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Abstract

In a bold move, Brazil constitutionalized the right to health and acted to universalize access to fully subsidized health care. We use rich administrative data to investigate the restructuring of the system, which moved away from specialized services centralized in hospitals, and toward expansions in primary care. We show that this movement led to increases in access to primary care and hospital services, alongside large reductions in maternal, fetal, and infant mortality. We also show that these improvements relied heavily on the complementarities across different layers of the health system and that they reduced health inequalities across socioeconomic groups. Brazil presents a success story with potentially important lessons for other countries considering universal health coverage.

Key Words: universal health coverage, health systems, primary care, maternal mortality, infant mortality, birth outcomes.
JEL Codes: I12, I18, J10, J13, J24, O54.

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1 Introduction

Universal health coverage (UHC) is today at the forefront of the worldwide public health debate. This represents the confluence of an ethical perspective which espouses the right to health as a human right (Rumbold et al., 2017) and an efficiency perspective which recognizes the growing evidence that health contributes to human capital accumulation and productivity growth (Almond and Currie, 2011; Dupas and Miguel, 2017). Both the World Health Organization and the World Bank have recently endorsed UHC, and called on the global community to universalize access to affordable health care within a generation (WHO and World Bank, 2017; Bloom et al., 2018). This movement has also reached the policy world, with several developing countries in Africa, Asia, and Latin America trying to expand access to health care (Boerma et al., 2014; Atun et al., 2015; Reich et al., 2016), and with Obamacare becoming one of the key domestic policy debates in the US over the last decade (Cotlear et al., 2015; Reinhardt, 2017).

While there is buy-in from the international community, national governments are faced with the challenge of implementation, which involves issues of design related to both equity and financial sustainability. UHC refers to the ability of all people to obtain good-quality services when they need them, without facing financial hardship (Evans et al., 2013). In 2015, it was estimated that 400 million people did not have access to essential health services, and that 6% of people in low- and middle-income countries had been tipped into or pushed further into extreme poverty because of health spending (World Bank, 2015). The focus of UHC programs has been on expanding coverage and reducing financing gaps. In line with this, evaluations of UHC have tended to focus on measures of coverage and out-of-pocket expenditures, rather than on how universality is achieved and whether health outcomes improve (Frean et al., 2016; Knaul et al., 2012; Jowett et al., 2003). However, even where coverage is successfully expanded, there are weak links in the chain linking health coverage to health outcomes. Previous work has identified, among these, low provider quality (Mohanan et al., 2017; Kruk et al., 2016; Powell-Jackson et al., 2015) and low rates of utilization (Banerjee et al., 2010). These and other aspects of performance of a health system will depend, inter alia, on how it is structured, and how healthcare is financed and delivered.[1]

This paper investigates the universalization of access to health in Brazil, a country that is considered a forerunner by the public health community and a potential model for other developing and developed societies (Harris, 2014; Atun et al., 2015). The Brazilian 1988 Constitution established universal and egalitarian access to health care as a constitutional right. Legislation instituted in the following years created the present Brazilian public health system, called the Unified Health System (SUS, for *Sistema Único de Saúde*). By virtue of guaranteeing free universal coverage, SUS comes closer to the British and Canadian models than to the subsidized health insurance schemes typical of most

[1] Kruk et al. (2018) estimate that 15.6 million excess deaths from 61 treatable conditions occurred in low- and middle-income countries in 2016, excess deaths being defined with reference to case-specific fatality rates in high-income countries. After excluding deaths that could be prevented through public health measures, they estimated that 8.6 million excess deaths were amenable to health care, of which 3.6 million were estimated to be due to non-utilization of available health care, and 5 million due to poor quality care.

developing countries. Prior to SUS, a major part of the population was forced to rely upon occasional access to philanthropic institutions, local public hospitals, or the private sector, when these existed (Paim et al., 2011). The new system was built on an integrated conception of public health – from primary care units, through medium-complexity facilities, to high-complexity hospitals – and rolled out through the expansion of a network of primary care community services, implemented under the Brazilian Family Health Program (PSF, for *Programa Saúde da Família*). This was accompanied by rationalization in the use of public health resources (Gragnolati et al., 2013). The result was a dramatic shift in health care provision from a centralized model structured around public hospitals in main urban centers to a decentralized one, where the first point of contact between the population and the public health system was placed in local communities. This shift allows us to interpret the implementation of the Family Health Program as marking the arrival of SUS in a municipality, as the expansion of the community health network was conceived as a way to expand primary care and to reorganize the allocation of care across the different layers of the public health system.

More specifically, in this paper we identify impacts of systems restructuring and expansion towards UHC. We explore the staggered process of the arrival of SUS across municipalities and use an event study framework for the analysis, allowing for duration effects and the inspection of pre-trends in the outcomes. A fairly unique contribution of this paper is that it estimates changes brought about by the introduction of a new health system in a unified and sequential way, along various dimensions over the chain linking health coverage to health outcomes – including rationalization in the use of resources, access to and utilization of health care, health outcomes, and inequalities in both access and outcomes. We focus upon maternal and child health as these are markers of population health.

We use several administrative data sets including vital statistics containing the universe of births and deaths and indicators of antenatal care, and hospitalization registers with information on admissions, main diagnosis, and patient demographics, as well as data on outpatient production, health infrastructure and public expenditures. In particular, among outcomes, we investigate maternal mortality, infant mortality (by age and cause of death), fertility and indicators of the quality of births. So as to investigate changes in equity, we present results broken down by education of the mother. The wealth of data available also allows us to analyze aspects of the optimal design of public health systems, such as the degree of complementarity across facilities of different complexity levels (primary care and hospitals). Finally, we conduct an exploratory cost-effectiveness analysis of the Brazilian experience of universalization of health. Although this exercise encounters data limitations and is sensitive to assumptions, we could find no similar estimates for the creation of health systems with no-fee universal access and public provision, whether for developing or developed countries.

Our main findings are as follows. We first document that the roll-out of the Unified Health System was associated with immediate and large increases in the population covered by primary care and attended by teams of general physicians, nurses and outreach workers. We also find an increase in home visits attended by professionals with a college degree, suggesting close monitoring where needed. In line with the intention to rationalize the use of resources in the public health system, we show that implementation was associated with a decline in hospital beds per capita and with a shift of outpatient care from specialists – gynaecologists and pediatricians – to general practitioners. There is no evidence of restructuring having reduced utilization: we find increases in prenatal care visits, hospital births, and maternal hospitalization for reasons other than delivery, alongside no change in infant hospitalizations. While cost-saving was built into the restructuring model, increased resources were committed to this ambitious venture and coverage increased concomitantly.

Turning to outcomes, we identify large impacts on mortality and fertility. We find significant reductions in maternal, foetal, neonatal and post-neonatal mortality. Although post-neonatal mortality is often responsive to policy interventions, maternal and neonatal mortality are not (for example, see Conti and Ginja, 2018), and foetal mortality is typically not studied. Importantly, most outcome responses are increasing in duration of exposure to the new system.

Improvements in access and health outcomes were concentrated among less educated women, while fertility declines were greater among more educated women. As the reduction in fertility among the more educated probably shifted the composition of births towards higher-risk births, our estimates of mortality decline are likely to be conservative. Finally, despite the very large reductions in mortality after birth, we find no evidence of improved health at birth. There is no significant improvement in birth weight, gestation length, or APGAR scores. This is likely the result of endogenous selection into the sample of births created by both foetal survival improvements and the education gradient in fertility.

We find significant complementarity between primary care and hospitals. In particular, the documented impacts are driven by municipalities that had a hospital prior to the expansion. Although primary care programs have been shown to be effective on their own in some contexts where the baseline level of development and public health infrastructure was low (Mann et al., 2010), our results suggest that within the epidemiological profile of medium-income countries, their potential is not realized in isolation (Boone et al., 2016). Thus devising ways to integrate community health care in smaller municipalities with higher-complexity facilities in other areas may be important to maximizing the gains from the ongoing process of universalization of access to public health.

Our results indicate that the expansion in access to health care for events surrounding birth led to a reduction in the yearly number of deaths of between 11,000 and 19,000. We estimate the cost per life saved to be between US$341 and US$582 thousand, which is well below currently available estimates for the value of a statistical life in Brazil (Lavetti and Schmutte, 2018). This suggests that universalization of health care with public provision and a no-fee for service approach can be cost-effective, even in the context of a medium-income developing country with limited state capacity.

This paper is related to a literature analyzing initiatives to extend health coverage in developed and developing countries. There are studies on the implementation of subsidized health insurance schemes in various countries in Latin America and Asia, including Colombia, India, Mexico, and Peru, among others (see, for example, Gaviria et al., 2006; Acharya et al., 2012; Camacho and Conover, 2013; Knox, 2018; Conti and Ginja, 2018). There is also a closely related literature on the initial implementation and subsequent expansions of Bismarck's health insurance in Germany, of Medicaid in the US, and of the Canadian National Health Insurance (Currie and Gruber, 1996; Hanratty, 1996; Bailey and Goodman-Bacon, 2015; Goodman-Bacon, 2018b; Bauernschuster et al., 2018). For Brazil, previous research has documented that the introduction of the community health network was associated with reductions in infant mortality (Rocha and Soares, 2010; Guanais, 2013; Harris, 2014), but it does not look at the range of process outcomes we consider. Thus it has not addressed how this goal was achieved and has not explored any of the systemic aspects of the implementation of the Unified Health System.

We contribute fairly novel evidence on how the *de jure* universalization of health care impacted actual access to different services, inequalities in health access and outcomes, the structure of health provisions across different layers of the health system, and cost effectiveness in the use of health resources, for which there is no evidence currently available. Overall, a particularity of our paper is that it looks comprehensively at the process and the broad implications of the introduction and expansion of a universal, no-access-fee, public-provision health system in a developing country. It thus provides potentially valuable information for the design of health systems in future efforts towards universalization in other developing countries.

The remainder of the paper is structured as follows. Section 2 outlines a brief history of the Brazilian Unified Health System and discusses its organizational structure. Section 3 describes the various datasets used in our analysis. Section 4 discusses our empirical strategy. Section 5 presents the results, Section 6 discusses robustness checks, and Section 7 provides a preliminary cost-effectiveness analysis. Finally, Section 8 concludes the paper.

2 The Brazilian Unified Health System

The Unified Health System, envisioned by the 1988 Brazilian Constitution and implemented by regulation instituted in the following years, is based on the principles of universal and equal access to public health, decentralization of health provision, and hierarchical organization of delivery. Within these principles, there is also great emphasis on the role of prevention and early detection as ways to improve health conditions at low cost.

Before the changes brought about by the constitution, public health in Brazil was based on a corporative system organized around occupational categories, each with different access to services and levels of coverage, which were typically provided by the Ministry of Health and the social security system (retirement and pension institutes of each occupational category). Workers in the informal sector or employed in less organized occupations or sectors had limited and irregular access to public health and relied partly on local philanthropic institutions and public hospitals, and on the private sector (with out-of-pocket expenses), when these were available (Paim et al., 2011). With the constitutional changes, access to health care became a universal right and public provision a responsibility of the state through the Ministry of Health.

Within this context of universalization and restructuring, the Family Health Program (PSF) emerged both as the primary care arm of the Brazilian Unified Health System and as the vector of structural change towards the consolidation of the new system (DAB, 2000). The program was designed to focus on prevention and provision of basic health care, to handle coordination of public health campaigns and actions, and to function as the first point of contact between citizens and public health provision within the newly designed hierarchical system.[2] According to the Brazilian Ministry of Health, the key characteristics of the PSF can be listed as follows: i) to serve as an entry point into a hierarchical and regional system of health; ii) to have a definite territory and delimited population of responsibility of a specific health team, establishing liability (co-responsibility for the health care of a certain population); iii) to intervene in the key risk factors at the community level; iv) to perform integral, permanent, and quality assistance; v) to promote education and health awareness activities; vi) to promote the organization of the community and to act as a link between different sectors of civil society; and vii) to use information systems to monitor decisions and health outcomes (DAB, 2000, as translated by Rocha and Soares, 2010).

The program targets provision of basic health care through the use of professional health-care teams directly intervening at the community level. Each team is responsible for a given number of families residing in a specific location. The teams are supposed to provide health counseling, orientation related to prevention and recovery, advice for fighting endemic diseases, and primary care for simpler health conditions. Typically, teams are composed of one family doctor, one nurse, one assistant nurse, and six health community agents. A health team follows between 3,000 and 4,500 individuals (roughly 1,000 families), and performs their work both in the basic health units and in the households. The motivation for this type of intervention is that, by accompanying families, health teams can monitor health conditions, teach better practices, and change habits, leading to improved outcomes. In addition, by interacting recurrently with the same population, community health teams should be able to detect early symptoms of more complicated health problems, which might require a more specialized type of care. In these cases, families would be referred to hospitals or specialists. This last point highlights the role of the PSF in the hierarchical restructuring of the Brazilian health system. Within the newly designed Unified Health System, simpler conditions should in principle be dealt with in the context of primary care, either in the households upon visits of community health workers, or in the community health centers. This should lessen the pressure on public hospitals, which then would be left to deal with more serious medical conditions and would not have to allocate specialized resources to conditions that in principle did not require them. The goal of the establishment of the hierarchical structure in the Brazilian public health system was precisely to rationalize this allocation

[2]The following description of the PSF draws from Rocha and Soares (2010).

of resources.[3]

The expansion of the PSF after the implementation of the Unified Heath System is portrayed in Figure 1. It started as a pilot project covering few municipalities in 1994 and grew into a nationwide large scale program in less than 10 years. By 2006, it was already estimated to cover more than 85 million people (Brazilian Ministry of Health, 2006). Key to our identification strategy is the fact that the expansion of the PSF after the introduction of the Unified Health System came from a centralized push by the Brazilian federal government, was fast, and did not seem to be related to local health shocks. The share of municipalities covered increased from zero in the early 1990s to over 90 percent by 2005. Rocha and Soares (2010) analyze explicitly the process of expansion of the PSF across municipalities and show that it was not correlated to previous health shocks, but instead seemed to be affected by the ideological orientation of the party holding mayoral office.[4]

In the decades following the 1988 Brazilian Constitution and the introduction of the new system, there were improvements along many dimensions of access to health services, health coverage and health outcomes. Figures 1 and 2 show that the roll-out of the Unified Health System across municipalities seemed indeed to be accompanied by some restructuring, with the increase in public spending being accompanied by expansions in primary care and declines in the density of hospital facilities. At the same time, there was also a continuous reduction in infant mortality, suggesting that the new system may have at least partly achieved its objectives.

3 Data

Municipalities are the smallest administrative units in the Brazilian political system. As the borders of some municipalities have changed over time, with new municipalities being created over the years, we combine municipalities into Minimum Comparable Areas (MCA's), which are the smallest geographic units that can be consistently compared over time.[5] Our main sample consists of balanced yearly data for 4,265 MCA's. In the remainder of the paper, we use the terms MCA and municipality interchangeably. Our main sample covers the interval between 1996 and 2004. Several of our variables of interest are available only from 1996 onwards. In addition, as shown in Figure 1, the interval between 1996 and 2004 is the period of fastest expansion in coverage and contains most of

[3]In administrative and budgetary terms, the PSF is a federally sponsored program that is implemented in a decentralized way by municipalities. The cost of maintaining one family health team was estimated to be of the order of R$ 215,000 to R$ 340,000 in 2000 (between US$ 109,610 and US$ 173,400 at the exchange rate of the mid-2000s) – the exchange rate (R$/US$) varied between 1.84 and 2.72 in the period under consideration. Given that a health team covers on average 3,500 individuals, these numbers would correspond to a yearly cost between US$ 31 and US$ 50 per person covered (FGV-EPOS, 2001). The federal budget allocated to the program expanded from R$ 280 million in 1998 to R$ 2.7 billion in 2005 (or from US$ 233 million to US$ 1.2 billion, using the same exchange rate as before).

[4]We address concerns related to the validity of the parallel trends assumption in our empirical strategy.

[5]We obtained the coding of MCA's from Ipeadata, and combined the municipality codes into MCA codes using the 1991 layer of minimum comparable areas as reference.

the variation used in our identification strategy.[6]

We combine data on health system restructuring and implementation of the Family Health Program with administrative records of births, deaths, hospitalizations, prenatal care, health expenditures, and registers of activities in ambulatory health facilities. Data on the date of implementation of PSF in each municipality, starting from 1996, were obtained from the Brazilian Ministry of Health (Department of Basic Attention, MS/DAB). Data on population coverage and number of teams by municipality are available from 1998 onwards. Since the PSF was implemented at the municipality level, we define the date of introduction of the PSF in an MCA as the first date at which any of its constituent municipalities implemented the PSF.[7]

Data on health outcomes and access to health care are also available from the Brazilian Ministry of Health (MS/Datasus). We construct data on infant and maternal mortality using microdata from the Brazilian National System of Mortality Records (Datasus/SIM). SIM gathers information on every death officially registered in Brazil. It contains data on cause of death, date of birth, and municipality of residence. We select all deaths of individuals up to one year of age (infant mortality) and of women aged 10 to 49 years. The National System of Mortality Records also provides an auxiliary dataset on fetal deaths (SIM – Óbitos Fetais), which are defined as deaths that occurred before the fetus was expelled or extracted from the body of the mother, independently of gestation length. In our main sample, the microdata record a total of 574,793 infant deaths, 565,452 deaths of women aged 10-49 years, and 163,720 fetal deaths.

The birth registers containing every registered birth are obtained from the National System of Information on Birth Records (Datasus/SINASC). These data provide information on birth weight, length of gestation, and APGAR score. The data also provide the exact date of birth, the municipality of birth, the municipality of residence of the mother, as well as selected characteristics of the mother, including age and schooling. The data contain a total of 27,501,026 births.

Administrative records of all hospitalizations are obtained from the National System of Information on Hospitalizations (Datasus/SIH). This dataset is managed by the National Health Care Agency (SAS/Ministry of Health) with the support of local and regional public health agencies, which receive information about hospitalizations from public and private hospitals through a standardized inpatient form, the AIH (*Autorização de Internação Hospitalar*). These data include all hospital admissions funded by the Brazilian Unified Health System. They provide information on cause of hospitalization, duration of stay, final outcome (discharge or death) as well as socioeconomic characteristics of the patient (municipality of residence, gender, and date of birth). Information on the cause of hospitalization considers the ICD-9 classification up to 1997, and the ICD-10 from 1998 onwards. Given that conversions of ICD-9 into ICD-10 classification levels are not readily available, for these data we

[6] In some robustness exercises in Section 6, we present results using a wider window of data. They are qualitatively similar to those obtained with our preferred sample.

[7] By choosing MCAs as units of analysis, we are probably losing some precision in the definition of treatment. In any case, results are very similar if we use municipalities instead of MCAs and restrict the sample to municipalities that existed throughout the entire period.

restrict the main sample to the 1998-2004 period. We select all hospital admissions of children up to one year of age (infant hospitalization) and of women aged 10 to 49 years, constructing alternative definitions of maternal hospitalization based on the full sample of women of reproductive age. We observe a total of 5,114,890 infant hospital admissions, and 19,951,777 maternal hospitalizations.

We also use the National System of Information on Ambulatory Care (Datasus/SIA), which contains administrative information on all ambulatory visits funded by SUS in which medical care is provided on an outpatient basis, including: diagnosis, observation, consultation, treatment, intervention, and rehabilitation services provided by health professionals. Ambulatory visits may take place in clinics, hospitals, health facilities that provide low-complexity primary health services, and PSF units. SIA provides microdata at the procedure level. For this reason, its use is limited by severe compatibility issues. Many procedure codes change over time, often either duplicating visits or aggregating multiple visits into a single string of data for procedures of low complexity. Despite its limitations, the dataset allows us to identify the number of different health facilities that provided a given health service in a given municipality and year. We are also able to identify the type of health professional that provided the service, including physicians by specialization, nurses, or community health agents. We use these data to analyze the supply of outpatient health care.

Other variables are obtained as follows. Information on hospital infrastructure (number of hospital beds and presence of hospital in the municipality) is obtained from the Ministry of Health. Administrative data on yearly municipality public expenditures, containing total as well as health spending, are obtained from FINBRA/Ministry of Finance. We collect data from the Ministry of Social Development (MDS/SAGI) on the coverage of the *Bolsa Família* Program, the main conditional cash transfer policy in Brazil (starting in 2004). Annual data on municipality population, by age and gender, are obtained from the Brazilian Census Bureau (IBGE, after *Instituto Brasileiro de Geografia e Estatística*).

Table 1 presents descriptive statistics in the baseline year of the sample period and details the sources of data. Average infant mortality was at 19 per 1,000 live births in 1996, when more than half of pregnant women still had less than 7 pre-natal visits and 93% of births took place in hospitals. In 1996, hospital facilities were present in 74% of municipalities, while the number of hospital beds per capita (per 1,000) was 2.61.

