table: Definitions of Indexes (I)

| Index | Sub-Index | Variables |
|---|---|---|
| 1. **Access & Production of Health Services Index** | 1a. *Primary Care Access & Production Index* | Population covered by Community Health Agents |
| | | Population covered by Family Health Agents |
| | | N. of People Visited by Primary Care Agents (pc) |
| | | N. of People Visited by Community Health Agents (pc) |
| | | N. of People Visited by Family Health Agents (pc) |
| | | N. of Household Visits and Appointments (pc) |
| | | N. of Household Visits and Appointments from Community Health Agents (pc) |
| | | N. of Household Visits and Appointments from Family Health Agents (pc) |
| | | N. of Health Facilities with Ambulatory Service and ACS Teams (pc) |
| | | N. of Health Facilities with Ambulatory Service and Community Doctors (pc) |
| | | N. of Health Facilities with Ambulatory Service and ACS Nurses (pc) |
| | | N. of Health Facilities with Ambulatory Service and PSF Teams (pc) |
| | | N. of Health Facilities with Ambulatory Service and PSF Doctors (pc) |
| | | N. of Health Facilities with Ambulatory Service and PSF Nurses (pc) |
| | | N. of Health Facilities with Ambulatory Service and PSF Nursing Assistants (pc) |
| | | N. Primary Care Outpatient Procedures (per capita) |
| | | N. Low & Mid Complexity Outpatient Procedures (pc) |
| | | Proportion of births with unknown prenatal care coverage |
| | | Proportion of births with 0 prenatal visits‡ |
| | | Proportion of births with 1-6 prenatal visits‡ |
| | | Proportion of births with 7+ prenatal visits |
| | | Maternal Hospitalization Rate |
| | | Infant Hospitalization Rate - APC‡ |
| | 1b. *Non-Primary Care Access & Production Index* | N. Outpatient Procedures (per capita) (pc) |
| | | N. High Complexity Outpatient Procedures (pc) |
| | | Infant Hospitalization Rate - non-APC |

Notes: Main indexes and sub-indexes consist of the variables listed here, in each case following Anderson (2008) in the construction of indices. The abbreviation pc refers to per-capita. Each variable is included in one and only one index, and one and only one sub-index. ‡ Variable has been multiplied by minus 1 such that higher values refer to 'better' outcomes. ◂ Back

## Table: Definitions of Indexes (II)

| Index | Sub-Index | Variables |
|---|---|---|
| 2. **Health Inputs Index** | 2a. *Human Resources Index* | N. of Doctors (pc)<br>N. of Nurses (pc)<br>N. of Nursing Assistants (pc)<br>N. of Administrative Professionals (pc) |
| | 2b. *Hospitals Index* | N. of Municipal Hospitals (pc)<br>N. of Federal and State Hospitals (pc)<br>N. of Private Hospitals (pc) |
| 3. **Birth Outcomes Index** | 3a. *Infant Mortality Index* | Infant Mortality Rate - APC‡<br>Infant Mortality Rate - non-APC‡ |
| | 3b. *Other Birth Outcomes Index* | 1 Minute APGAR<br>5 Minute APGAR<br>Proportion LBW ($< 2.5$kg)‡<br>Proportion premature births‡<br>Sex Ratio at Birth‡ |

Notes: Main indexes and sub-indexes consist of the variables listed here, in each case following Anderson (2008) in the construction of indices. The abbreviation pc refers to per-capita. Each variable is included in one and only one index, and one and only one sub-index. ‡ Variable has been multiplied by minus 1 such that higher values refer to 'better' outcomes.

◂ Back

# Summary Statistics

Back

Table: Descriptive Statistics (at the baseline year)