4 Empirical Strategy

We consider the implementation of the Family Health Program (PSF) as marking the arrival of the Unified Health System in a municipality. We explore the sequential process of implementation of the program starting in the mid-1990s and adopt a difference-in-differences strategy to analyze the effects of the universalization of public health.

Research designs working in such a setting often employ the single coefficient difference-in-differences

(DiD) estimator. As shown in Goodman-Bacon (2018a), this is only strictly valid when treatment occurs once, between the pre and the post period, generating fixed treated and control units. When treatment varies over time, arriving in some regions after others, there are in fact multiple experiments. Previously treated units can act as controls for later treated units because their treatment status does not change. However, if there are changes in treatment effects over time, these get subtracted from the DiD estimate, biasing the single coefficient estimator away from the true treatment effect. This is not a problem with the underlying design but, rather, with the restriction to a single coefficient. For this reason, we present throughout flexible coefficient estimates using an event-study style specification, as in Jacobson et al. (1993):

$$
\begin{aligned}
Health_{mt} \quad = \quad & \alpha + \sum_{i=1}^{I} \beta_{pre,i} \times PSF_{mt+i} + \sum_{j=0}^{J} \beta_j \times PSF_{mt-j} + \gamma \times X_{mt} \\
& + \theta_m + \mu_{st} + \epsilon_{mt},
\end{aligned}
\tag{1}
$$

where $Health_{mt}$ denotes a health-related outcome for municipality m in year t, PSF_{mt-j} are year-specific indicators for whether the municipality m has received the program in year $t-j$, PSF_{mt+i} capture whether municipality m will receive the program i years into the future, X_{mt} denotes a set of municipality controls, θ_m refers to municipality fixed-effects, μ_{st} are state-year fixed effects, ϵ_{mt} is a random error term, and α, β's, and γ are parameters.

We allow for state-specific time dummies because, in Brazil, various public policies that could end up affecting health – such as those related to education and public security – are at least partly determined at the state level. Further, it is often the case in developing countries that registration of births and deaths is incomplete, especially in more remote rural areas and among the poor. Although vital statistics data have greater coverage in Brazil than in many other developing countries, there are variations across regions, with coverage tending to be lower in poorer regions (Paes and Albuquerque, 1999). Municipality fixed effects included in all of our specifications control for constant differences but the implementation of PSF, at different times in different municipalities, may have improved registration. To the extent that surveillance of births and deaths is determined by state-level capacity, this will be addressed by our controls for state-specific time dummies.[8]

Our set of controls in X_{mt} includes a dummy for the presence of hospitals in the municipality, the local coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time.[9] To deal with the fact that the variance of some health outcomes (such as

[8] In the case of mortality specifically, this strategy deals with the potential problem of underreporting – systematic variation in mortality recording across states at a point in time, or across time within states, is controlled for by the state-year dummies. The remaining possibility of bias is that recording of health outcomes may be improved by the presence of PSF itself. This would bias the estimated coefficient in the direction of finding an increase, rather than a reduction, in mortality.

[9] The indicator for the presence of hospitals is not included in specifications in which the dependent variable characterizes the local health infrastructure, such as the number of hospital beds per capita and the presence of hospitals itself. PSF was interrupted in a very few municipalities, more specifically in about 2.4% of all municipality-by-year cells over the

mortality) is strongly related to population size, we weight regressions by the relevant population group in each specification. Finally, we cluster standard errors at the municipality level to account for the possibility of serially correlated and heteroscedastic errors (Bertrand et al., 2004).

A potential challenge to identification is that there may exist pre-existing trends in the outcome. Although the rollout of PSF across municipalities was not random, this would only bias our estimates if there were differential trends in the outcomes independent of PSF implementation.[10] We follow the conventional strategy in event-study analyses of testing the significance of the terms $\beta_{pre,i}$. Similarly, as mentioned before, we also include a sequence of β_j terms to allow for both a lag in program effects, and heterogeneity of treatment by time of exposure. Lags may arise if administrative and logistical barriers need to be surmounted before primary care is effective, and impacts may grow over time as staff are recruited, people gain trust in the new establishments and learn of their potential benefits. We estimate impacts on every outcome for each year in the eight years before and after the date of intervention.[11]

Our identifying assumption is that, conditional on fixed-effects and controls, the timing of the introduction of PSF is exogenous. In this case, a potential challenge to interpretation of our estimates, especially the duration effects, relates to compositional effects. Early reformers will have some missing pre-PSF years and late reformers will have some missing post-PSF years. Our finding of no evidence of differential pre-trends in the outcomes indicates that any factors predicting the timing of PSF implementation are captured by municipality fixed effects and the state-year controls in our model. We nevertheless show that expansion of the PSF was similar across municipalities with distinct baseline characteristics. See Figure 3 where each plot reports the increase in the coverage of the program for municipalities above *vs* below the median of the baseline characteristic.[12] This suggests that early and late reformers did not differ in terms of relevant observable determinants of health or markers of health convergence. While we cannot rule out differences in unobservables, the evidence suggests that any compositional bias is small. Still, even for coefficients far from the implementation date the interpretation of the estimates relies on variation in adoption for most municipalities. This is shown in Figure 4. By the end of our benchmark sample, about 60% and 70% of the municipalities had experienced at least 4 and 5 years in PSF, respectively.

Finally, a challenge in trying to analyze the impact of any program on access to health is disentangling demand from access. An intervention may increase, for example, heart and circulatory diseases hospitalization because it increased access, or because it had a perverse impact on the underlying

period of analysis.

[10]This may be the case if, for instance, PSF was implemented earlier in areas where (for example) infant mortality rates were already declining more rapidly. Rocha and Soares (2010) investigated PSF implementation as a function of a vector of likely observables and found that political orientation and other fixed initial characteristics were significantly correlated with the timing of adoption, past health shocks bearing little influence. Municipality fixed effects absorb most of this cross-sectional variation. Most importantly, we test for rather than assume the absence of differential pre-trends.

[11]Bailey and Goodman-Bacon (2015), for instance, use a similar specification in their analysis of impacts of a community primary care intervention in the United States.

[12]As computed in either 1991 (income per capita and the share of urban population) or 1996 (number of hospital beds per capita, municipal health expenditures per capita, infant mortality rate, the share of pregnant women accessing 7 or more prenatal visits).

incidence of heart and circulatory diseases in the population, therefore affecting demand. Since we typically do not observe the incidence of a certain health condition in the overall population, it becomes a difficult challenge to disentangle these two potential effects. For this reason as well, we focus most of our analysis on one particular health event for which we know the underlying demand and for which we also have a wealth of information on health-related outcomes: a birth.[13] By observing the number of births from birth registries, we know the underlying demand for services surrounding birth and maternal care, such as pre-natal visits. At the same time, we observe health outcomes at birth and have various pieces of information on child and maternal health after birth, from hospitalization records to mortality. We are therefore able to characterize restructuring, access, and health outcomes for events surrounding births in a reasonably accurate way. We use a vast array of variables constructed from the administrative health datasets to capture these dimensions.

5 Results

We present our main results in graphical form, plotting together in the same figure the estimated pre- and post-intervention coefficients $\beta_{pre,i}$ and β_j, based on estimates from equation 1, and their respective 95% confidence intervals. Regression tables that mirror the plots are in the Appendix Section A.

The different sets of results are presented in five subsections. We present the results in the following order: (i) restructuring of the system; (ii) access; (iii) health outcomes; (iv) socioeconomic heterogeneities in the effects on access and health outcomes; and (v) complementarities across different layers of the Unified Health Systems. Section 6 complements the results with some robustness exercises. We explain in detail the definition of each variable used as results are presented.

5.1 System Restructuring

Figure 5a shows a statistically significant increase in the number of PSF teams immediately upon the introduction of the program, with a slower but steady increase in the share of population covered. These plots are markers of compliance and suggest the timing of the expansion of the program within municipalities. Alongside with coverage expansion, we observe a tendency of the number of hospital beds to decline in tandem with a stable pattern in the overall presence of hospital facilities at the local level.

Also alongside with coverage expansion, in Figure 5b we observe that municipality health expenditures per capita increased by close to 20% in the first year of the program, and this increase was sustained through the following years. Figure 5c shows that outpatient productivity rose continuously, marked by an increase in the total number of outpatient procedures per capita, and a jump in

[13]The PSF also could have impacted access to family planning, therefore changing the number of births and possibly affecting selection. We also analyze this issue explicitly in Section 5.

home visits made by health personnel with a college degree (doctors and nurses). We also observe a tendency of educational in-group activities carried out by health professionals to increase in the first years of the program. Figure 5c also shows a decline in the density of outpatient facilities with specialists alongside an increase in facilities staffed with PSF teams. Outpatient facilities with a gynaecologist/obstetrician declined by 5% in the first year of the program, and 35% by the eighth year, while the corresponding decline in facilities with pediatricians was 9% and 50%, respectively.

These results are in line with the stated aims of the Unified Health System and PSF. They indicate some degree of substitution of general practitioners for specialists at the local level, and a tendency for hospital beds to decline, consistent with a new emphasis on primary care. The focus on primary care facilitates outreach and prevention, which may directly reduce the disease burden and hence the demand for specialized health care. In addition, it acts to sift cases, providing outpatient care where appropriate and referrals for inpatient (hospital) care for more specialized or serious cases. Unusually we have data that record facility-level activity, and these data confirm a sharp rise coincident with the introduction of PSF in home visits by college-educated personnel – an immediate increase of 0.02 (11%), rising to 0.07 (39%) in eight years. Similarly we see a jump in educational (outreach) activities carried out by health professionals – an increase of 0.036 (13%) in the first year rising to 0.106 (38%), consistent with prevention. We also witness a rise in outpatient procedures of 1.2 (4%) in the first year, rising to 7.1 (23%) by the eighth year.

Starting from a situation in which many individuals from lower socioeconomic background in both urban and rural areas had very limited access to basic public health care, the results so far suggest a positive change in the landscape. However, it is unclear a priori whether health outcomes improved, as this depends upon how well matched the intervention design was to the health needs of the population, and on the reach and quality of service provision at different levels of healthcare. Below we analyze data on access and health outcomes. In particular, we are able to assess whether maternal and child health suffered from the decline in pediatricians and obstetric specialists, or if the expansion of primary care was possibly more effective at expanding broad-based population health.

5.2 Access

Figure 6a presents effects on indicators of access to health services. There was an increase in access to prenatal care among pregnant women. This was most marked at the margin of 7 or more visits, which only 44% of the population achieved before the arrival of PSF and the process of system restructuring. The share of women accessing 7+ visits increased by 1.0 percentage points (2.2%) in the year marking the arrival of PSF, rising to 7.2 percentage points (16%) by the eighth year.[14]

Despite no significant increase in the density of hospital facilities, the share of hospital births increased gradually by 0.6 percentage points (0.63%) in year-2 and by 1.8 percentage points (1.9%) in year-8.

[14]The birth records data report prenatal visits as 0, 1-6 or 7-plus so our construction of outcome measures is restricted by the available data.

The pre-intervention mean was 96%, so the low-hanging fruit had been picked, suggesting that this small increase may mark efficacy of information or referral. This is impressive given recent evidence that it can be difficult to encourage women to give birth in institutional facilities (Mohanan et al., 2014), albeit this evidence is from India where variation in hospital quality is probably greater than in Brazil. The share of caesarean sections also increased through the period, by 1.7% (0.83%) in the third year, and by 3.3% points (9.1%) by year-8, on a pre-intervention mean of 38%. By itself, this increase in C-sections should not be seen as positive, given that extreme high rates observed in Brazil.[15] But it does indicate an increase in supervised births.

In Figure 6b we assess hospital admissions. We recorded above suggestive evidence that hospital beds and density declined with the restructuring of the system and this, in principle, may have led to a supply-driven decline in hospitalization. On the premise that expanding primary care allows general practitioners to catch health problems early and deal with them, we may have expected demand-driven declines in hospitalization for causes that are amenable to primary care. We find an increase in maternal hospitalization rates (MHR) for reasons other than delivery, i.e. pregnancy complications, which are typically not amenable to primary care (Alfradique et al., 2009). These rates increase by 0.39 percentage points (4.5%) in the first year, climbing steadily to 4.2 percentage points (48.8%) in the eighth year. There is no significant change in maternal hospitalizations for delivery-related reasons, or in infant hospitalizations, consistent with these conditions being amenable to primary care. At this stage, it is still not clear whether the increase in hospitalization indicates increased access or deterioration in the health of the mothers. As we show in the next section, health outcomes of mothers and children indeed improved with the implementation of the Unified Health System, so this increase in hospitalization seems indeed to indicate increased access.

To put our findings in perspective, consider that, in the US, transitioning into age-determined eligibility for Medicare in above-median spending regions increases the probability of at least one hospital visit by 36% and the probability of having more than five doctor visits by 25% relative to similar individuals in below-median spending regions (Callison et al., 2018). The authors argue that their results provide support for a causal supply-side explanation of regional variation in health-care utilization. In our setting, results are likely to be a combination of an increase in the share of supervised births, for which complications can be detected and referred to the hospital, with the change in the rationalization in the use of resources in the system, so that, despite the reduction in density, hospital resources became increasingly available for the populations of lower socioeconomic status.

In summary, the results so far indicate a substantial increase in prenatal and outpatient care, alongside an increase in hospitalization for pregnancy complications that are not readily treated by general practitioners. Given a tendency for decreasing hospital capacity, this lines up with system restructuring having contributed to (a) dealing with cases amenable to primary care, and (b) as first point of contact, performing triage and referral to hospital for cases that needed it. Our findings for changes in

[15] According to the latest records from the United Nations Children's Fund (2007-2012), Brazil ranked first place with the highest cesarean section rate among 139 countries in the world.

infrastructure and access would lead us to expect health outcomes to have improved. We investigate this next.

5.3 Maternal and Child Health Outcomes

5.3.1 Maternal Mortality

We have maternal mortality rates (MMR) identified by ICD-10 code under the chapter O, and in line with global conventions, these refer to mortality of women within 42 days of childbirth. However, maternal mortality as a cause of death is thought to suffer from a serious reporting problem in Brazil. Szwarcwald et al. (2014) discuss this issue in further detail and present some aggregate estimates for maternal mortality in the country. For this reason, alongside estimates for MMR we also report estimates for female mortality rates in the reproductive ages (age 10-49), a large share of which is determined by MMR. Although MMR is more often reported per birth, since fertility is potentially endogenous, we also present MMR per woman, which will account for any effects on fertility.

In Figure 7 we observe a clear tendency for sharp reductions in maternal mortality (MMR) and, more precisely determined, in mortality among women of reproductive age (FMR), upon the arrival of PSF and the process of system restructuring. The coefficients for FMR are statistically significant from year-2 onwards, the coefficients for MMR exhibit a similar pattern but are imprecise until year-5 (per birth) or year-7 (per woman). The percentage reductions in MMR (FMR) per woman are strikingly similar, at 3.2 (2.2) in year-1, growing to 32.3 (26) in year-8. The percentage reductions in MMR (FMR) per birth are 5.2 (3.2) in year-1 and 42.3 (39.4) in year-8.

To place these changes in perspective, consider that over a 25 year period, 1990 to 2015, maternal mortality worldwide dropped by about 44% (World Health Organization, 2015), close to the 39% decline generated by eight years since the beginning of the process of universalization of health care at the municipality level, as marked by the arrival of PSF. It is also useful to compare this latter expansion with a different policy approach. Using quasi-experimental variation in policy implementation across countries, Bhalotra et al. (2018a) estimate that the introduction of quotas for women in parliament led to a roughly 10% decline in maternal mortality on average, which rises to 13% ten years after exposure (roughly two electoral terms). While this is impressive on its own, the 13% drop after ten years pales in comparison to the drop of 39% after eight years from the implementation of PSF and the process of system restructuring.

5.3.2 Infant Mortality

We present results for foetal, neonatal and infant mortality and sub-categories of neonatal and infant. Figure 8a displays a consistent tendency for every measure of pre and post birth mortality to decline with the process of system restructuring. The infant mortality rate exhibits a significant drop of 9.4%

in year-2, rising steadily to 36.3% in year-8. In relative terms these are reductions of 1.72 and 6.58 percentage points, on a sample mean of 18.12 deaths per 1000 births. We used a classification of causes of death into those that are amenable to primary care (ICSAP), and those that are not (non-ICSAP).[16] ICSAP causes account for 11.3% of all infant mortality. As shown in Figure 8b, we find marked declines in infant mortality from both ICSAP and non-ICSAP causes. This is important because it establishes that the expansion in primary care did not generate a trade-off with non-primary care. It also indicates that both the prevention and treatment of simpler conditions as well as referral of more complex conditions to hospital care were addressed.[17] We also find mortality declines across a vast array of causes of death, as shown in Figures 8c and 8d.

The bio-medical literature tends to distinguish neonatal (first 27 days) from post-neonatal (28 days and onwards to age 1) mortality in infancy. We have an unusual granularity in the administrative death records, allowing us to also report estimates that split neonatal mortality into death in the first day of life vs the rest of the first month. Interventions that address pregnancy/maternal risk factors will tend to exhibit impacts in the first day or month after birth, and interventions such as immunization and nutrition will tend to exercise larger impacts on post-neonatal mortality. Figure 9 presents the results. Postneonatal mortality shows a significant decline of 4% in the first year upon the arrival of PSF, rising to 36% in year-8 (mean of 7.21 per 1000 births). Neonatal mortality decline is only statistically significant from year-3, rising steadily to 36.2% in year-8 (mean 10.9). Mortality in the first day vs the rest of the first month of life both show significant declines, the former slightly larger in percentage terms. Foetal mortality also shows a steady decline, becoming precisely determined from year-5 and rising continuously to a reduction of 38.7% in year-8 (mean of 4.8 per 1000). These results suggest that the implementation of PSF and the process of system restructuring effectively improved both the prenatal and post-birth health of children. In particular, the very substantial reductions in foetal and neonatal mortality, and the reduction in infant mortality from congenital causes (Figure 8c), all suggest improvements in maternal health which may cover a wider range of conditions than those which determine maternal mortality.

To put these achievements in perspective, we note that the 36% decline in each of infant and neonatal mortality associated with eight years of exposure to the intervention compare favourably with global declines in these rates of 49.2% and 47% respectively in the last 25 years (1990-2015). A recent analysis of *Seguro Popular* (SP), rolled out in 2002-2010 across Mexican municipalities, identifies a 10% reduction in infant mortality which is only evident at three or more years of exposure, and restricted to a sub-sample of poorer municipalities (Conti and Ginja, 2018). In contrast we found a significant drop of 9% in year-2, rising steadily to 34% in year-8.[18] In India, where infant mortality among girls bears the brunt of macroeconomic fluctuations in income, it is estimated that a 4.4 percent increase in

[16]We base this classification on Alfradique et al. (2009), which adapt the international ICD10 list of conditions amenable to primary care to the Brazilian context.

[17]We implemented the same distinction for infant hospitalization, ICSAP causes accounting for 40% of all infant hospitalizations. The estimates were imprecise for both sub-samples, indicating insignificant changes, in line with the pooled sample result.

[18]Infant mortality is about two-thirds of child mortality and child mortality reductions worldwide are more rapid, which makes the difference in the success of the Brazilian and Mexican programs even larger.

state income (the median income shock in the sample period) led to a decrease in infant mortality of 0.25 percentage points for girls, much smaller than the 1.73 percentage point drop in the first year upon the arrival of PSF (which rose to 6.55 by year-8).[19]

5.3.3 Fertility and Quality of Births

Figure 9 shows that fertility exhibits a clear pattern of decline immediately upon the intervention, and this is true for the count and the rate, and for births to teenage women and older women. The overall rate of births per woman of reproductive age is 5% at baseline. The immediate decline is 2.1% (year-1), rising steadily to 6.4% in year-3 (at which point it becomes statistically significant) and 21.4% in year-8. Teenage fertility (age 10-19), which has a baseline rate of 3%, falls in parallel, falling 3% in year-1, 6% by year-3 and 21.1% by year-8.

The PSF may have stimulated fertility decline directly through outreach workers providing information about birth control, and local clinics providing contraceptives.[20] In Figure 5c we showed that the intervention was associated with educating people on health matters. Alternatively or, in addition, fertility may have declined in response to reductions in mortality. As discussed below, fertility decline stems more from more-educated women, while mortality decline stems more from less-educated women, which suggests that mortality reduction is not the main driver.[21]

Figure 10 shows no significant change in the quality of births. Birth weight and APGAR-1 scores show no consistent pattern, while indicators for low birth weight, APGAR-5 and gestation of at least 37 weeks suggest a deterioration, even if all coefficients are indistinguishable from zero.

The same reproductive health service expansion that we have observed led to survival improvements may have been expected to also yield improvements in indicators of health at birth. Potential explanations of our finding that there were none include selective foetal survival (we documented declines in foetal mortality, so the marginal birth post-intervention is likely to have been more fragile); endogenous heterogeneity in fertility decline that, as we noted above, raised the share of births from higher-risk (less educated) mothers; and endogenous increases in the use of C-sections (which may be associated with breathing difficulties among newborns). These results imply that our estimates

[19]See Bhalotra (2010) for the case of India.

[20]Bailey (2012) shows that the introduction of the pill in the US led to a decline in the fertility rate of 2% within 5 years of establishing federal family planning programs. This is of similar magnitude to the immediate decline we estimate.

[21]It is useful to compare our estimates with estimates of the quantity-quality tradeoff in another setting where both infant and maternal mortality declined at the same time. This was the case following the introduction of the first antibiotics in America. This led to a sharp decline in infant pneumonia mortality of 28%, which is estimated to have led to a decline in fertility of between 4.0 and 7.4%. However, this was entirely offset by an increase in fertility stemming from the concomitant decline in maternal mortality of 42% (Bhalotra et al., 2018b). We take away two things from this comparison. First, if it were the case that fertility decline in our sample was entirely driven by infant mortality decline so that we could take the ratio of our reduced form coefficients to estimate the "quantity-quality tradeoff" (defined as the drop in fertility in response to lower infant mortality), then the trade off is larger but broadly in line with the historical estimate. However if, as in early twentieth century America, maternal mortality created offsetting increases, then our observation of net fertility decline in Brazil suggests that the direct impacts of PSF on fertility through enhancing birth control or changing preferences for fertility may have been large.

of impacts on early childhood mortality are conservative. Since boys are more vulnerable to foetal death (Gluckman and Hanson, 2004; Low, 2015), the share of boys at birth is an indicator of foetal health. We examined this and we find a slight tendency towards increase, in line with our finding of reduced foetal mortality. However these estimates are imprecise.

5.4 Gradients in Program Impact on Access and Outcomes by Education

We analyze socio-economic gradients by dividing the sample of mothers in the vital statistics data into more and less educated women, polarized so that high refers to having at least 12 years of schooling and low to having no schooling. The population of women of reproductive age in a municipality and year is not readily available by education, and it is potentially endogenous because the implementation of PSF and the process of system restructuring led to maternal mortality decline. Therefore when looking for education gradients in impacts, we measure fertility as a count rather than a rate – in particular, as the logarithm of the number of births in a municipality and year. The baseline population of women at risk of birth is absorbed by municipality fixed effects. We similarly use the logarithm of the total number of deaths when studying mortality outcomes. We may expect larger improvements among less educated women because they have higher baseline rates of fertility and child mortality, allowing more room for improvement. However, educational differences may be mitigated or even reversed if educated women are more likely to respond to health-related information and services.[22]

Figure 11a shows that the increases in prenatal care visits and C-section births come from less educated women, while the increase in the share of hospital births comes from both groups. Figure 11b shows that maternal and infant mortality decline is only precisely identified among women with low levels of education. Although the dynamic response of birth weight post-intervention remains statistically insignificant in each group, as it was on average, separating women by education reveals that the tendency for birth weight to deteriorate stems from less educated women, consistent, for instance, with their witnessing greater foetal mortality decline.

While evident in both groups, fertility decline is larger and only statistically significant among more educated women. Although baseline fertility was higher in the less educated group, it may be that fertility among less educated women was encouraged by declining maternal mortality (Bhalotra et al., 2018a; Albanesi and Olivetti, 2014). Declining infant mortality will have reduced fertility more among educated women if they perceive higher returns to investment in their children (Becker and Tomes, 1979). Educated women may also have been more responsive to information concerning contraception (Rosenzweig and Schultz, 1989).

[22] In the hospitalization data we do not have education but we do have the zip code of the individual. We classified all individual hospitalizations into poor and non-poor zip-codes, identified by using GIS to associate zip-codes with income in the 1991 census track, and cutting the sample at the median income. We do not report these results because the data had non-random missing observations and the estimates were noisy.

5.5 Gradients in Program Impact by Baseline Hospital Infrastructure

Next, we investigate whether the marginal impacts of the implementation of PSF and the process of system restructuring varied with the baseline presence of public hospital facilities. In 1992, about only 35% of all municipalities had a public hospital with inpatient services.[23] As portrayed in Figures 12a-12c for the main indicators of access and outcomes, we consistently find that impacts are stronger in places with pre-existing hospital facilities. The figures confirm that this is not on account of pre-trends in the outcomes within the sub-samples with *vs* without a hospital. Also, it is not because the PSF expanded more rapidly in areas with pre-existing hospital facilities. In fact, as shown in Figure 12d, PSF teams per capita grew more rapidly in areas without a hospital at baseline – which is in line with the PSF intending to reach more remote places with poorer healthcare.

Appendix Section B shows additional regression tables in which we run the typical single coefficient DiD regression, but include an interaction term between PSF and the indicator for pre-existing public hospital, alongside with interaction terms between PSF and both the income per capita and the share of urban population calculated at the municipality level based on data from the 1991 Census. In general, the PSF interaction with hospital at the baseline is statistically significant conditional upon income and urbanization. Interestingly, although prenatal visits do not behave differently in both groups, mortality declines are particularly observed in places with pre-existing hospital facilities, despite an increase in low birth weight.

Overall, in terms of structure of local public health providers, we find that impacts thus come almost exclusively from municipalities that already had some existing higher-level public health infrastructure when universalization took place: gains in access and outcomes are large and significant in municipalities that had a hospital in the beginning of the sample, but small and mostly non-significant in municipalities that had no high-complexity facilities. This result points to a strong complementarity between primary care units and hospitals in realizing the potential gains from universalization of access to health. To take one example, we document an increase in prenatal care visits following system restructuring, at which some women may have been advised to have an ultrasound scan or an X-ray to avoid a potential complication. However, these facilities were typically only available in hospitals. Figuring out ways to integrate community health care in smaller municipalities to higher-complexity facilities in other areas may therefore be an important step to maximize the gains from the ongoing process of universalization of access to public health in this context.

6 Robustness Checks

There are two main identification challenges to the approach we take. First, we need to test whether significant changes in outcome variables upon the introduction of the program in a municipality

[23]Data from *Pesquisa de Asssitência Médico-Sanitária* (AMS 1992), publicly available by IBGE.

might reflect pre-existing trends, or mean reversion. Studying the coefficients to the left of the vertical line indicating the date of intervention, we see no evidence of pre-trends, or of upticks in outcomes in the year before the arrival of PSF that might generate spontaneous reversion behaviour. This is confirmed by formal tests of significance in the Appendix Section A tables containing the corresponding regressions.

A second challenge arises if unobserved events or policy changes coincided with the arrival of the PSF across municipalities. The main candidate concern here is the local political economy – for instance, if the municipality government introducing PSF also introduced other programs that may have impacted health access or health outcomes, then we may not be capturing effects of the process of system restructuring but of those other programs. However, we showed in Figure 5b that there is a structural break in local public health expenditure coincident with the arrival of PSF but no change in other local government expenditures. This greatly mitigates that concern. *Bolsa Família*, a large cash-transfer program that, inter alia, was conditional upon immunization for children, started expanding significantly only towards the very end of our sample period, in 2004 (it was created in the end of 2003, adapting a previously existing small-scale conditional cash transfer program, *Bolsa Escola*, created in 2001). We nevertheless have consistently controlled for the population coverage of this program in the municipality. Also, the equations control for state-year fixed effects, which help address concerns about both pre-trends and unobserved factors that coincide in timing with the program of interest.

It is useful to assess how much difference the controls make to the estimates shown. As we have a multitude of outcomes, for parsimony, we test the extent to which our results on prenatal visits (access) and infant mortality (health outcome) respond to different sets of covariates. Figure C.1 in the Appendix Section C presents the results. In the specification "No Control", we include only year and municipality fixed-effects, while in "Controls" we add a dummy for the presence of hospitals in the municipality, the local coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Finally, we add state-specific time dummies in the remainder one. We find a stable pattern across the different specifications.

For municipalities joining the program after 1996, the data contain less than eight post-intervention years since we have restricted the sample to end in 2004. To investigate if the coefficients are sensitive to this, we extended the sample forward to 2010.See Figure C.2 in the Appendix Section C, which shows that the pattern of coefficients is similar for prenatal visits (access) and infant mortality rates (health outcomes). We do not use this sample in the main specification because that there are virtually no untreated units as we move into the later years of the 2000's, so identification of treatment effects becomes much noisier and relies almost entirely on the comparison of different exposures to treatment.

It seems plausible that the expansion of primary care facilities improves the registration of births and deaths, precision in classifying cause of death (with more local doctors available to diagnose cause of death), and records of clinic attendance. Relative to many developing countries, vital statistics data in Brazil have been comprehensively gathered since the early 1990s, but rural births and deaths are likely to have been under-counted relative to urban births and deaths. If expansion of the PSF led to more extensive registration then birth and death counts will have jumped at PSF implementation. As discussed in Section 3, this implies that our estimates of declines in fertility are conservative. It is harder to sign the bias on estimates of declines in mortality rates since both the numerator and denominator will tend to increase with improved coverage. However we find sharp declines in death counts (i.e. keeping just the numerator) and so, again, our estimates of declines in death counts will tend to be biased downward. The classification of deaths by cause is more tricky and we find some evidence that this did improve. One of the causes of mortality in our data is labelled ill-defined, and another is labelled other. Using the same event study specification as for other causes of death, we found marked declines in each of these, statistically significant for the first year, right after the implementation of PSF and the process of system restructuring. The implication of this is that our estimates by cause of death are likely to be either underestimated (if deaths by ill-defined causes are assigned to other causes of death over time) or increasingly more precisely estimated (if there is just a net reduction in mortality from ill-defined causes).

7 Cost-Effectiveness Analysis

It is not an easy task to conduct a cost-effectiveness analysis of a process of system restructuring and expansion such as the one represented by the introduction of the Unified Health System in Brazil. There is really no direct cost estimate associated with the policy. One might be tempted to use the expansion in municipality expenditures on health discussed before as such number, but this would clearly underestimate the change in health costs. Municipal expenditures are only a part of the overall costs associated with the reform of the health system, and they are concentrated mostly on primary care, leaving aside changes in costs associated with higher complexity procedures, and with measures introduced at the state and federal levels.

We choose instead to start from the aggregate expansion in health expenditures in Brazil and, from there, try to reconstruct the change in costs associated particularly with events surrounding birth, which are the focus of our empirical analysis. Between 1995 and 2005, the period marking the main expansion of the Unified Health System, public expenditures on health increased by 57% in real terms, far ahead of the rate of growth of the economy, so that the share of GDP allocated to public health increased by 0.63 percentage points. This amounted to an expansion of US$22 billion (in 2010 values) in the Brazilian public health budget in only 10 years. Our goal is to provide an estimate of how much of this increase was due to the expansion and reorganization of health provision associated with events surrounding birth.

We have the composition of federal expenditures on health (a bit more than half of the total throughout the period) for 1996 and 2004. This includes the following expenditure categories: personnel, medium and high complexity procedures, basic attention, medicines, and other expenditures (sanitary surveillance, research, sanitation, etc.). In order to be as conservative as possible, we assume that 100% of the expenditures on basic attention are related to events surrounding birth. As for the "other expenditures" category, we assume that they are not directly related to events surrounding births. For the remaining three categories – personnel, medium and high complexity procedures, and medicines – we must assign a share of costs to events surrounding birth. For the 2000's, we can calculate the share of all hospitalization costs related to children below 1 year of age and to pregnancy and birth related procedures. This number amounts to, on average, 22.7% of total hospital expenditures. Since we do not have another source of cost information that allows for this type of decomposition, we assume that this number applies to the three remaining categories listed before (personnel, medium and high complexity procedures, and medicines). In fact, at least 89% of the cost related to these three categories comes from personnel and medium and high complexity procedures, which are indeed related to a great extent to hospital costs. So this approximation is likely to be quite reasonable. We assume that the same composition of federal expenditures on health applies to state and municipal expenditures. Under these assumptions, we estimate that there was an expansion of US$ 6.3 billion in health expenditures related to events surrounding birth (and up to 1 year of age). This is our benchmark cost number, but we also consider some alternative hypotheses when discussing the cost-effectiveness of the introduction of the Unified Health System in the next paragraphs.

As for the effects of the introduction of the new system, we look at the numbers from 2005 when the main phase of expansion was complete. We think of this cost-effectiveness exercise as comparing the initial situation without coverage to what would be the close to steady-state situation of the program in 2005, when 91% of municipalities (accounting for 95.5% of total births), were already covered and further expansions slowed down substantially. In order to be conservative and take into account the issue of potential selection in our estimates of the long-term effects of exposure to the new health system, we choose the coefficient corresponding to the fourth year of program exposure as corresponding to its average long-term effect on health outcomes. This is a conservative decision because our results indicate that effects increase substantially between the fourth and eight year of implementation. The four-year effect of the program corresponds to a reduction of 3.7 in the infant mortality rate and 2.7 in the female mortality rate at reproductive ages (both calculate per 1,000 births). Given the number of births and municipality coverage observed in 2005, these would correspond to a reduction of 18,597 in the yearly number of deaths.

Using the cost number discussed in the previous paragraph, our estimates imply a cost of US$341 thousand per life saved. This number is considerably below the estimates currently available for the value of a statistical life in Brazil, which are of the order of US$1.16 million (based on the estimates presented by Lavetti and Schmutte, 2018, adjusted for 2010 US$).

In order to illustrate the sensitivity of the cost calculations to our simplifying assumptions, we consider some extreme alternatives. A first concern might be related to the share of health expenditures associated to events surrounding birth and up to one year of age. We used the composition of hospital costs to assign those values and argued that this should be a reasonable approach, given that hospital costs are indeed the major part of expenditure categories associated with higher complexity procedures, personnel, and medicines. One extreme alternative would be to assume that all growth in expenditures not related to "other expenditures" was associated to events surrounding birth, in which case the relevant number for the increase in expenditures would be US$13.9 billion. This is clearly a grossly overestimated cost number, since it considers that there is no growth in hospital, personnel, or medicine costs that are related to the treatment of, for example, chronic conditions, old age diseases, cancer, etc. Nevertheless, even in this case we obtain a cost of US$750 thousand per life saved, considerably below the estimated value of a statistical life.

Another alternative concerns the fact that we use the composition of expenditures at the federal level as representative of the composition of expenditures at the state and municipal levels. If state and municipal expenditures are more concentrated on primary care, which at the margin might be the case, this could bias our cost estimates. The extreme alternative in this case would be to consider all state and municipal expenditures on health as being related to events surrounding birth. This, again, would be a grossly overestimated cost number, since the vast majority of public hospitals in the country are run by states and municipalities and, obviously, they take care of all types of health conditions. Even under this scenario, we estimate an expansion in health expenditures related to events surrounding births of the order of US$17.2 billion, and a cost per life saved of US$ 925 thousand.

Finally, a more serious concern related to our benchmark cost-effectiveness calculation is that we use all female mortality between 15 and 49 as a proxy for maternal mortality. Maternal mortality is an important cause of death in this age group, but it is possible that the expansion of the Unified Health System also reduced mortality due to other causes of death for females of reproductive age. In that case, part of the reductions observed in female mortality would not be related to improvements in access to health related to events surrounding birth. The alternative in this case would be to ignore the underreporting and look at maternal mortality only, instead of looking broadly at female mortality at reproductive ages. In this case, we estimate a yearly reduction of 10,916 in the number of deaths and a cost of saving a life of US$582 thousand. Combing this number with our benchmark calculation gives us lower and upper bounds on the cost per life saved of, respectively, US$341 thousand and US$582 thousand.

Even if we make extreme assumptions regarding the expansion in costs associated with events surrounding birth and very conservative assumptions regarding the effect of the introduction of the Unified Health System, we still obtain quite positive numbers from a cost-effectiveness perspective. Notice as well that these calculations consider only the effects on mortality, therefore ignoring other benefits from the expansion of coverage on morbidity and, through that, on future socioeconomic outcomes. Considering these additional dimensions, it seems clear that the introduction of he Unified Health System in Brazil achieved improvements in health outcomes surrounding birth at considerably low cost. The fact that the system still displays significant inefficiencies along various dimensions indicates that universalization of health care with public provision and a no-fee for service approach can be cost-effective, even in the context of a medium-income developing country with limited state capacity.

8 Final Remarks

Brazil is a forerunner in the provision of universal health coverage through a unified health system. Aggregate trends show impressive improvements in indicators of population health since democratization in 1988. So as to identify causal effects of the introduction of universal health coverage through the Unified Health System, we exploit municipality-level variation in the expansion of the Family Health Program (PSF). We show that re-structuring and, in particular, the massive expansion of primary health care since 1995 has resulted in large and sustained declines in maternal, foetal and infant mortality. These reductions have been most marked among less educated women, with higher baseline mortality rates.

We provide some of the scarce structured evidence that universal health coverage can work when targeted at primary care. We also show that a mechanism for these improved outcomes was improved access to both primary and hospital care (the latter, especially for conditions less treatable with primary care). Importantly, despite our finding that PSF-expansion was associated with a decline in hospital beds and specialists per capita, we find no evidence that hospitalization for morbidities that required hospital care was compromised. Also, we document strong complementarities across public health facilities of different complexity levels, with the impact of the introduction of community health services being particularly strong in localities with the presence of a public hospital.

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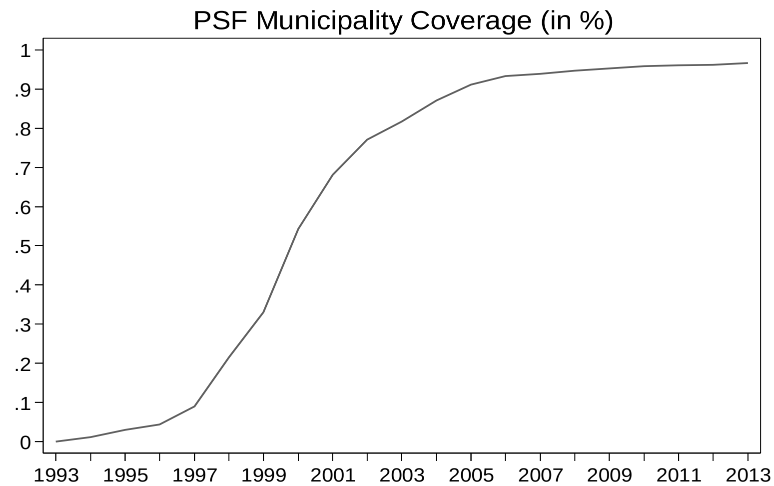
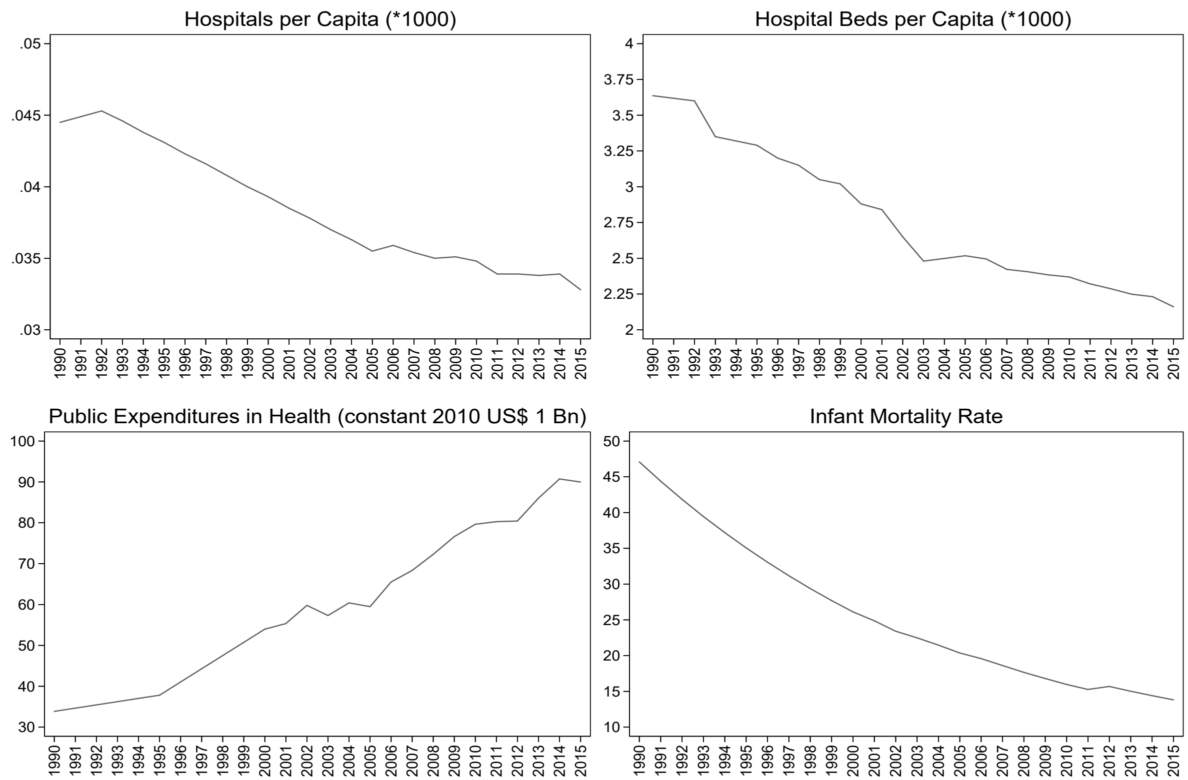
Main Figures and Tables

Figure 1: PSF Expansion



Source: Brazilian Ministry of Health, SAS/Dept de Atenção Básica – DAB.