| | Mean | Std. Dev. | Min | Max | Obs. | Source of Data |
|---|---|---|---|---|---|---|
| **EC 29 Variables** | | | | | | |
| Share of Municipality's Own Resource Spent in Public Health | 0.138 | 0.068 | 0 | 0.802 | 5224 | Datasus/SIOPS |
| Distance to the EC29 Target | 0.012 | 0.068 | -0.652 | 0.15 | 5224 | Datasus/SIOPS |
| **Public Revenue** | | | | | | |
| Total Revenue per capita | 1225.274 | 2282.128 | 132.386 | 121105.017 | 5288 | Finbra |
| **Public Spending** | | | | | | |
| Total Spending per capita | 1284.77 | 2395.06 | 129.735 | 127974.259 | 5304 | Finbra |
| Spending by Category - per capita | | | | | | |
| Health and Sanitation | 217.08 | 276.14 | 0.037 | 12559.61 | 5286 | Finbra |
| Transport | 91.551 | 138.28 | 0 | 5865.789 | 5304 | Finbra |
| Education and Culture | 419.945 | 640.291 | 0 | 36319.154 | 5304 | Finbra |
| Housing and Urban | 116.052 | 301.25 | 0 | 19842.146 | 5304 | Finbra |
| Social Assistance | 84.052 | 253.836 | 0 | 13814.629 | 5304 | Finbra |
| Other Categories | 472.878 | 1201.128 | 32.002 | 65369.184 | 5304 | Finbra |
| **Public Health Spending** | | | | | | |
| Total Health Spending per capita | 192.543 | 110.44 | 24.632 | 1397.575 | 5225 | Datasus/SIOPS |
| Health Spending by Source - per capita | | | | | | |
| Own Resources spending per capita | 119.763 | 96.992 | 0 | 1232.875 | 5225 | Datasus/SIOPS |
| Transfers Spending per capita | 72.779 | 50.002 | 0 | 1099.097 | 5225 | Datasus/SIOPS |
| Health Spending by Type - per capita | | | | | | |
| Human Resources Spending per capita | 71.337 | 61.87 | 0 | 1118.758 | 5225 | Datasus/SIOPS |
| Investiments Spending per capita | 14.567 | 26.899 | 0 | 361.969 | 5225 | Datasus/SIOPS |
| 3rd parties services Spending per capita | 33.149 | 43.284 | 0 | 1041.135 | 5225 | Datasus/SIOPS |
| Other Spendings per capita | 73.49 | 52.755 | 0 | 602.699 | 5225 | Datasus/SIOPS |

# Summary Statistics

Back

Table: Descriptive Statistics (at the baseline year) – *Cont.*

| | Mean | Std. Dev. | Min | Max | Obs. | Source of Data |
|---|---|---|---|---|---|---|
| **Primary Care Coverage** | | | | | | |
| Extensive Margin | | | | | | |
| Population covered (share) by Community Health Agents | 0.635 | 0.409 | 0 | 1 | 5507 | Datasus/SIAB |
| Population covered (share) by Family Health Agents | 0.311 | 0.383 | 0 | 1 | 5507 | Datasus/SIAB |
| | | | | | | |
| Intensive Margin | | | | | | |
| N. of People Visited by Primary Care Agents (per capita) | 0.271 | 0.285 | 0 | 2.798 | 5507 | Datasus/SIAB |
| N. of People Visited by Community Health Agents (per capita) | 0.121 | 0.18 | 0 | 1.518 | 5507 | Datasus/SIAB |
| N. of People Visited by Family Health Agents (per capita) | 0.15 | 0.252 | 0 | 1.834 | 5507 | Datasus/SIAB |
| N. of Household Visits & Appointments (per capita) | 1.876 | 2.541 | 0 | 88.85 | 5507 | Datasus/SIAB |
| N. of Household Visits & Appointments by Community Health Agents (per capita) | 1.072 | 2.156 | 0 | 85.989 | 5507 | Datasus/SIAB |
| N. of Household Visits & Appointments by Family Health Agents (per capita) | 0.8 | 1.505 | 0 | 43.389 | 5507 | Datasus/SIAB |
| | | | | | | |
| **Health Human Resources** | | | | | | |
| N. of Health Professionals (per capita*1000) | 5.104 | 4.825 | 0 | 187.904 | 5507 | IBGE/AMS |
| N. of Doctors (per capita*1000) | 1.529 | 2.385 | 0 | 95.132 | 5507 | IBGE/AMS |
| N. of Nurses (per capita*1000) | 1.159 | 1.636 | 0 | 95.097 | 5507 | IBGE/AMS |
| N. of Nursing Assistants (per capita*1000) | 1.26 | 1.456 | 0 | 22.009 | 5507 | IBGE/AMS |
| N. of Administrative Professionals (per capita*1000) | 1.155 | 1.251 | 0 | 36.599 | 5507 | IBGE/AMS |
| | | | | | | |
| **Health Infrastructure** | | | | | | |
| N. of Municipal Hospitals (per capita*1000) | 0.06 | 0.138 | 0 | 1.357 | 5507 | IBGE/AMS |
| N. of Federal and State Hospitals (per capita*1000) | 0.015 | 0.084 | 0 | 1.892 | 5507 | IBGE/AMS |
| N. of Private Hospitals (per capita*1000) | 0.03 | 0.058 | 0 | 0.609 | 5507 | IBGE/AMS |
| N. of Health Facilities (per capita*1000) with Ambulatory Service | 0.517 | 0.355 | 0 | 3.628 | 5493 | Datasus/SIA |
| | | | | | | |
| **Primary Care Related Infrastructure and Human Resources** | | | | | | |
| Number of Health Facilities (per capita * 1000) with | | | | | | |
| Ambulatory Service and ACS Teams | 0.14 | 0.197 | 0 | 2.41 | 5493 | Datasus/SIA |
| Ambulatory Service and Community Doctors | 0.082 | 0.154 | 0 | 1.957 | 5493 | Datasus/SIA |
| Ambulatory Service and ACS Nurses | 0.072 | 0.156 | 0 | 2.41 | 5493 | Datasus/SIA |
| Ambulatory Service and PSF Teams | 0.083 | 0.159 | 0 | 2.41 | 5493 | Datasus/SIA |
| Ambulatory Service and PSF Doctors | 0.077 | 0.149 | 0 | 1.957 | 5493 | Datasus/SIA |
| Ambulatory Service and PSF Nurses | 0.075 | 0.149 | 0 | 2.41 | 5493 | Datasus/SIA |
| Ambulatory Service and PSF Nursing Assistants | 0.05 | 0.123 | 0 | 1.957 | 5493 | Datasus/SIA |
| | | | | | | |
| **Ambulatorial Production** | | | | | | |
| N. Outpatient Procedures (per capita) | 8.8 | 4.55 | 0 | 48.258 | 5507 | Datasus/SIA |
| N. Primary Care Outpatient Procedures (per capita) | 7.415 | 3.974 | 0 | 39.367 | 5507 | Datasus/SIA |
| N. Low & Mid Complexity Outpatient Procedures (per capita) | 9.467 | 5.801 | 0 | 171.126 | 5493 | Datasus/SIA |
| N. High Complexity Outpatient Procedures (per capita) | 0.005 | 0.052 | 0 | 2.58 | 5493 | Datasus/SIA |

# Summary Statistics

Back

Table: Descriptive Statistics (at the baseline year) – *Cont.*

| | Mean | Std. Dev. | Min | Max | Obs. | Source of Data |
|---|---|---|---|---|---|---|
| **Infant Mortality Rate** | | | | | | |
| Total | 23.069 | 26.163 | 0 | 1000 | 5507 | Datasus/SIM |
| APC | 2.097 | 7.101 | 0 | 333.333 | 5507 | Datasus/SIM |
| non-APC | 20.972 | 22.291 | 0 | 666.667 | 5507 | Datasus/SIM |
| Fetal | 0.003 | 0.078 | 0 | 3.571 | 5507 | Datasus/SIM |
| Within 24h | 5.554 | 10.146 | 0 | 333.333 | 5507 | Datasus/SIM |
| 1 to 27 days | 13.727 | 15.891 | 0 | 333.333 | 5507 | Datasus/SIM |
| 27 days to 1 year | 9.342 | 16.341 | 0 | 666.667 | 5507 | Datasus/SIM |
| Infectious | 1.999 | 7.03 | 0 | 333.333 | 5507 | Datasus/SIM |
| Respiratory | 1.515 | 4.454 | 0 | 142.857 | 5507 | Datasus/SIM |
| Perinatal | 11.041 | 16.32 | 0 | 666.667 | 5507 | Datasus/SIM |
| Congenital | 2.127 | 5.008 | 0 | 93.023 | 5507 | Datasus/SIM |
| External | 0.366 | 1.914 | 0 | 43.478 | 5507 | Datasus/SIM |
| Nutritional | 0.601 | 3.221 | 0 | 166.667 | 5507 | Datasus/SIM |
| Other | 0.87 | 3.597 | 0 | 142.857 | 5507 | Datasus/SIM |
| Ill-Defined | 4.551 | 10.684 | 0 | 142.857 | 5507 | Datasus/SIM |
| **Fertility** | | | | | | |
| Rates of Birth per Woman (10-49y) | 0.055 | 0.017 | 0.002 | 0.169 | 5507 | Datasus/SINASC |
| **Birth Oucomes** | | | | | | |
| Apgar 1 | 8.183 | 0.903 | 1 | 9 | 5428 | Datasus/SINASC |
| Apgar 5 | 8.663 | 0.885 | 1 | 9 | 5082 | Datasus/SINASC |
| Low Birth Weight (<2.5k) | 0.066 | 0.032 | 0 | 0.5 | 5507 | Datasus/SINASC |
| Premature Birth | 0.093 | 0.107 | 0 | 1 | 5507 | Datasus/SINASC |
| Sex Ratio at Birth | 1.074 | 0.247 | 0.154 | 5 | 5505 | Datasus/SINASC |