Figure 2: System Restructuring, Public Expenditures and Health Outcomes



Sources: SIM/Datasus, FINBRA/STN, Brazilian Ministry of Health, SAS/Dept de Atenção Básica – DAB.

Table 1: Main Descriptive Statistics (at the baseline year)

	Obs.	Mean	Stand Dev	Min	Max	Source of Data	Baseline Year
Municipality Public Expenditures and Health Infrastructure							
Total Expenditures, Except in Health (in R$ per capita)	4,022	613.0	416.2	0	7620	Finbra	1996
Expenditures in Health (in R$ per capita)	4,022	135.5	116.2	0	1969	Finbra	1996
Dummy for Hospital	4,267	0.74	0.44	0	1.00	Datasus	1996
Hospital Beds (per capita*1000)	4,267	2.61	3.24	0	69.57	Datasus	1996
Number of Health Facilities with Ambulatory Service (per 1000 women 10-49yo)							
Total	4,267	1.42	1.09	0	19	Datasus/SIA	1996
With Obstetrical / Gyneco. Services	4,267	0.25	0.35	0	4	Datasus/SIA	1996
With Pediatric Services	4,267	0.22	0.36	0	4	Datasus/SIA	1996
Number of Outpatient Procedures							
Total (per capita*1000)	4,267	8.65	5.86	0	71.85	Datasus/SIA	1996
Household Visits (per capita*1000)	4,267	0.22	0.52	0	6.37	Datasus/SIA	1996
Household Visits by College Degree Personnel (per capita*1000)	4,267	0.01	0.06	0	2.36	Datasus/SIA	1996
Household Visits by Non-College Degree Personnel (per capita*1000)	4,267	0.22	0.51	0	5.91	Datasus/SIA	1996
N. of Educational Activities in Group (per capita*1000)	4,267	0.02	0.08	0	1.42	Datasus/SIA	1996
Access to Health Services (Mean, Conditional on Birth)							
Prenatal Visits None	4,102	0.12	0.15	0	1.00	Datasus/SINASC	1996
Prenatal Visits 1-6	4,102	0.44	0.24	0	1.00	Datasus/SINASC	1996
Prenatal Visits 7+	4,102	0.44	0.27	0	1.00	Datasus/SINASC	1996
Birth at Hospital	4,150	0.96	0.12	0	1.00	Datasus/SINASC	1996
Share C-Sections	4,155	0.38	0.23	0	1.00	Datasus/SINASC	1996
Maternal Mortality and Hospitalization Rates (per 1000 women 10-49yo)							
Female Mortality Rate (Irrespective of Cause)	4,267	0.98	0.73	0	6.34	Datasus/SIM	1996
Maternal Mortality Rate (MMR, only if ICD10="O")	4,267	0.03	0.10	0	1.90	Datasus/SIM	1996
Female Mortality Rate (Irrespective of Cause, per 1,000 population 0-1yo)	4,265	16.57	13.60	0	166.7	Datasus/SIM	1996
Maternal Mortality Rate (MMR, only if ICD10="O", per 1,000 population 0-1yo)	4,265	0.40	1.52	0	28.57	Datasus/SIM	1996
Maternal Hospitalization Rate (MHR, only if ICD10="O")	4,267	54.34	21.50	0	397.1	Datasus/SIH	1998
MHR: Only Deliveries	4,267	44.41	20.09	0	347.7	Datasus/SIH	1998
MHR: Only Complications	4,267	9.93	8.32	0	73.35	Datasus/SIH	1998

Table 1: Main Descriptive Statistics (at the baseline year) – *Cont.*

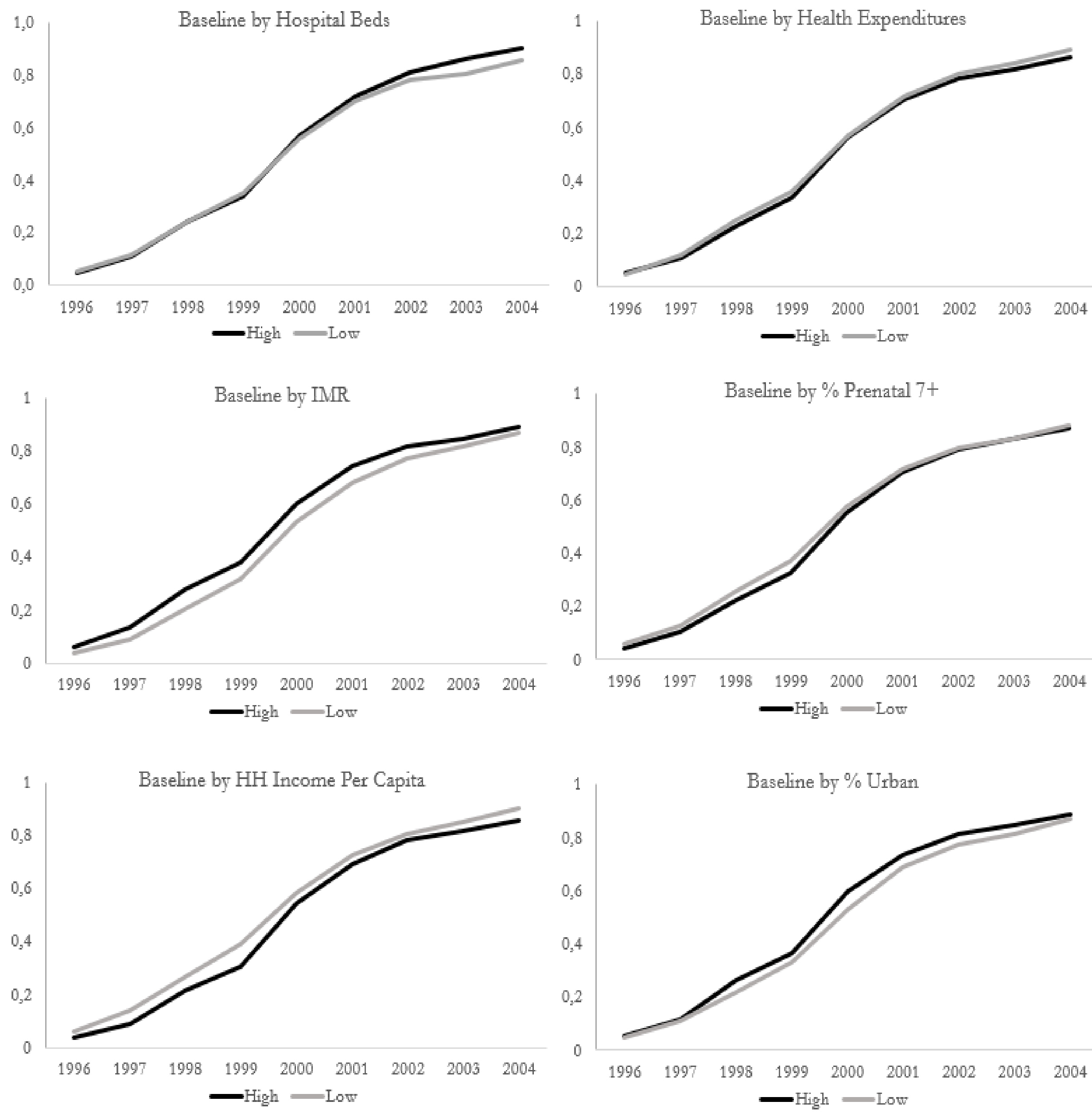
	Obs.	Mean	Stand Dev	Min	Max	Source of Data	Baseline Year
Infant Mortality Rate (IMR, per 1,000 population 0-1yo)							
Total	4,265	19.33	17.87	0	221.61	Datasus/SIM	1996
Infectious	4,265	2.24	4.10	0	37.04	Datasus/SIM	1996
Perinatal	4,265	8.31	9.16	0	90.91	Datasus/SIM	1996
Respiratory	4,265	1.50	2.91	0	32.26	Datasus/SIM	1996
Congenital	4,265	1.67	3.67	0	54.05	Datasus/SIM	1996
External	4,265	0.38	2.00	0	71.43	Datasus/SIM	1996
Nutritional	4,265	0.47	1.52	0	23.81	Datasus/SIM	1996
Ill-Defined	4,265	4.07	10.04	0	160.7	Datasus/SIM	1996
Others	4,265	0.70	2.02	0	30.30	Datasus/SIM	1996
ICSAP	4,265	2.17	4.03	0	37.07	Datasus/SIM	1996
Non-ICSAP	4,265	17.17	16.29	0	202.2	Datasus/SIM	1996
Fetal	4,265	4.44	6.73	0	142.86	Datasus/SIM	1996
Neonatal	4,265	10.37	10.59	0	90.91	Datasus/SIM	1996
Within 24hs	4,265	3.95	5.89	0	90.91	Datasus/SIM	1996
Within 24hs-27 days	4,265	6.42	7.58	0	75.47	Datasus/SIM	1996
Within 27 days - 1 year	4,265	8.96	11.17	0	163.43	Datasus/SIM	1996
Total Infant Hospitalization Rate (IHR, per 1,000 population 0-1yo)	4,265	245.7	146.10	0	2190.2	Datasus/SIH	1998
Fertility and Other Birth Outcomes (Mean, Conditional on Birth)							
Rate of Births per Woman (age 10-49)	4,267	0.05	0.02	0	0.14	Datasus/SINASC	1996
Rate of Births per Teenage Woman (age 10-19)	4,267	0.03	0.02	0	0.10	Datasus/SINASC	1996
Apgar 1	4,082	8.01	0.80	1	10.00	Datasus/SINASC	1996
Apgar 5	4,071	9.11	0.68	1	10.00	Datasus/SINASC	1996
Birth Weight	4,155	3224	170	800	4550	Datasus/SINASC	1996
Low Birth Weight (<2,5k)	4,155	0.07	0.07	0	1.00	Datasus/SINASC	1996
Gestation Weeks 37+	4,138	0.92	0.17	0	1.00	Datasus/SINASC	1996
% Girls	4,156	0.49	0.10	0	1.00	Datasus/SINASC	1996

Table 1: Main Descriptive Statistics (at the baseline year) – *Cont.*

	Obs.	Mean	Stand Dev	Min	Max	Source of Data	Baseline Year
Access, Fertility and Health Outcomes if Less Educated Mothers							
Total number of maternal deaths	4,267	0.03	0.20	0	6	Datasus/SIM	1996
Total number of infant deaths	4,267	1.0	3.5	0	92	Datasus/SIM	1996
Total number of births	4,267	43.6	121.5	0	3077	Datasus/SINASC	1996
% Girls	3,488	0.49	0.23	0	1.00	Datasus/SINASC	1996
Birth Weight	3,475	3185	273	1150	5100	Datasus/SINASC	1996
Prenatal Visits 7+	3,315	0.32	0.30	0	1	Datasus/SINASC	1996
Birth at Hospital	3,486	0.93	0.16	0	1	Datasus/SINASC	1996
Share C-Sections	3,481	0.24	0.25	0	1	Datasus/SINASC	1996
Access, Fertility and Health Outcomes if More Educated Mothers							
Total number of maternal deaths	4,267	0.01	0.25	0	13	Datasus/SIM	1996
Total number of infant deaths	4,267	0.9	8.0	0	417	Datasus/SIM	1996
Total number of births	4,267	82.0	508.5	0	13219	Datasus/SINASC	1996
% Girls	3,747	0.49	0.22	0	1	Datasus/SINASC	1996
Birth Weight	3,744	3298	261	355	5220	Datasus/SINASC	1996
Prenatal Visits 7+	3,596	0.61	0.29	0	1	Datasus/SINASC	1996
Birth at Hospital	3,752	0.97	0.11	0	1	Datasus/SINASC	1996
Share C-Sections	3,749	0.56	0.28	0	1	Datasus/SINASC	1996

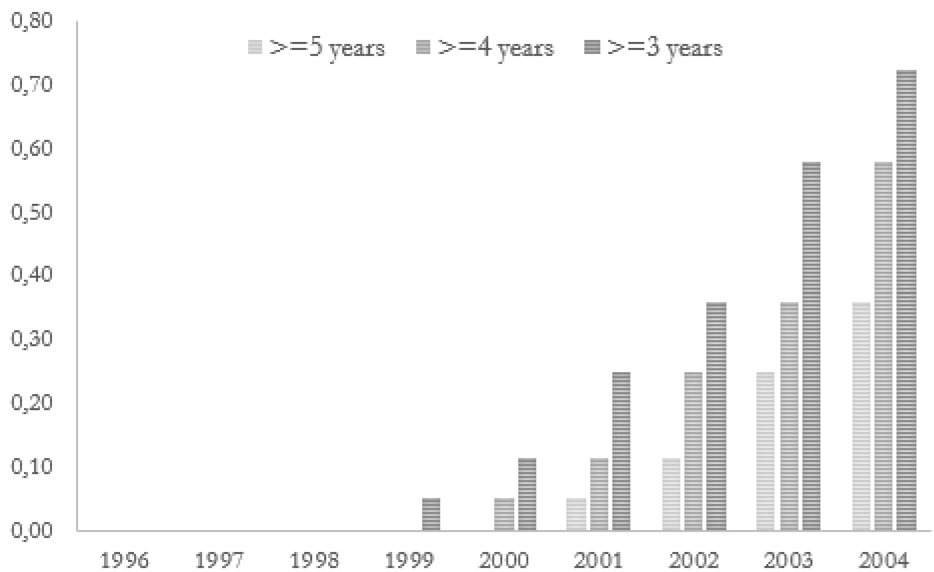
Notes: All tabulations refer to baseline years (either 1996 or 1998, depending on availability of data). Authors' own tabulations from different sources of data: Finbra/Ministry of Finance, Datasus (SIM, SIH, SIA, SINASC). We use data on population by gender and age provided by IBGE to convert counts in rates.

Figure 3: PSF Expansion by Baseline Characteristics: % of Municipalities Covered by PSF, Above *vs* Below Baseline Median



Sources: SIM/Datasus, FINBRA/STN, Brazilian Ministry of Health, IBGE/Census, SAS/Dept de Atenção Básica – DAB. Each baseline characteristic is computed for 1996, except % Urban and Household Income per Capita, both computed for 1991.

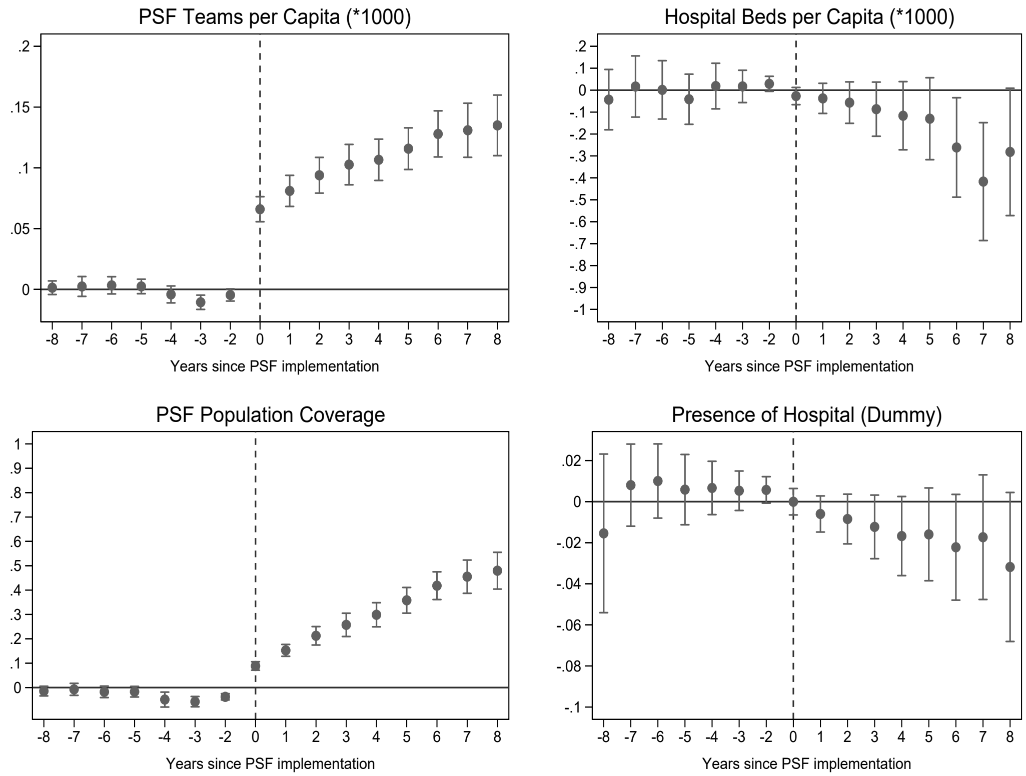
Figure 4: Annual Share of Municipalities Covered by PSF: For 3, 4 and 5 Years or More of Coverage



Sources: Brazilian Ministry of Health, SAS/Dept de Atenção Básica – DAB.