# Summary Statistics

Back

Table: Descriptive Statistics (at the baseline year) – *Cont.*

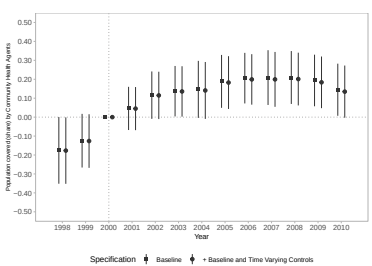
| | Mean | Std. Dev. | Min | Max | Obs. | Source of Data |
|---|---|---|---|---|---|---|
| **Controls** | | | | | | |
| Population (1,000) | 29.773 | 178.831 | 0.711 | 9968.485 | 5507 | IBGE/Census |
| GDP per capita (2010 R$) | 9.531 | 11.231 | 1.365 | 271.779 | 5507 | IBGE/Census |
| 'Bolsa Familia' transfers per capita (2010 R$) | 0 | 0 | 0 | 0 | 5507 | IBGE/Census |
| Life Expectancy | 68.385 | 3.962 | 57.46 | 77.24 | 5507 | IBGE/Census |
| Expected Years of Study | 8.337 | 1.794 | 2.29 | 13.02 | 5507 | IBGE/Census |
| Illiteracy Rate (above 18y old) | 23.626 | 13.516 | 1 | 63.01 | 5507 | IBGE/Census |
| Income per capita | 338.35 | 192.807 | 62.65 | 1759.76 | 5507 | IBGE/Census |
| Share of Population Below Poverty Line | 0.411 | 0.228 | 0.007 | 0.908 | 5507 | IBGE/Census |
| Gini Coefficient | 0.547 | 0.068 | 0.3 | 0.87 | 5507 | IBGE/Census |
| Access to Sewage Network | 0.251 | 0.302 | 0 | 0.993 | 5507 | IBGE/Census |
| Access to Garbage Collection Service | 0.535 | 0.271 | 0 | 1 | 5507 | IBGE/Census |
| Access to Water Network | 0.583 | 0.241 | 0 | 1 | 5507 | IBGE/Census |
| Access to Electricity | 0.869 | 0.165 | 0.081 | 1 | 5507 | IBGE/Census |
| Urbanization Rate | 0.602 | 0.227 | 0 | 1 | 5507 | IBGE/Census |
| Average Neighbors Spending Health Spending per capita (2010 R$) | 206.387 | 125.041 | 1.741 | 3298.403 | 5504 | Finbra |
| Municipality's Spending in Human Resources (% of Total Revenue) | 0.415 | 0.109 | 0 | 1.242 | 5304 | Finbra |

Notes: Authors' own tabulation. Statistics for IBGE/AMS data refer to the year 1999 and statistics for all remaining variables refer to the baseline year o 2000. Data sources indicated in the table.

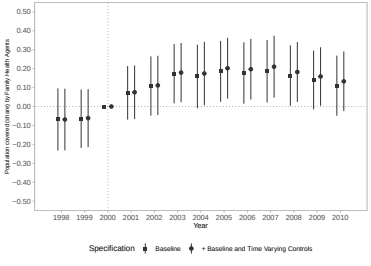
# Access and Production of Health Service

## Effects on Primary Care Coverage

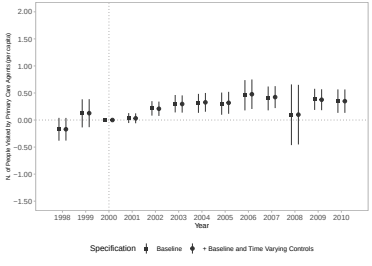
### Population Covered by Community Health Agents