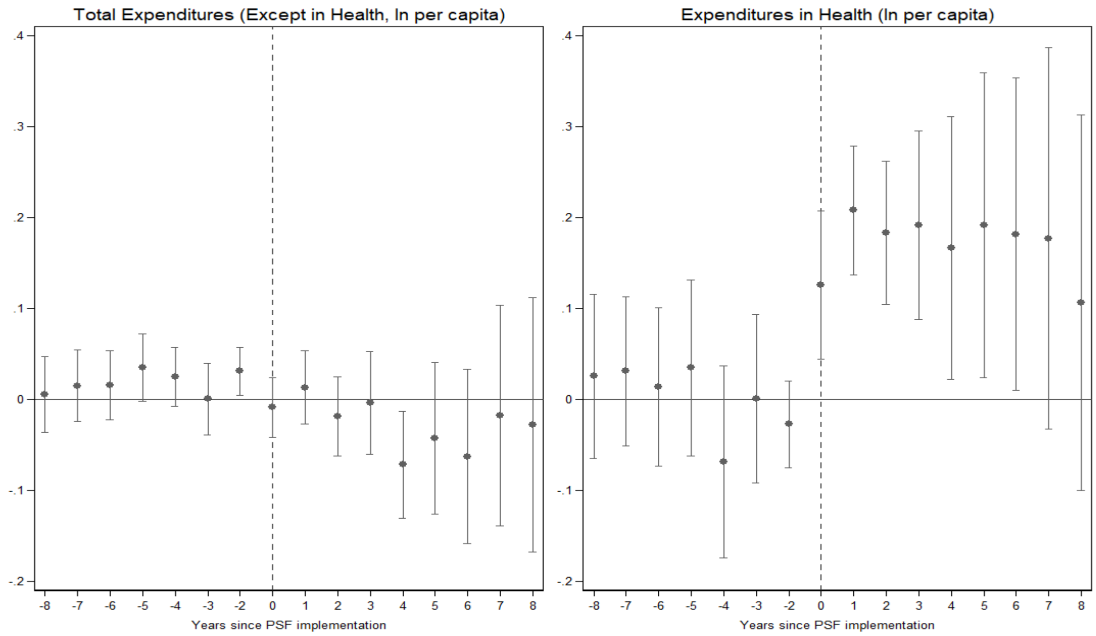
Figure 5: Health System Restructuring

(a) PSF Coverage and Health Infrastructure



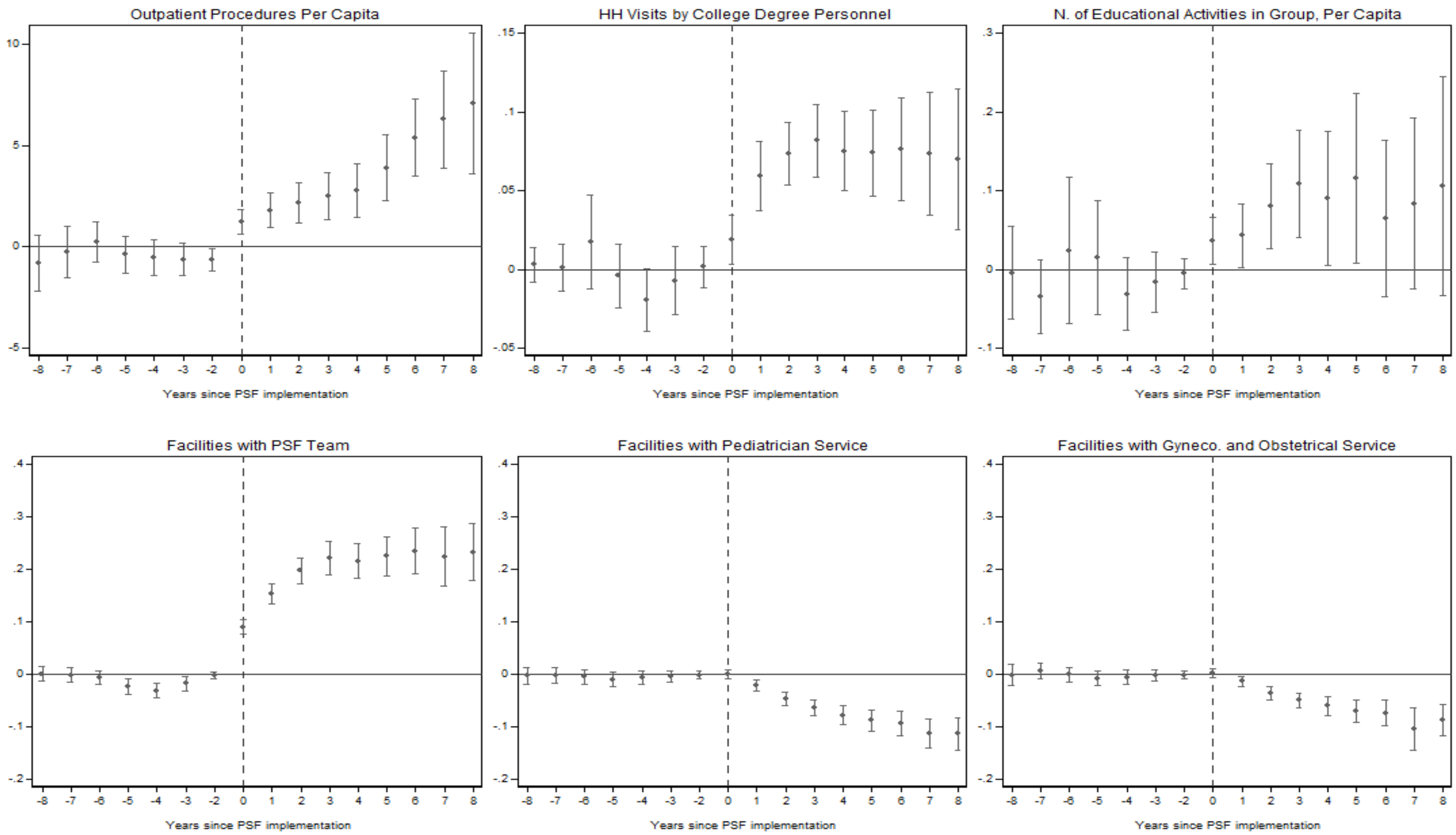
Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. All specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level to account for the possibility of serially correlated and heteroscedastic errors. The sample period for the specifications on PSF coverage and PSF teams per capita covers the interval between 1998-2004, while the reminder specifications are based on 1996-2004. The respective regression tables with the estimates are presented for the interested reader in the Appendix Section A.

(b) Health Expenditures (Figure 3 – *cont.*)



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. All specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level to account for the possibility of serially correlated and heteroscedastic errors. The sample period for all specifications covers the interval between 1996-2004. The respective regression tables with the estimates are presented for the interested reader in the Appendix Section A.

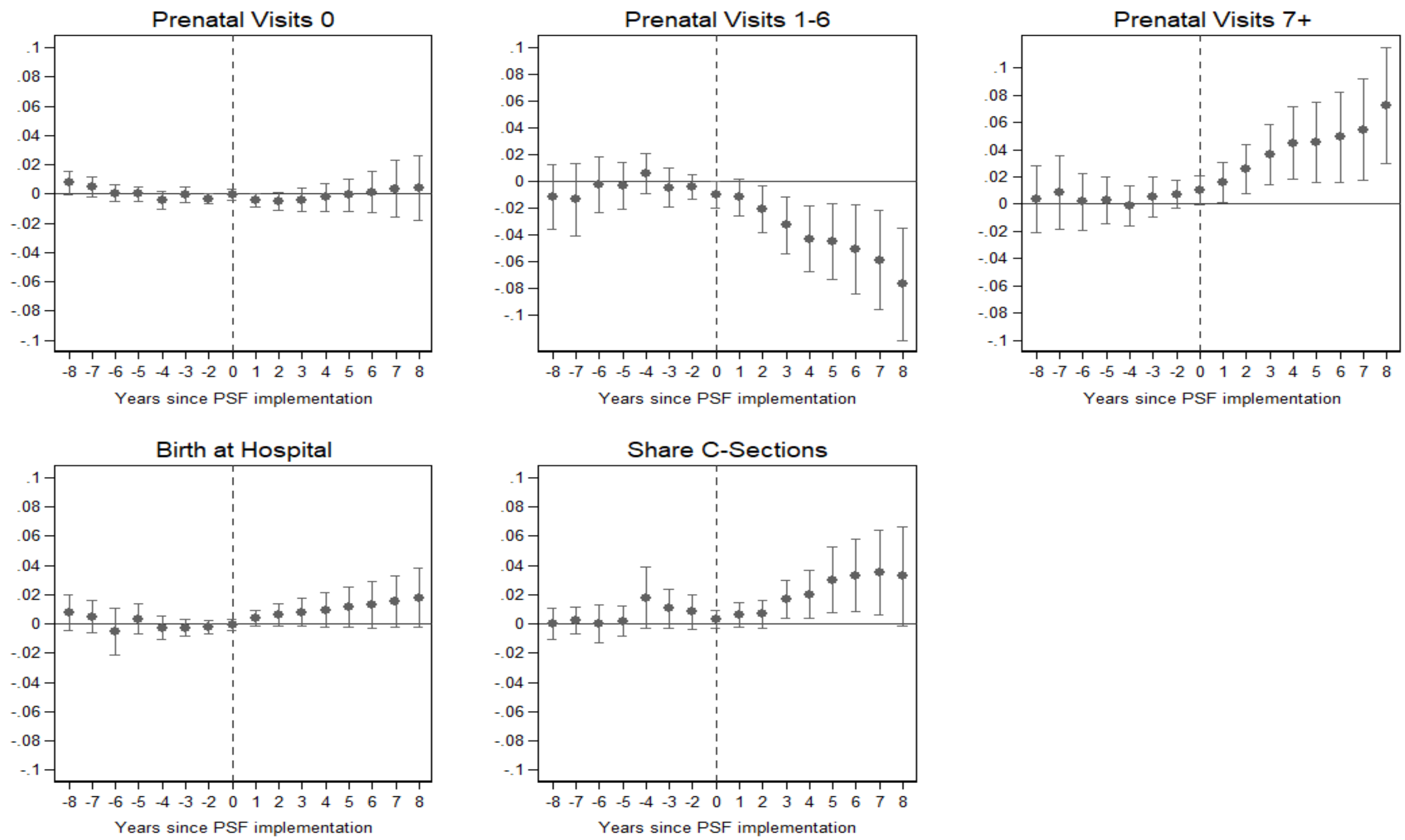
(c) Primary Care Activity, Productivity and Ambulatory Procedures (Figure 3 – *cont.*)



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. All specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level to account for the possibility of serially correlated and heteroscedastic errors. The sample period for all specifications covers the interval between 1996-2004. The respective regression tables with the estimates are presented for the interested reader in the Appendix Section A.

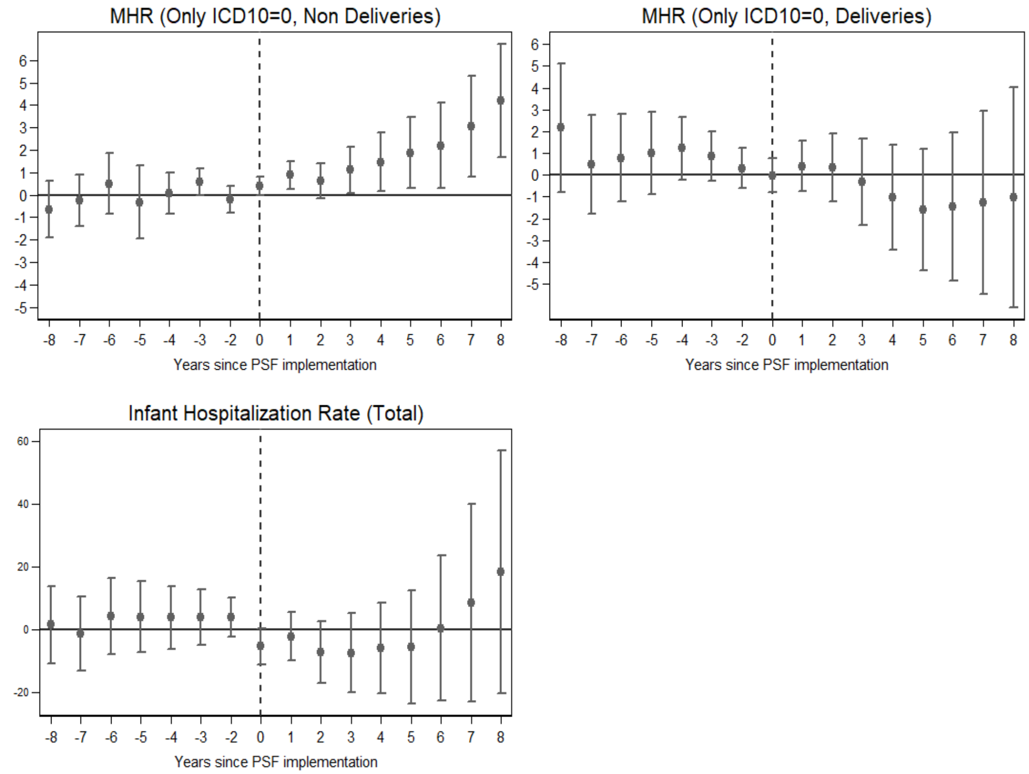
Figure 6: Access to Health Services, Prenatal and Delivery Conditions

(a) PSF Effects on Access to Health Services



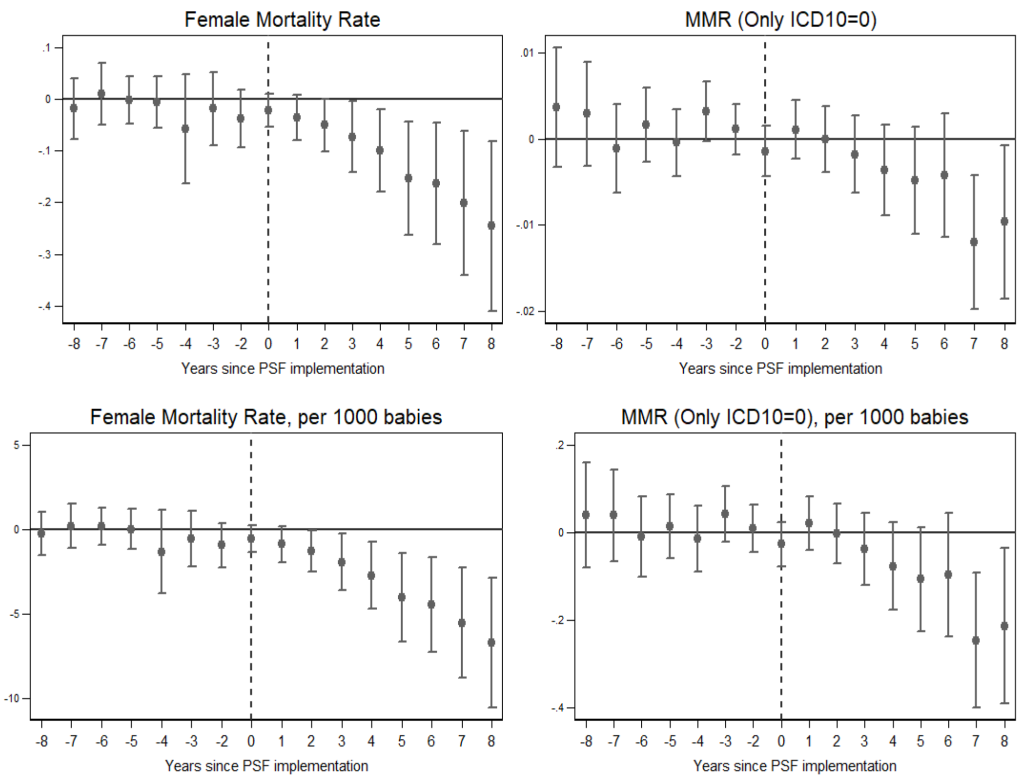
Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. All specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level to account for the possibility of serially correlated and heteroscedastic errors. The sample period for all specifications covers the interval between 1996-2004. The respective regression tables with the estimates are presented for the interested reader in the Appendix Section A.

(b) PSF Effects on Hospitalization Rates (Figure 4 – *cont.*)



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1998-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

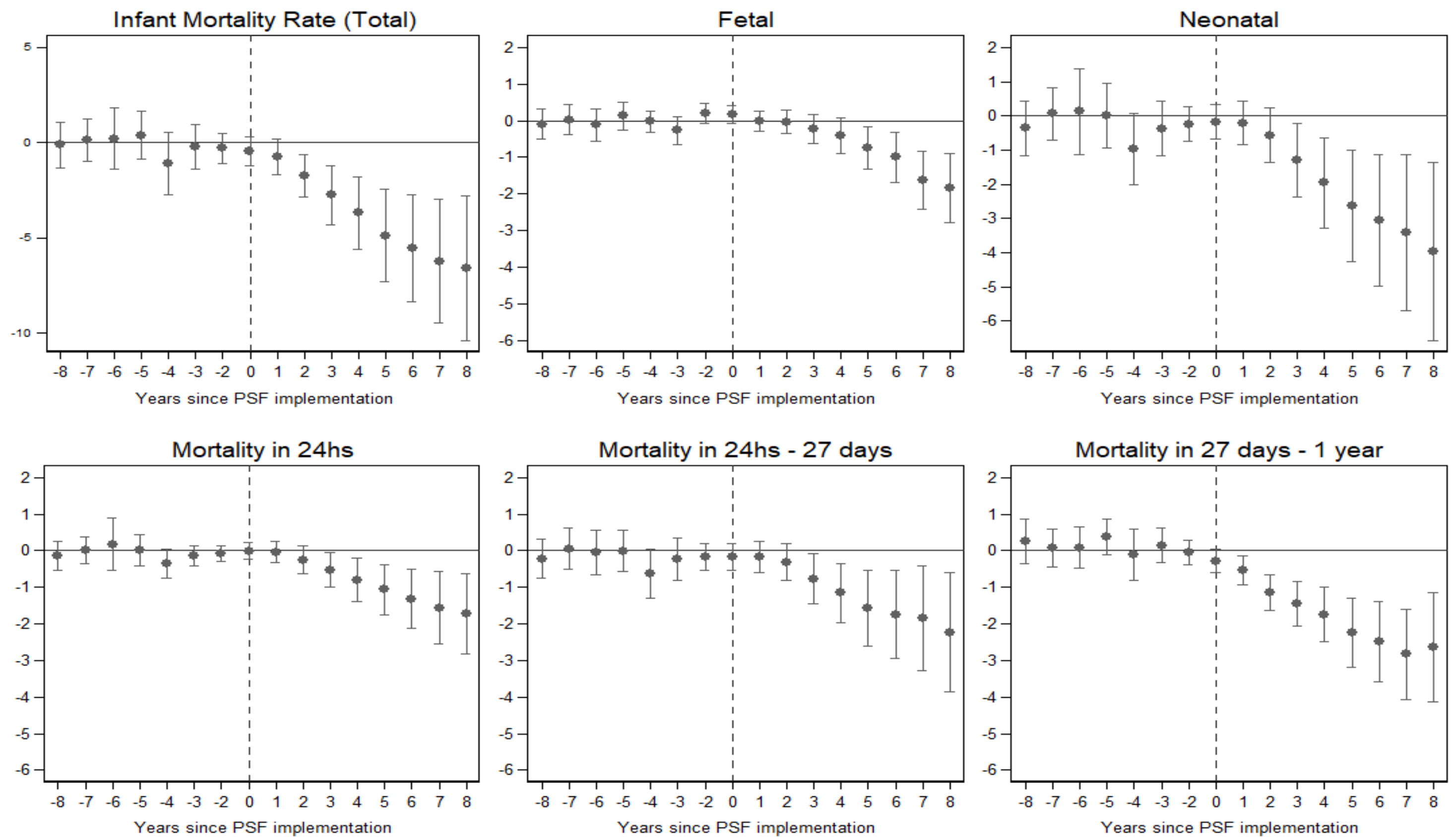
Figure 7: PSF Effects on Female Mortality (FM) and Maternal Mortality (MMR) Rates



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

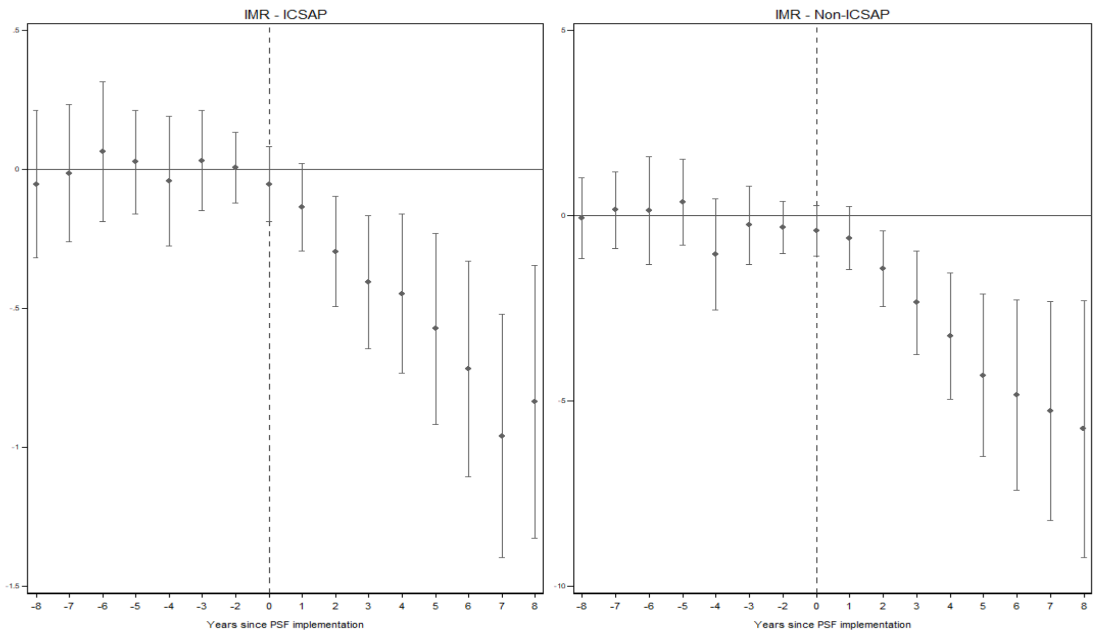
Figure 8: Infant Mortality Rate

(a) Foetal, Neonatal and Infant Mortality



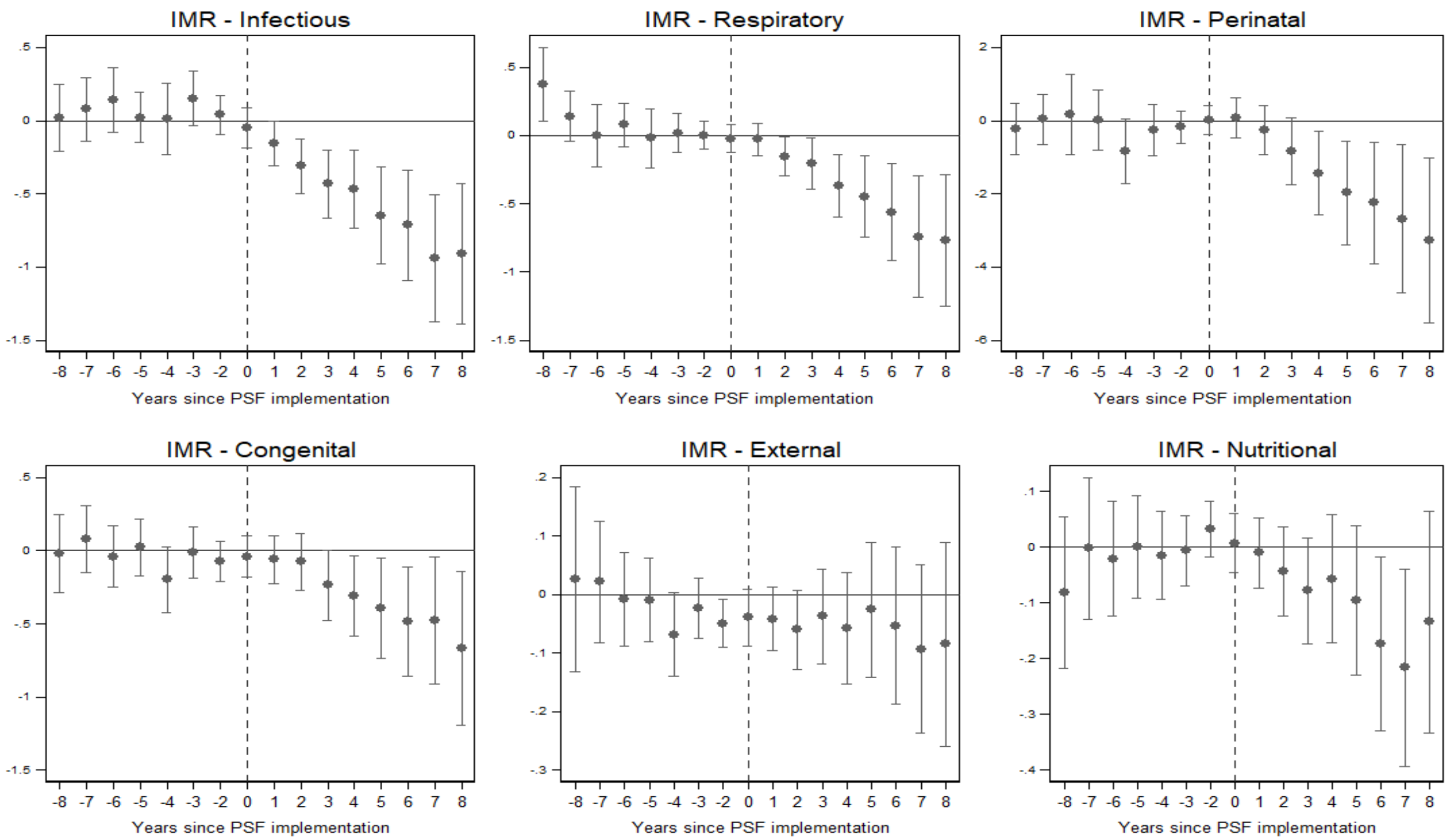
Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