### Population Covered by Family Health Agents



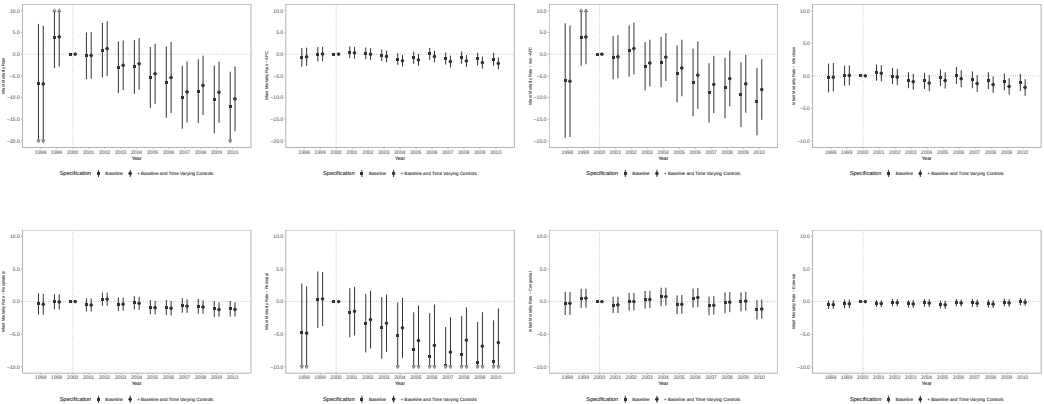

### N. of People Visited



# Where do Infant Mortality Declines Occur? I

Back

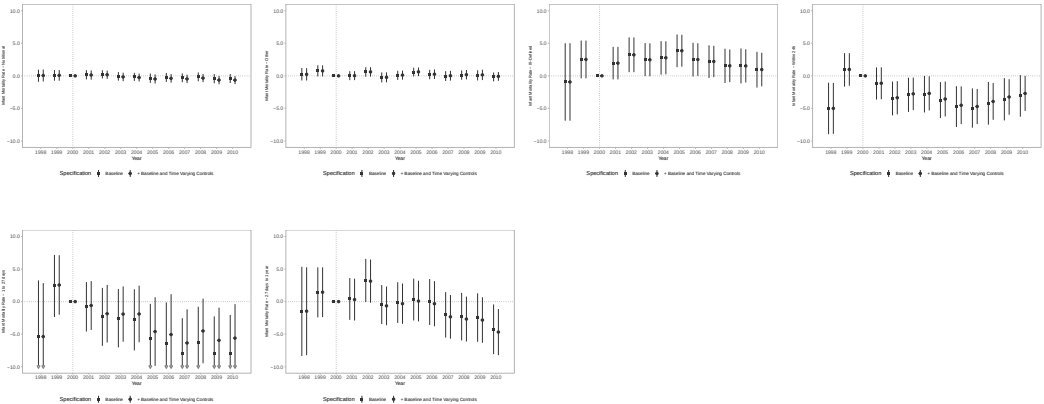
Figure: Continuous Event Studies, Variable by Variable – Infant Mortality



# Where do Infant Mortality Declines Occur? II

Back

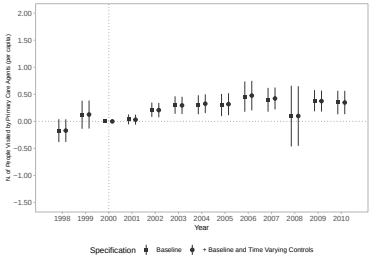
Figure: Continuous Event Studies, Variable by Variable – Infant Mortality



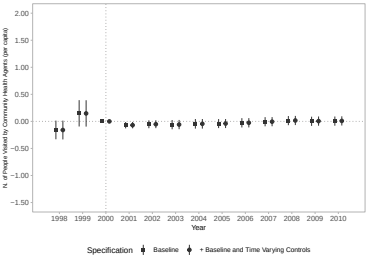
# Access and Production of Health Service

Effects on Primary Care Coverage

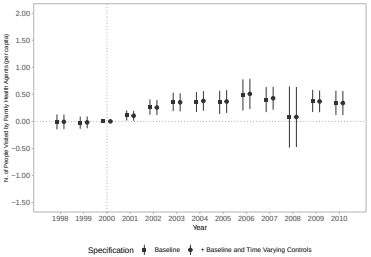
(a) N. of People Visited




(b) People Visited by CH Agents

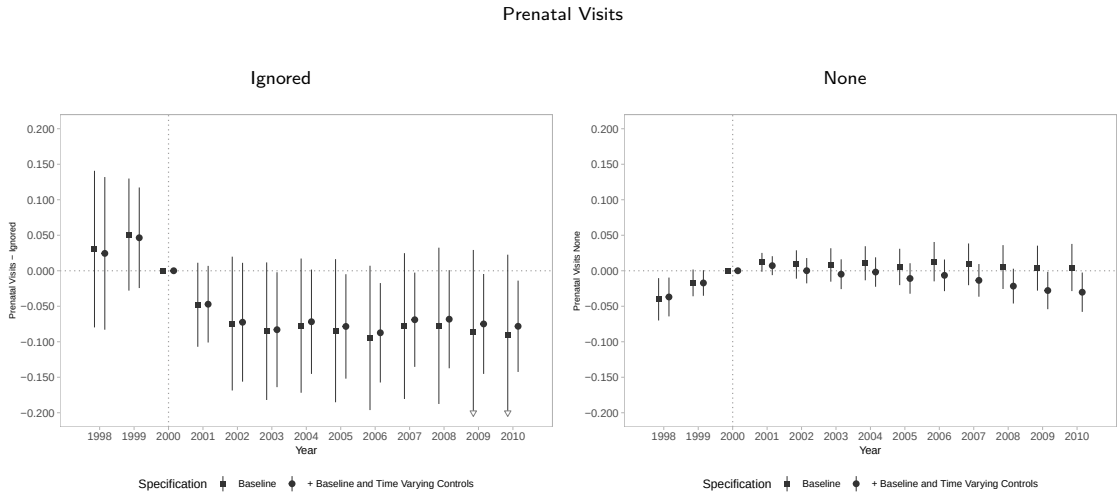



(c) People Visited by FH Agents

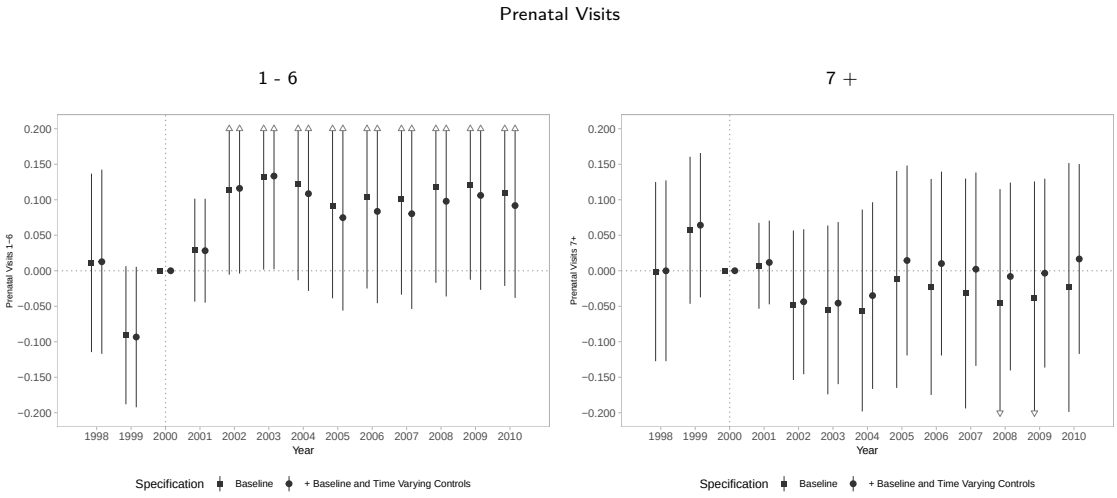


# Access and Production of Health Service

Indexes



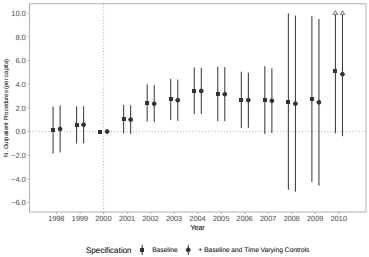
# Access and Production of Health Service



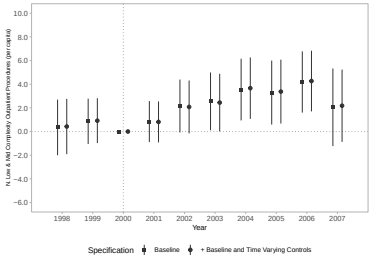
# Access and Production of Health Service

Ambulatory Production

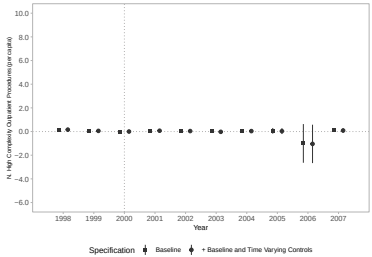
(a) Total




(b) Low and Mid Complexity



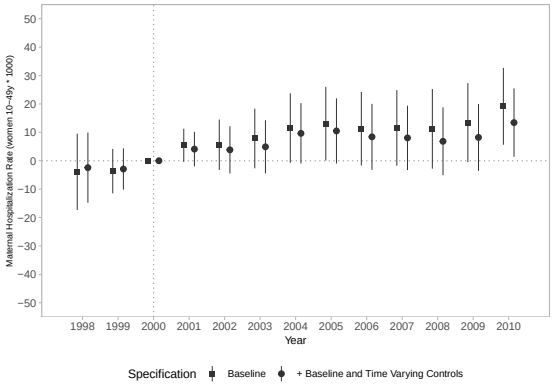

(c) High Complexity



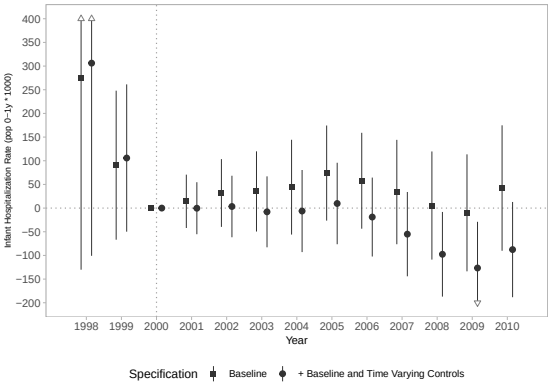
# Access and Production of Health Service