(b) IMR: ICSAP and non-ICSAP (Figure 6 – *cont.*)



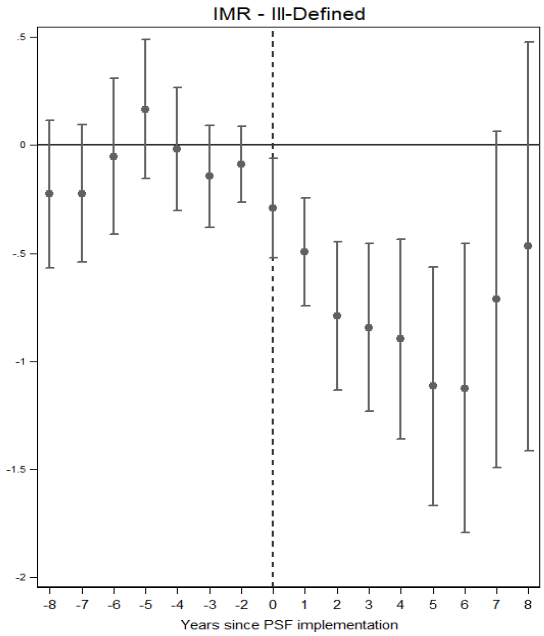
Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

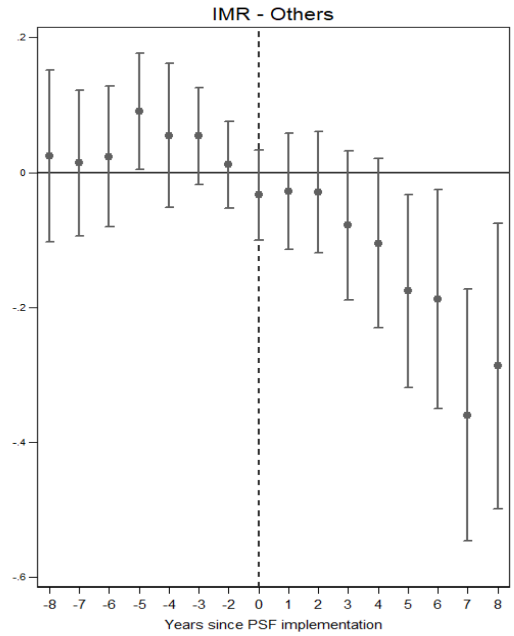
(c) Infant Mortality By Cause of Death (Figure 6 – *cont.*)



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

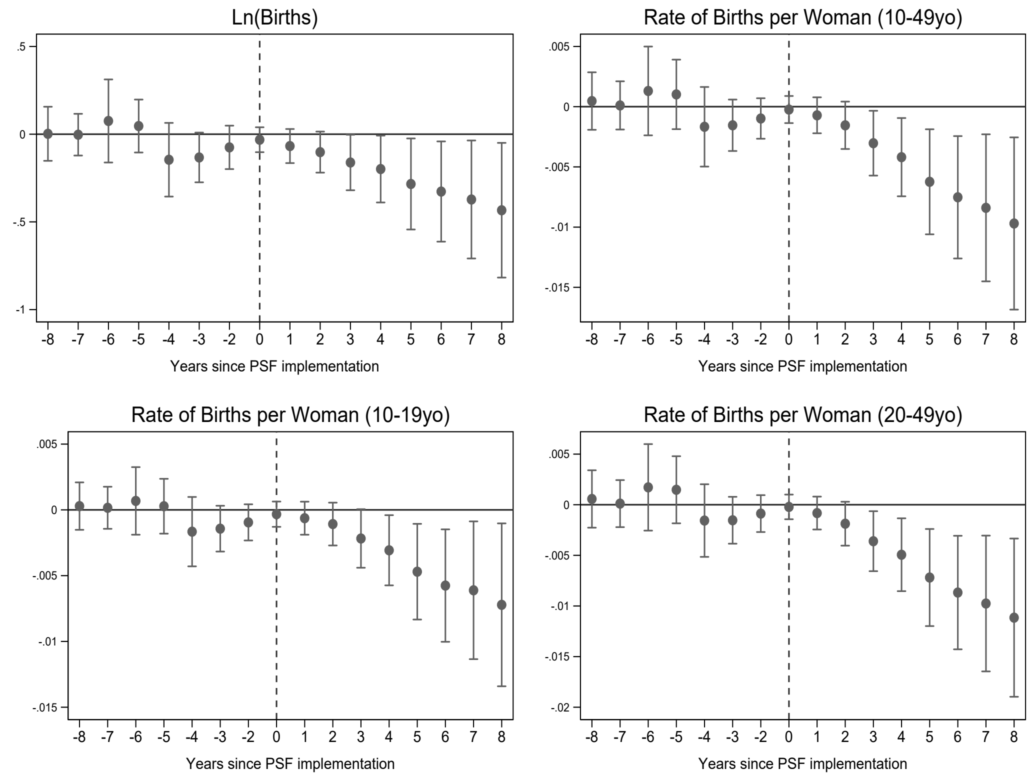
(d) Ill Defined and Others (Figure 6 – *cont.*)





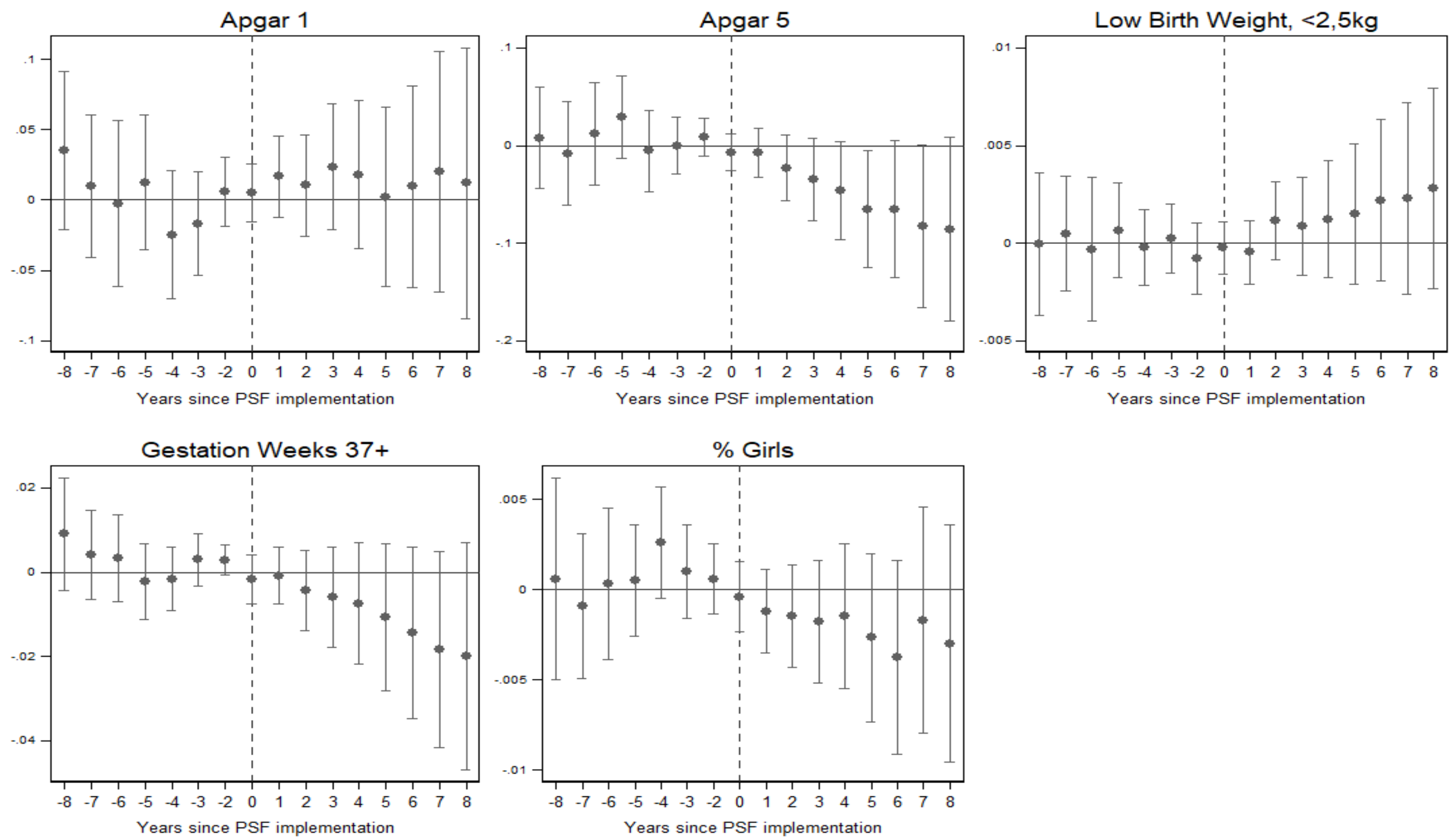
Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

Figure 9: PSF Effects on Fertility



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

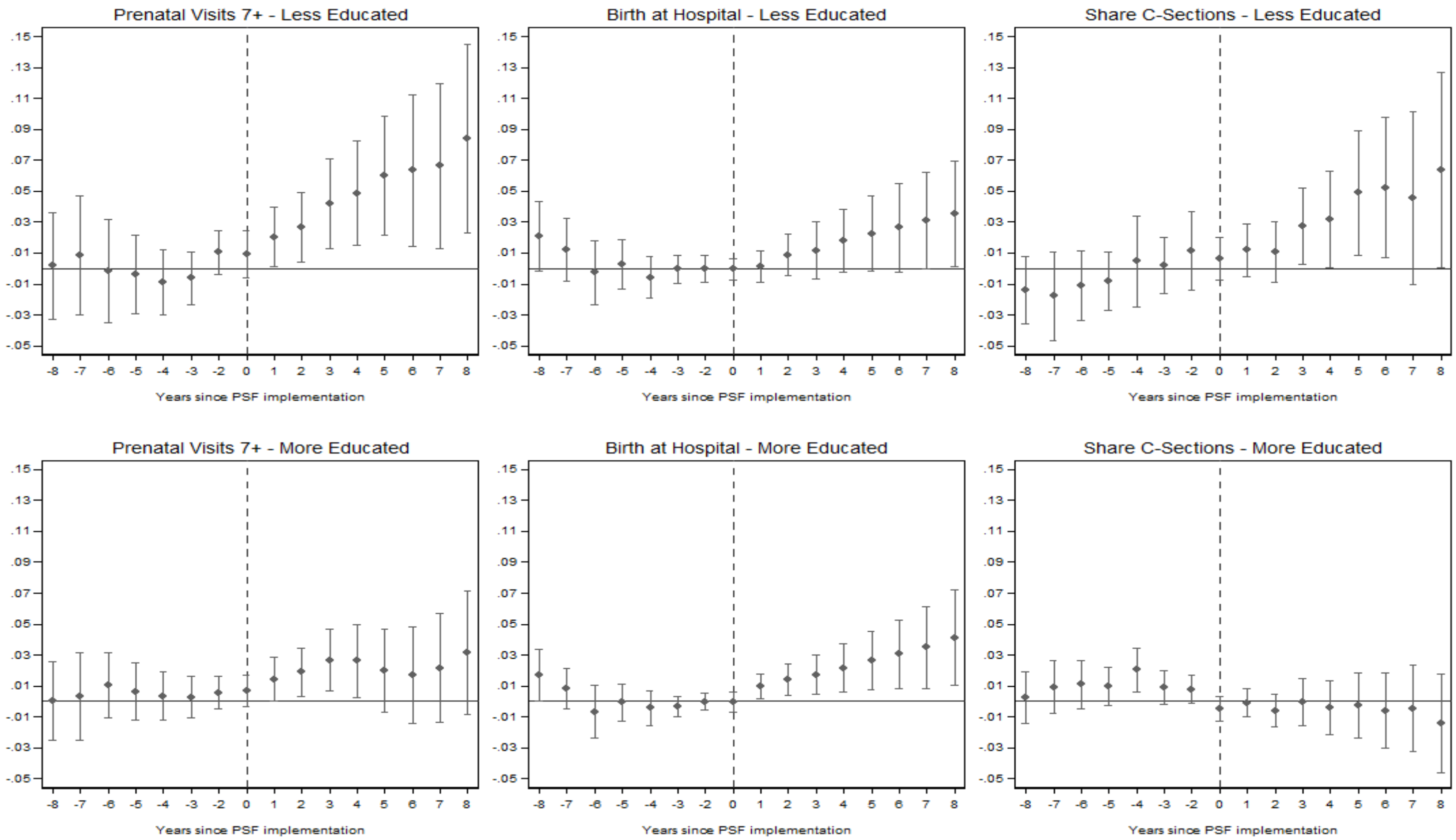
Figure 10: PSF Effects on Quality of Births



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

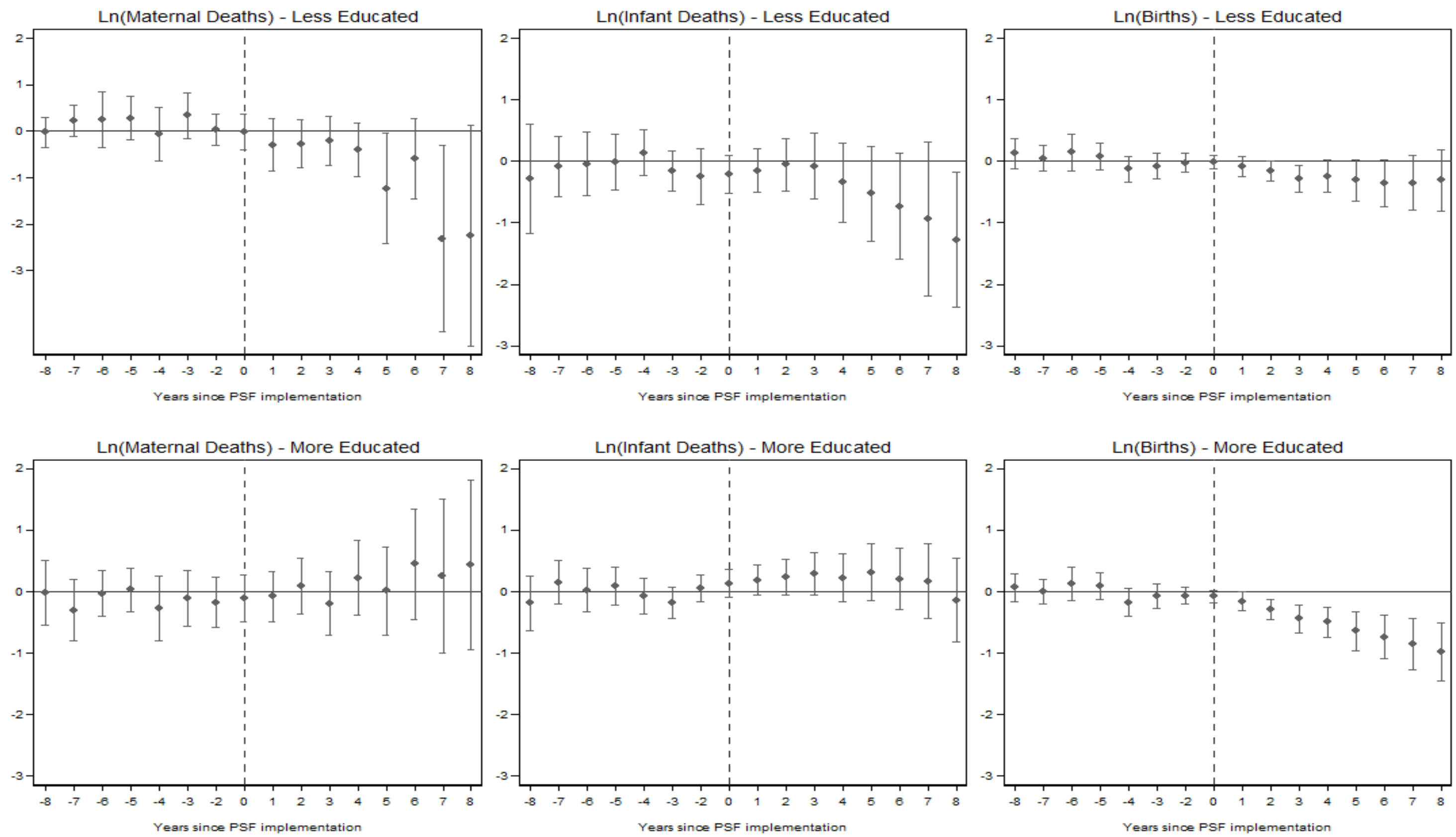
Figure 11: Inequality in Access to Health Services and Health Outcomes

(a) PSF Effects on Access to Health Services by Education of the Mother



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

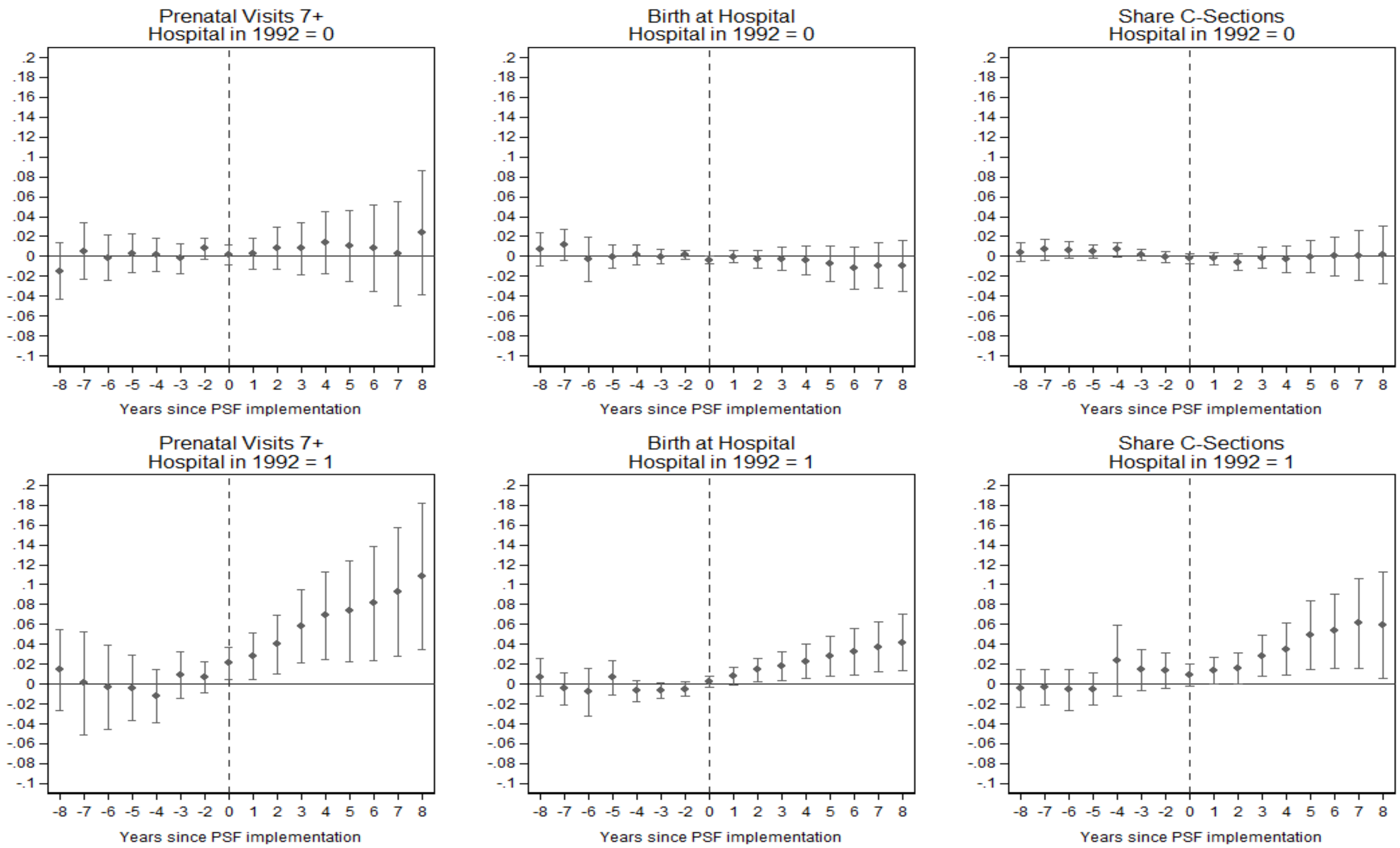
(b) PSF Effects on Health Outcomes by Education of the Mother (Figure 9 – *cont.*)



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

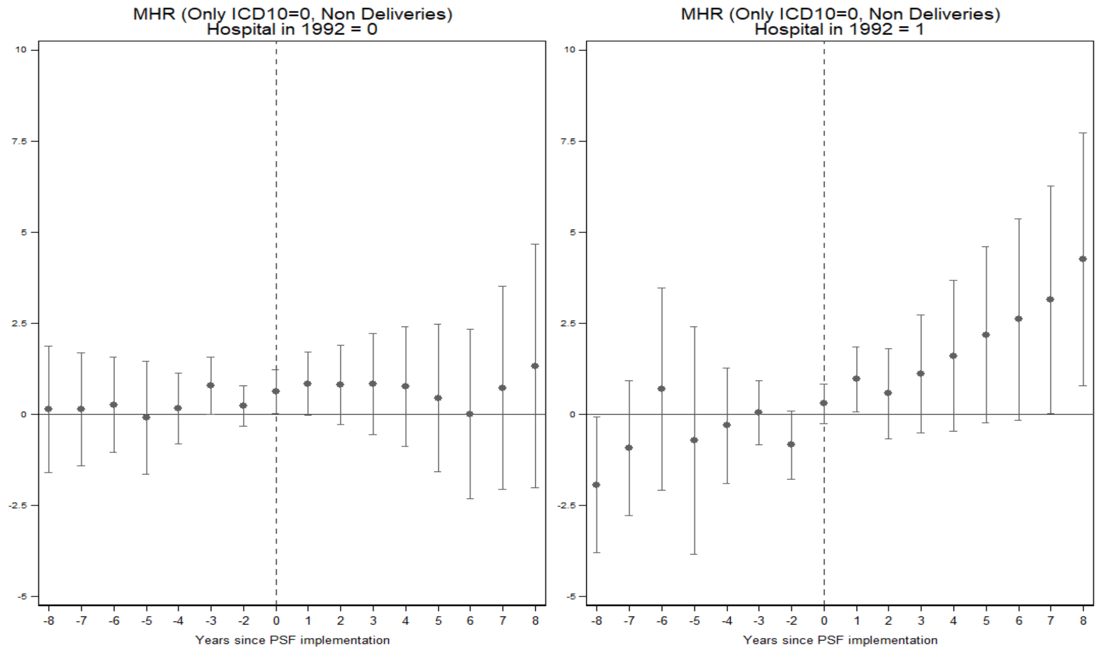
Figure 12: PSF Effects by Baseline Hospital Infrastructure

(a) Access to Health Services



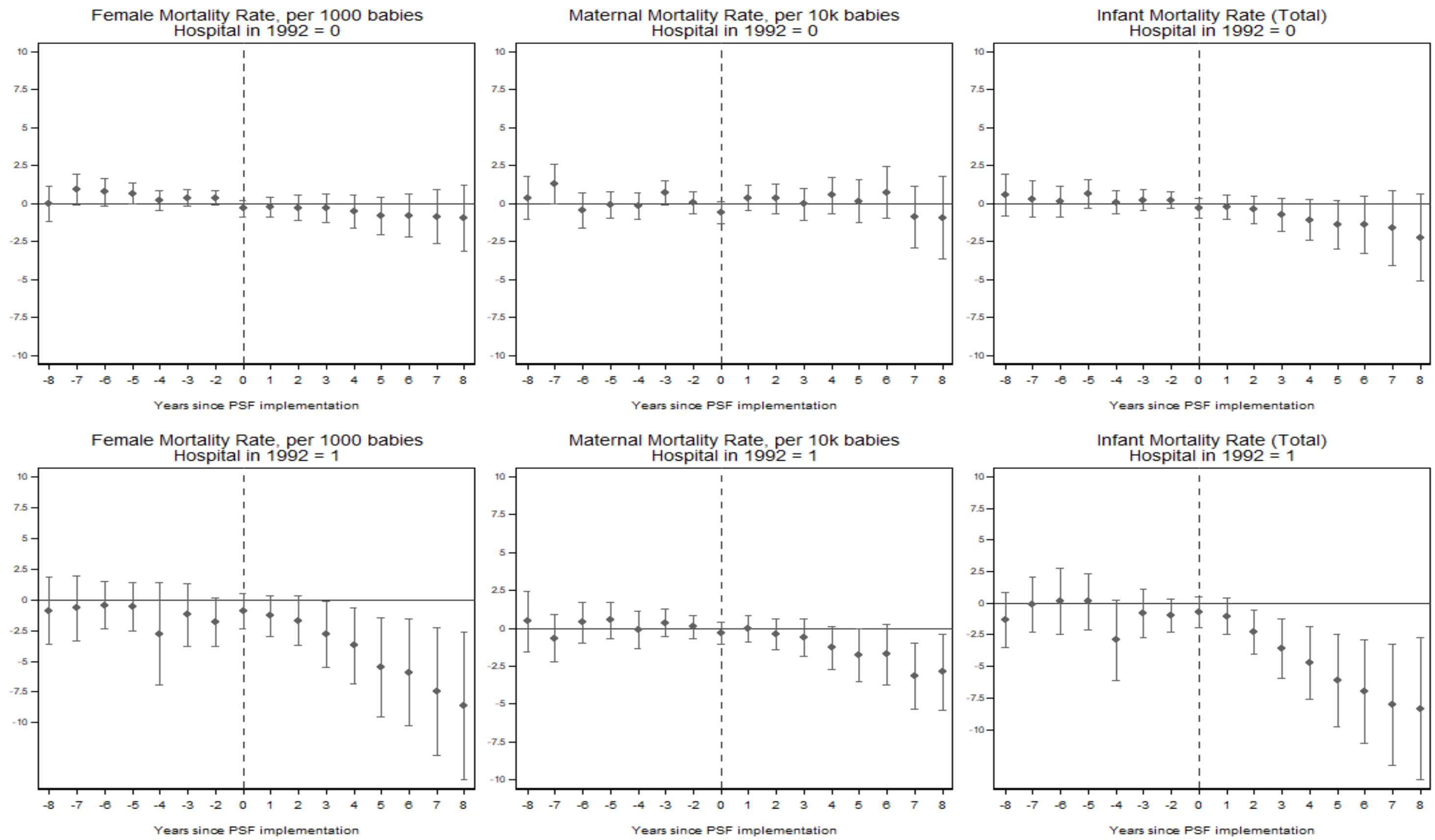
Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

(b) Maternal Hospitalization Rates (non-delivery) (Figure 10 – *cont.*)



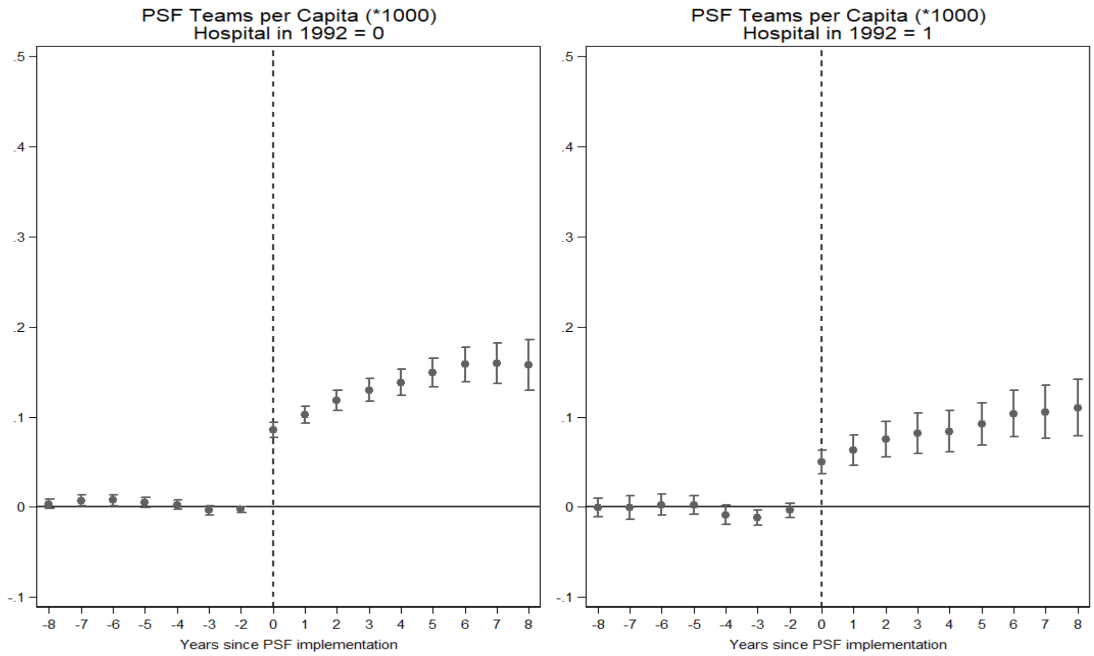
Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1998-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

(c) Health Outcomes (Figure 10 – *cont.*)



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

(d) PSF Teams per Capita (Figure 10 – *cont.*)



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004. The respective regression tables with the estimates are presented in the Appendix Section A.

Appendix Section

A Regression Tables

Table A.1: PSF Coverage and Health System Restructuring

	PSF Teams per Capita (*1000)	Dummy for Hospital	Hospital Beds per Capita	Outpatient Procedures Per Capita	HH Visits by College Degree Personnel	N. of Educational Activities in Group Per Capita	Facilities with PSF Team	Facilities with Pediatrician Service	Facilities with Gyneco. and Obstetrical Service	Total Expenditures (Except in Health, ln per capita)	Expenditures in Health (ln per capita)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
PSF - Year -8	0.001	-0.015	-0.043	-0.785	0.003	-0.004	0.000	-0.003	-0.002	0.006	0.026
	(0.003)	(0.020)	(0.070)	(0.700)	(0.006)	(0.030)	(0.007)	(0.008)	(0.010)	(0.021)	(0.046)
PSF - Year -7	0.002	0.008	0.017	-0.254	0.001	-0.034	-0.001	-0.002	0.006	0.015	0.031
	(0.004)	(0.010)	(0.071)	(0.639)	(0.008)	(0.024)	(0.007)	(0.008)	(0.008)	(0.020)	(0.042)
PSF - Year -6	0.003	0.010	0.001	0.248	0.018	0.024	-0.006	-0.005	-0.001	0.016	0.014
	(0.004)	(0.009)	(0.068)	(0.506)	(0.015)	(0.047)	(0.006)	(0.007)	(0.007)	(0.019)	(0.044)
PSF - Year -5	0.002	0.006	-0.041	-0.384	-0.004	0.015	-0.023	-0.010	-0.008	0.035	0.035
	(0.003)	(0.009)	(0.058)	(0.467)	(0.010)	(0.037)	(0.008)***	(0.007)	(0.007)	(0.019)*	(0.049)
PSF - Year -4	-0.004	0.007	0.019	-0.525	-0.020	-0.031	-0.031	-0.007	-0.006	0.025	-0.068
	(0.004)	(0.007)	(0.053)	(0.453)	(0.010)*	(0.024)	(0.007)***	(0.006)	(0.007)	(0.016)	(0.054)
PSF - Year -3	-0.011	0.005	0.017	-0.626	-0.007	-0.016	-0.018	-0.004	-0.003	0.001	0.001
	(0.003)***	(0.005)	(0.038)	(0.404)	(0.011)	(0.020)	(0.007)**	(0.005)	(0.005)	(0.020)	(0.047)
PSF - Year -2	-0.005	0.006	0.029	-0.614	0.002	-0.005	-0.003	-0.001	-0.002	0.031	-0.027
	(0.003)*	(0.003)*	(0.017)*	(0.283)**	(0.007)	(0.010)	(0.003)	(0.004)	(0.003)	(0.013)**	(0.024)
PSF - Year 0	0.066	-0.000	-0.027	1.238	0.019	0.036	0.090	-0.001	0.002	-0.009	0.126
	(0.005)***	(0.003)	(0.020)	(0.303)***	(0.008)**	(0.015)**	(0.007)***	(0.004)	(0.004)	(0.017)	(0.041)***
PSF - Year +1	0.081	-0.006	-0.037	1.809	0.059	0.043	0.153	-0.022	-0.014	0.014	0.208
	(0.007)***	(0.004)	(0.035)	(0.442)***	(0.011)***	(0.021)**	(0.010)***	(0.005)***	(0.005)***	(0.021)	(0.036)***
PSF - Year +2	0.094	-0.008	-0.057	2.155	0.073	0.081	0.197	-0.048	-0.036	-0.019	0.183
	(0.007)***	(0.006)	(0.048)	(0.504)***	(0.010)***	(0.028)***	(0.013)***	(0.006)***	(0.006)***	(0.022)	(0.040)***
PSF - Year +3	0.103	-0.012	-0.087	2.508	0.082	0.109	0.221	-0.065	-0.050	-0.004	0.192
	(0.008)***	(0.008)	(0.063)	(0.585)***	(0.012)***	(0.035)***	(0.016)***	(0.007)***	(0.007)***	(0.029)	(0.053)***
PSF - Year +4	0.107	-0.017	-0.117	2.794	0.075	0.090	0.215	-0.078	-0.060	-0.071	0.167
	(0.009)***	(0.010)*	(0.079)	(0.672)***	(0.013)***	(0.043)**	(0.017)***	(0.009)***	(0.009)***	(0.030)**	(0.074)**
PSF - Year +5	0.116	-0.016	-0.130	3.908	0.074	0.116	0.224	-0.088	-0.071	-0.042	0.192
	(0.009)***	(0.012)	(0.095)	(0.834)***	(0.014)***	(0.055)**	(0.019)***	(0.010)***	(0.011)***	(0.043)	(0.085)**
PSF - Year +6	0.128	-0.022	-0.261	5.371	0.076	0.065	0.235	-0.095	-0.075	-0.062	0.182
	(0.010)***	(0.013)*	(0.116)**	(0.970)***	(0.017)***	(0.051)	(0.022)***	(0.012)***	(0.013)***	(0.049)	(0.088)**
PSF - Year +7	0.131	-0.017	-0.417	6.284	0.074	0.084	0.224	-0.113	-0.105	-0.018	0.177
	(0.011)***	(0.015)	(0.137)***	(1.230)***	(0.020)***	(0.056)	(0.029)***	(0.014)***	(0.021)***	(0.062)	(0.107)*
PSF - Year +8	0.135	-0.032	-0.282	7.088	0.070	0.106	0.232	-0.114	-0.087	-0.028	0.107
	(0.013)***	(0.019)*	(0.148)*	(1.766)***	(0.023)***	(0.071)	(0.028)***	(0.016)***	(0.016)***	(0.071)	(0.105)
Observations	29,323	37,701	37,701	37,701	37,701	37,701	37,701	37,701	37,701	34,987	34,675
y_mean	0.126	0.753	2.453	31.14	0.180	0.278	0.285	0.280	0.344	6.513	5.146

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta_{pre,i}$s and β_js and their respective standard errors were defined as in equation 1.

Table A.2: Access to Health Services, Prenatal and Delivery Conditions

	Prenatal Visits 0	Prenatal Visits 0-6	Prenatal Visits 7+	Birth at Hospital	Share C-Sections	MHR (Non Deliveries)	MHR (Only Deliveries)	Infant Hospitalization Rate (Total)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PSF - Year -8	0.007	-0.001	0.004	0.008	0.000	-0.644	2.167	1.484
	(0.004)*	(0.013)	(0.013)	(0.006)	(0.006)	(0.651)	(1.499)	(6.238)
PSF - Year -7	0.005	-0.013	0.009	0.005	0.002	-0.247	0.492	-1.439
	(0.003)	(0.014)	(0.014)	(0.006)	(0.005)	(0.589)	(1.156)	(6.049)
PSF - Year -6	0.000	-0.004	0.002	-0.006	0.000	0.506	0.786	4.106
	(0.003)	(0.011)	(0.011)	(0.008)	(0.007)	(0.693)	(1.016)	(6.195)
PSF - Year -5	0.000	-0.014	0.003	0.003	0.002	-0.324	1.003	4.009
	(0.003)	(0.009)	(0.009)	(0.005)	(0.005)	(0.835)	(0.962)	(5.727)
PSF - Year -4	-0.004	-0.005	-0.002	-0.003	0.018	0.065	1.230	3.775
	(0.003)	(0.008)	(0.008)	(0.004)	(0.011)*	(0.460)	(0.731)*	(5.137)
PSF - Year -3	-0.001	-0.004	0.005	-0.003	0.010	0.585	0.874	3.822
	(0.003)	(0.007)	(0.008)	(0.003)	(0.007)	(0.304)*	(0.573)	(4.566)
PSF - Year -2	-0.004	-0.009	0.007	-0.002	0.008	-0.225	0.307	3.846
	(0.002)**	(0.005)*	(0.005)	(0.002)	(0.006)	(0.304)	(0.474)	(3.242)
PSF - Year 0	-0.000	-0.013	0.010	-0.001	0.003	0.387	-0.026	-5.441
	(0.002)	(0.005)**	(0.005)*	(0.002)	(0.003)	(0.206)*	(0.393)	(2.927)*
PSF - Year +1	-0.004	-0.014	0.016	0.004	0.006	0.882	0.403	-2.316
	(0.002)**	(0.006)**	(0.007)**	(0.003)	(0.004)	(0.310)***	(0.589)	(3.921)
PSF - Year +2	-0.005	-0.024	0.026	0.006	0.007	0.619	0.356	-7.190
	(0.003)	(0.008)***	(0.009)***	(0.004)*	(0.005)	(0.407)	(0.796)	(5.046)
PSF - Year +3	-0.004	-0.033	0.037	0.008	0.017	1.107	-0.333	-7.536
	(0.004)	(0.011)***	(0.011)***	(0.005)	(0.007)**	(0.534)**	(1.008)	(6.446)
PSF - Year +4	-0.002	-0.038	0.045	0.009	0.020	1.458	-1.015	-5.977
	(0.005)	(0.013)***	(0.014)***	(0.006)	(0.008)**	(0.669)**	(1.233)	(7.409)
PSF - Year +5	-0.001	-0.034	0.046	0.012	0.030	1.883	-1.601	-5.764
	(0.006)	(0.016)**	(0.015)***	(0.007)*	(0.012)***	(0.818)**	(1.425)	(9.196)
PSF - Year +6	0.001	-0.032	0.049	0.013	0.033	2.204	-1.459	0.386
	(0.007)	(0.020)	(0.017)***	(0.008)	(0.012)***	(0.962)**	(1.732)	(11.785)
PSF - Year +7	0.004	-0.030	0.055	0.015	0.035	3.049	-1.253	8.519
	(0.010)	(0.024)	(0.019)***	(0.009)*	(0.015)**	(1.150)***	(2.140)	(16.109)
PSF - Year +8	0.004	-0.038	0.072	0.018	0.033	4.196	-1.008	18.304
	(0.011)	(0.027)	(0.022)***	(0.010)*	(0.017)*	(1.284)***	(2.577)	(19.771)
Observations	37,490	37,566	37,490	37,558	37,559	29,323	29,323	29,319
y_mean	0.063	0.483	0.454	0.949	0.362	8.593	39.52	220.4

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta_{pre,i}$s and β_js and their respective standard errors were defined as in equation 1.