Hospitalization Rates

Maternal (woman 10-49y * 1000)



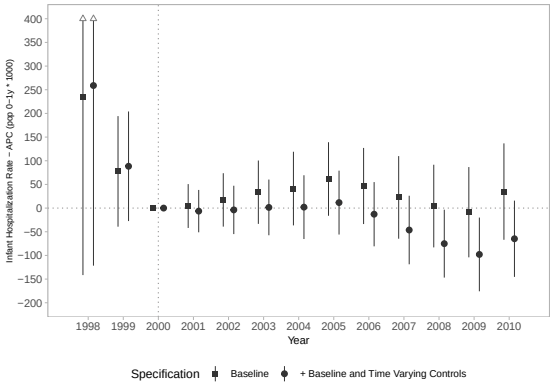

Infant (pop 0-1y * 1000)



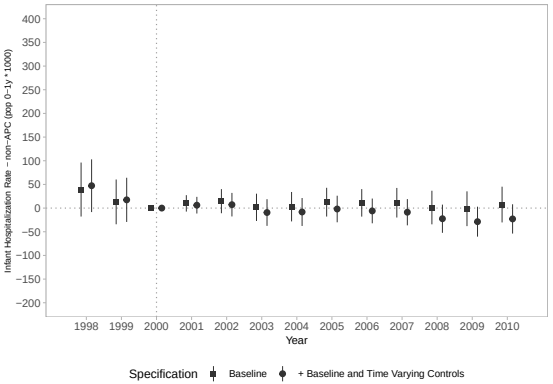
# Access and Production of Health Service

Hospitalization Rates

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




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

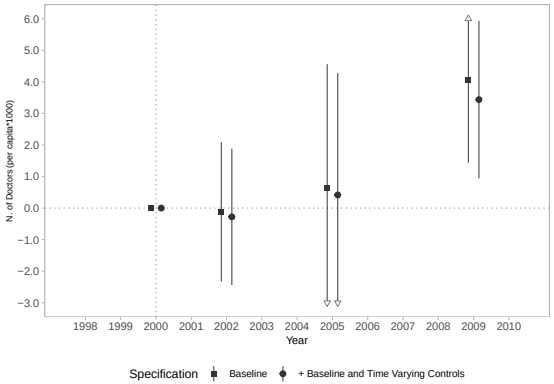


# Health Inputs

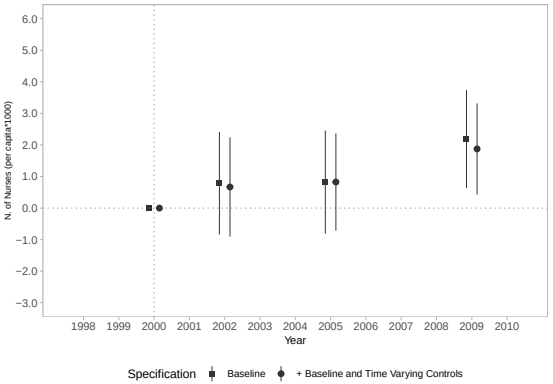
Indexes

Effects on Health Human Resources

Number of Doctors (per capita*1000)




Number of Nurses (per capita*1000)

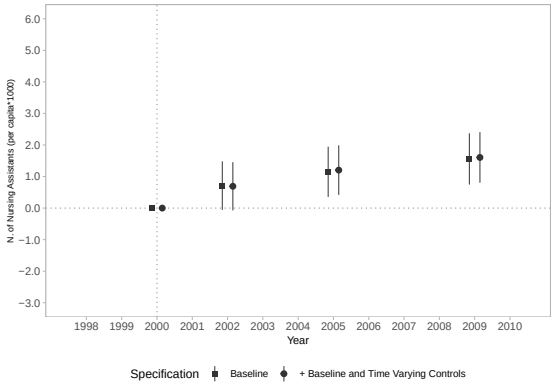


# Health Inputs

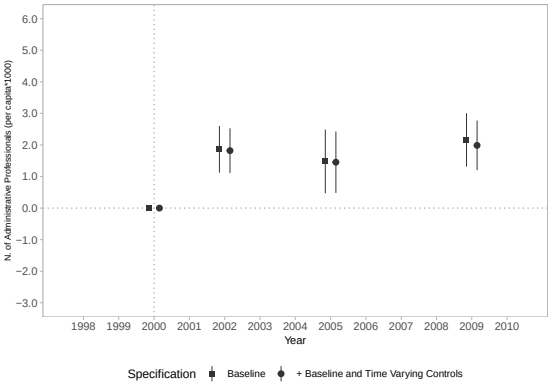
Indexes

Effects on Health Human Resources

Number of Nursing Assistants (per capita*1000)




Number of Administrative Professionals (per capita*1000)

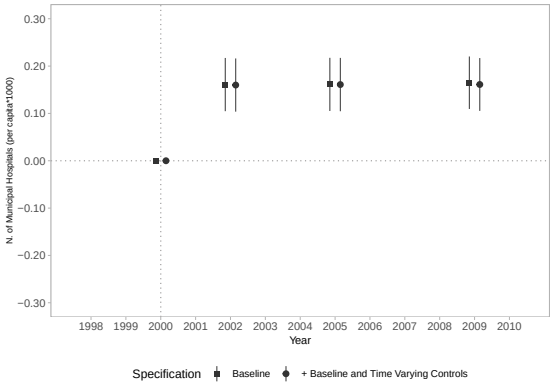


# Health Inputs

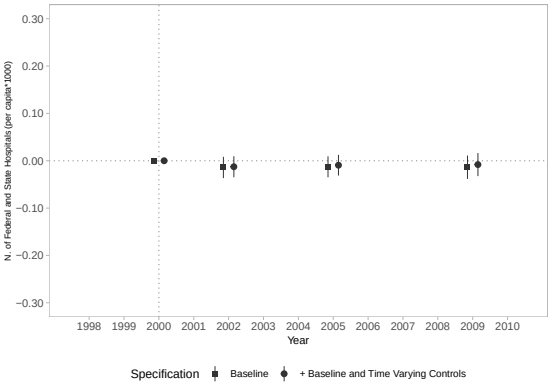
Indexes

Effects on Health Infrastructure

N. of Municipal Hospitals (per capita*1000)




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

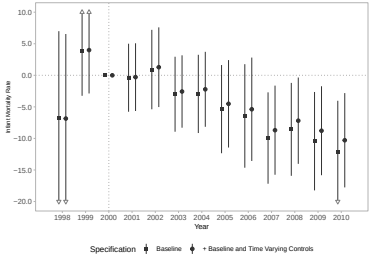


# Birth Outcomes

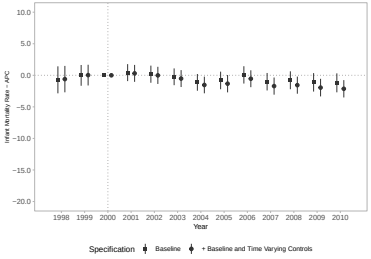
Indexes

Effects on Infant Mortality Rates

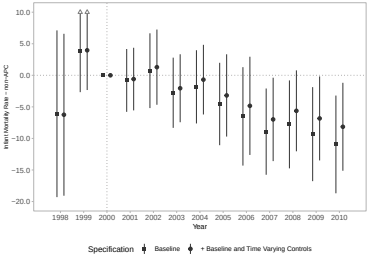
Total




Amenable to Primary Care

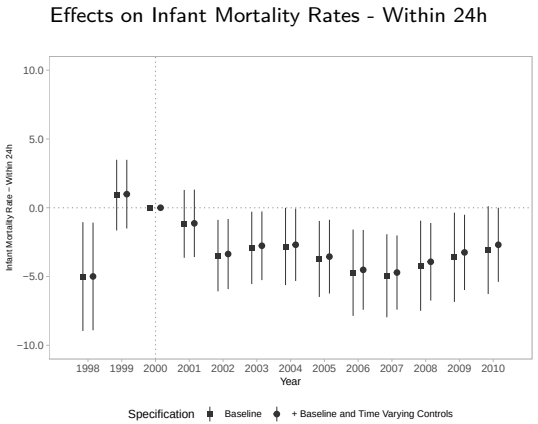



Non-Amenable to Primary Care



# Birth Outcomes



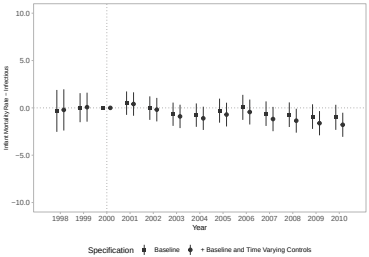


# Birth Outcomes

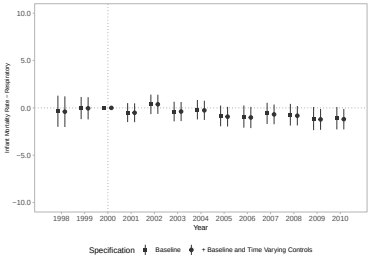
Indexes

Effects on Infant Mortality Rates

Infectious




Respiratory




Perinatal