Table A.3: Female Mortality (FM), Maternal Mortality (MMR) and Maternal Hospitalization (MHR) Rates

	Female Mortality Rate	MMR (Only ICD10=0)	Female Mortality Rate per 1000 population 0-1yo	MMR (Only ICD10=0) per 1000 population 0-1yo
	(1)	(2)	(3)	(4)
PSF - Year -8	-0.018	0.004	-0.242	0.040
	(0.030)	(0.004)	(0.654)	(0.061)
PSF - Year -7	0.010	0.003	0.210	0.039
	(0.031)	(0.003)	(0.665)	(0.053)
PSF - Year -6	-0.002	-0.001	0.182	-0.010
	(0.024)	(0.003)	(0.553)	(0.047)
PSF - Year -5	-0.006	0.002	0.006	0.014
	(0.025)	(0.002)	(0.604)	(0.038)
PSF - Year -4	-0.057	-0.000	-1.323	-0.014
	(0.054)	(0.002)	(1.263)	(0.038)
PSF - Year -3	-0.018	0.003	-0.564	0.043
	(0.036)	(0.002)*	(0.840)	(0.032)
PSF - Year -2	-0.037	0.001	-0.921	0.009
	(0.028)	(0.001)	(0.671)	(0.027)
PSF - Year 0	-0.021	-0.001	-0.543	-0.026
	(0.016)	(0.001)	(0.416)	(0.026)
PSF - Year +1	-0.035	0.001	-0.883	0.022
	(0.022)	(0.002)	(0.553)	(0.031)
PSF - Year +2	-0.050	-0.000	-1.297	-0.003
	(0.026)*	(0.002)	(0.630)**	(0.035)
PSF - Year +3	-0.072	-0.002	-1.931	-0.037
	(0.035)**	(0.002)	(0.867)**	(0.042)
PSF - Year +4	-0.099	-0.004	-2.724	-0.077
	(0.040)**	(0.003)	(1.003)***	(0.051)
PSF - Year +5	-0.153	-0.005	-4.017	-0.106
	(0.056)***	(0.003)	(1.329)***	(0.060)*
PSF - Year +6	-0.163	-0.004	-4.450	-0.096
	(0.060)***	(0.004)	(1.430)***	(0.072)
PSF - Year +7	-0.201	-0.012	-5.526	-0.246
	(0.072)***	(0.004)***	(1.657)***	(0.078)***
PSF - Year +8	-0.245	-0.010	-6.714	-0.213
	(0.084)***	(0.005)**	(1.967)***	(0.091)**
Observations	37,701	37,701	37,693	37,693
y_mean	0.961	0.0306	17.02	0.504

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta_{pre,i}s$ and $\beta_j s$ and their respective standard errors were defined as in equation 1.

Table A.4: Infant Mortality Rates

	Infant Hospitalization Rate (Total)	Infant Mortality Rate (Total)	Fetal	Neonatal	Mortality in 24hs	Mortality in 24hs - 27 days	Mortality in 27 days - 1 year	IMR - ICSAP	IMR - Non-ICSAP
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PSF - Year -8	1.484	-0.103	-0.091	-0.362	-0.145	-0.217	0.259	-0.052	-0.051
	(6.238)	(0.610)	(0.206)	(0.404)	(0.207)	(0.269)	(0.313)	(0.135)	(0.559)
PSF - Year -7	-1.439	0.149	0.029	0.069	0.011	0.058	0.080	-0.013	0.161
	(6.049)	(0.568)	(0.210)	(0.392)	(0.193)	(0.294)	(0.261)	(0.126)	(0.524)
PSF - Year -6	4.106	0.217	-0.113	0.128	0.179	-0.052	0.089	0.065	0.151
	(6.195)	(0.822)	(0.226)	(0.634)	(0.365)	(0.313)	(0.282)	(0.128)	(0.746)
PSF - Year -5	4.009	0.399	0.130	0.013	0.020	-0.006	0.385	0.028	0.370
	(5.727)	(0.633)	(0.196)	(0.477)	(0.222)	(0.293)	(0.247)	(0.096)	(0.591)
PSF - Year -4	3.775	-1.079	-0.021	-0.966	-0.345	-0.621	-0.113	-0.042	-1.038
	(5.137)	(0.840)	(0.151)	(0.525)*	(0.205)*	(0.346)*	(0.359)	(0.119)	(0.761)
PSF - Year -3	3.822	-0.215	-0.264	-0.364	-0.139	-0.225	0.149	0.033	-0.250
	(4.566)	(0.593)	(0.190)	(0.404)	(0.146)	(0.299)	(0.234)	(0.092)	(0.535)
PSF - Year -2	3.846	-0.295	0.196	-0.244	-0.076	-0.167	-0.051	0.008	-0.305
	(3.242)	(0.393)	(0.142)	(0.255)	(0.107)	(0.183)	(0.173)	(0.065)	(0.360)
PSF - Year 0	-5.441	-0.451	0.178	-0.172	-0.004	-0.168	-0.279	-0.052	-0.401
	(2.927)*	(0.377)	(0.123)	(0.261)	(0.118)	(0.180)	(0.164)*	(0.068)	(0.346)
PSF - Year +1	-2.316	-0.735	-0.022	-0.207	-0.037	-0.170	-0.528	-0.134	-0.601
	(3.921)	(0.472)	(0.141)	(0.328)	(0.149)	(0.219)	(0.200)***	(0.080)*	(0.434)
PSF - Year +2	-7.190	-1.722	-0.029	-0.565	-0.251	-0.314	-1.157	-0.295	-1.426
	(5.046)	(0.574)***	(0.166)	(0.404)	(0.190)	(0.256)	(0.248)***	(0.101)***	(0.520)***
PSF - Year +3	-7.536	-2.741	-0.220	-1.296	-0.522	-0.774	-1.445	-0.404	-2.338
	(6.446)	(0.788)***	(0.202)	(0.553)**	(0.247)**	(0.353)**	(0.309)***	(0.123)***	(0.712)***
PSF - Year +4	-5.977	-3.692	-0.406	-1.954	-0.803	-1.150	-1.739	-0.446	-3.247
	(7.409)	(0.963)***	(0.253)	(0.676)***	(0.304)***	(0.414)***	(0.376)***	(0.146)***	(0.870)***
PSF - Year +5	-5.764	-4.868	-0.743	-2.627	-1.060	-1.567	-2.241	-0.572	-4.297
	(9.196)	(1.240)***	(0.297)**	(0.833)***	(0.351)***	(0.529)***	(0.488)***	(0.176)***	(1.121)***
PSF - Year +6	0.386	-5.545	-0.997	-3.060	-1.317	-1.743	-2.485	-0.717	-4.829
	(11.785)	(1.447)***	(0.354)***	(0.977)***	(0.410)***	(0.617)***	(0.560)***	(0.197)***	(1.314)***
PSF - Year +7	8.519	-6.226	-1.630	-3.401	-1.558	-1.843	-2.825	-0.958	-5.268
	(16.109)	(1.658)***	(0.408)***	(1.163)***	(0.502)***	(0.725)**	(0.630)***	(0.223)***	(1.508)***
PSF - Year +8	18.304	-6.584	-1.844	-3.952	-1.724	-2.228	-2.631	-0.836	-5.749
	(19.771)	(1.936)***	(0.486)***	(1.331)***	(0.565)***	(0.836)***	(0.761)***	(0.250)***	(1.771)***
Observations	29,319	37,693	37,693	37,693	37,693	37,693	37,693	37,693	37,693
y_mean	220.4	18.12	4.769	10.91	4.203	6.708	7.212	1.774	16.35

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta_{pre,i}s$ and $\beta_j s$ and their respective standard errors were defined as in equation 1.

Table A.4: Infant Mortality Rates – *Cont.*

	IMR - Infectious	IMR - Respiratory	IMR - Perinatal	IMR - Congenital	IMR - External	IMR - Nutritional	IMR - Ill-Defined	IMR - Others
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
PSF - Year -8	0.018	0.375	-0.219	-0.020	0.026	-0.082	-0.226	0.024
	(0.117)	(0.137)***	(0.358)	(0.136)	(0.080)	(0.069)	(0.175)	(0.065)
PSF - Year -7	0.078	0.139	0.043	0.078	0.022	-0.002	-0.223	0.014
	(0.111)	(0.094)	(0.352)	(0.118)	(0.053)	(0.065)	(0.163)	(0.055)
PSF - Year -6	0.140	-0.004	0.177	-0.040	-0.008	-0.021	-0.051	0.024
	(0.112)	(0.116)	(0.556)	(0.107)	(0.041)	(0.053)	(0.184)	(0.053)
PSF - Year -5	0.024	0.077	0.024	0.025	-0.009	0.001	0.167	0.091
	(0.089)	(0.081)	(0.418)	(0.099)	(0.037)	(0.047)	(0.164)	(0.044)**
PSF - Year -4	0.012	-0.019	-0.831	-0.195	-0.068	-0.014	-0.018	0.055
	(0.126)	(0.110)	(0.448)*	(0.115)*	(0.036)*	(0.040)	(0.146)	(0.055)
PSF - Year -3	0.152	0.018	-0.256	-0.012	-0.023	-0.006	-0.143	0.054
	(0.095)	(0.073)	(0.362)	(0.088)	(0.027)	(0.032)	(0.120)	(0.037)
PSF - Year -2	0.042	0.002	-0.176	-0.071	-0.049	0.033	-0.087	0.011
	(0.068)	(0.053)	(0.225)	(0.069)	(0.021)**	(0.025)	(0.089)	(0.033)
PSF - Year 0	-0.046	-0.023	0.014	-0.041	-0.039	0.008	-0.290	-0.033
	(0.070)	(0.051)	(0.205)	(0.072)	(0.025)	(0.027)	(0.117)**	(0.034)
PSF - Year +1	-0.154	-0.028	0.084	-0.061	-0.042	-0.010	-0.494	-0.028
	(0.077)**	(0.060)	(0.276)	(0.083)	(0.028)	(0.032)	(0.128)***	(0.044)
PSF - Year +2	-0.310	-0.153	-0.261	-0.075	-0.060	-0.043	-0.791	-0.029
	(0.095)***	(0.074)**	(0.344)	(0.098)	(0.034)*	(0.041)	(0.174)***	(0.046)
PSF - Year +3	-0.431	-0.204	-0.836	-0.235	-0.037	-0.078	-0.843	-0.078
	(0.119)***	(0.095)**	(0.473)*	(0.123)*	(0.041)	(0.049)	(0.197)***	(0.056)
PSF - Year +4	-0.466	-0.370	-1.433	-0.307	-0.058	-0.057	-0.896	-0.105
	(0.137)***	(0.117)***	(0.583)**	(0.140)**	(0.049)	(0.059)	(0.236)***	(0.064)
PSF - Year +5	-0.646	-0.447	-1.972	-0.392	-0.026	-0.095	-1.115	-0.176
	(0.171)***	(0.152)***	(0.718)***	(0.174)**	(0.059)	(0.068)	(0.281)***	(0.073)**
PSF - Year +6	-0.714	-0.561	-2.247	-0.485	-0.053	-0.173	-1.124	-0.188
	(0.192)***	(0.183)***	(0.846)***	(0.190)**	(0.068)	(0.080)**	(0.342)***	(0.083)**
PSF - Year +7	-0.942	-0.741	-2.683	-0.478	-0.093	-0.216	-0.713	-0.360
	(0.221)***	(0.227)***	(1.030)***	(0.222)**	(0.074)	(0.090)**	(0.396)*	(0.095)***
PSF - Year +8	-0.908	-0.769	-3.269	-0.665	-0.085	-0.134	-0.468	-0.287
	(0.246)***	(0.244)***	(1.145)***	(0.268)**	(0.089)	(0.102)	(0.483)	(0.108)***
Observations	37,693	37,693	37,693	37,693	37,693	37,693	37,693	37,693
y_mean	1.699	1.237	8.958	1.882	0.311	0.507	2.842	0.687

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta_{pre,i}s$ and $\beta_j s$ and their respective standard errors were defined as in equation 1.

Table A.5: Fertility

	Ln(Births)	Rate of Births per Woman (10-49yo)	Rate of Births per Woman (10-19yo)	Rate of Births per Woman (20-49yo)
	(1)	(2)	(3)	(4)
PSF - Year -8	0.002	0.000	0.000	0.001
	(0.079)	(0.001)	(0.001)	(0.001)
PSF - Year -7	-0.003	0.000	0.000	0.000
	(0.061)	(0.001)	(0.001)	(0.001)
PSF - Year -6	0.075	0.001	0.001	0.002
	(0.121)	(0.002)	(0.001)	(0.002)
PSF - Year -5	0.046	0.001	0.000	0.001
	(0.077)	(0.001)	(0.001)	(0.002)
PSF - Year -4	-0.146	-0.002	-0.002	-0.002
	(0.107)	(0.002)	(0.001)	(0.002)
PSF - Year -3	-0.133	-0.002	-0.001	-0.002
	(0.072)*	(0.001)	(0.001)	(0.001)
PSF - Year -2	-0.075	-0.001	-0.001	-0.001
	(0.063)	(0.001)	(0.001)	(0.001)
PSF - Year 0	-0.032	-0.000	-0.000	-0.000
	(0.036)	(0.001)	(0.000)	(0.001)
PSF - Year +1	-0.068	-0.001	-0.001	-0.001
	(0.050)	(0.001)	(0.001)	(0.001)
PSF - Year +2	-0.102	-0.002	-0.001	-0.002
	(0.060)*	(0.001)	(0.001)	(0.001)*
PSF - Year +3	-0.161	-0.003	-0.002	-0.004
	(0.081)**	(0.001)**	(0.001)*	(0.002)**
PSF - Year +4	-0.199	-0.004	-0.003	-0.005
	(0.097)**	(0.002)**	(0.001)**	(0.002)***
PSF - Year +5	-0.284	-0.006	-0.005	-0.007
	(0.132)**	(0.002)***	(0.002)**	(0.002)***
PSF - Year +6	-0.327	-0.008	-0.006	-0.009
	(0.146)**	(0.003)***	(0.002)***	(0.003)***
PSF - Year +7	-0.372	-0.008	-0.006	-0.010
	(0.172)**	(0.003)***	(0.003)**	(0.003)***
PSF - Year +8	-0.434	-0.010	-0.007	-0.011
	(0.196)**	(0.004)***	(0.003)**	(0.004)***
Observations	37,701	37,701	37,701	37,701
y_mean	5.339	0.0505	0.0374	0.0575

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta_{pre,i}s$ and $\beta_j s$ and their respective standard errors were defined as in equation 1.

Table A.6: Quality of Births

	Apgar 1	Apgar 5	Low Birth Weight < 2.5kg	Gestation Weeks 37+	% Girls
	(1)	(2)	(3)	(4)	(5)
PSF - Year -8	0.035	0.008	-0.000	0.009	0.001
	(0.029)	(0.026)	(0.002)	(0.007)	(0.003)
PSF - Year -7	0.010	-0.008	0.000	0.004	-0.001
	(0.026)	(0.027)	(0.001)	(0.005)	(0.002)
PSF - Year -6	-0.002	0.012	-0.000	0.003	0.000
	(0.030)	(0.027)	(0.002)	(0.005)	(0.002)
PSF - Year -5	0.012	0.029	0.001	-0.002	0.001
	(0.024)	(0.022)	(0.001)	(0.005)	(0.002)
PSF - Year -4	-0.025	-0.005	-0.000	-0.002	0.003
	(0.023)	(0.021)	(0.001)	(0.004)	(0.002)*
PSF - Year -3	-0.017	-0.000	0.000	0.003	0.001
	(0.019)	(0.015)	(0.001)	(0.003)	(0.001)
PSF - Year -2	0.006	0.009	-0.001	0.003	0.001
	(0.013)	(0.010)	(0.001)	(0.002)*	(0.001)
PSF - Year 0	0.005	-0.007	-0.000	-0.002	-0.000
	(0.011)	(0.010)	(0.001)	(0.003)	(0.001)
PSF - Year +1	0.017	-0.007	-0.000	-0.001	-0.001
	(0.015)	(0.013)	(0.001)	(0.003)	(0.001)
PSF - Year +2	0.010	-0.023	0.001	-0.004	-0.001
	(0.018)	(0.017)	(0.001)	(0.005)	(0.001)
PSF - Year +3	0.024	-0.034	0.001	-0.006	-0.002
	(0.023)	(0.022)	(0.001)	(0.006)	(0.002)
PSF - Year +4	0.018	-0.047	0.001	-0.007	-0.001
	(0.027)	(0.026)*	(0.002)	(0.007)	(0.002)
PSF - Year +5	0.002	-0.065	0.002	-0.011	-0.003
	(0.033)	(0.031)**	(0.002)	(0.009)	(0.002)
PSF - Year +6	0.010	-0.065	0.002	-0.014	-0.004
	(0.036)	(0.036)*	(0.002)	(0.010)	(0.003)
PSF - Year +7	0.020	-0.082	0.002	-0.018	-0.002
	(0.044)	(0.043)*	(0.003)	(0.012)	(0.003)
PSF - Year +8	0.012	-0.086	0.003	-0.020	-0.003
	(0.049)	(0.048)*	(0.003)	(0.014)	(0.003)
Observations	37,378	37,342	37,559	37,538	37,564
y_mean	8.066	9.208	0.0720	0.937	0.487

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta_{pre,i}$s and β_js and their respective standard errors were defined as in equation 1.

Table A.7: Inequality in Access and Outcomes by Education of the Mother

	Prenatal Visits 7+ - Less Educated	Birth at Hospital - Less Educated	Share C-Sections - Less Educated	Prenatal Visits 7+ - More Educated	Birth at Hospital - More Educated	Share C-Sections - More Educated
	(1)	(2)	(3)	(4)	(5)	(6)
PSF - Year -8	0.002	0.021	-0.014	0.000	0.017	0.003
	(0.018)	(0.012)*	(0.011)	(0.013)	(0.008)**	(0.008)
PSF - Year -7	0.008	0.012	-0.018	0.003	0.008	0.009
	(0.020)	(0.010)	(0.015)	(0.015)	(0.007)	(0.009)
PSF - Year -6	-0.001	-0.003	-0.011	0.010	-0.007	0.011
	(0.017)	(0.010)	(0.011)	(0.011)	(0.009)	(0.008)
PSF - Year -5	-0.004	0.003	-0.008	0.006	-0.000	0.010
	(0.013)	(0.008)	(0.010)	(0.009)	(0.006)	(0.006)
PSF - Year -4	-0.009	-0.006	0.005	0.004	-0.004	0.021
	(0.011)	(0.007)	(0.015)	(0.008)	(0.006)	(0.007)***
PSF - Year -3	-0.006	-0.001	0.002	0.003	-0.003	0.009
	(0.009)	(0.005)	(0.009)	(0.007)	(0.003)	(0.005)
PSF - Year -2	0.010	-0.000	0.011	0.006	-0.000	0.008
	(0.007)	(0.004)	(0.013)	(0.005)	(0.003)	(0.005)*
PSF - Year 0	0.009	-0.001	0.006	0.007	-0.000	-0.004
	(0.008)	(0.004)	(0.007)	(0.005)	(0.003)	(0.004)
PSF - Year +1	0.020	0.001	0.012	0.015	0.010	-0.001
	(0.010)**	(0.005)	(0.009)	(0.007)**	(0.004)**	(0.005)
PSF - Year +2	0.027	0.009	0.011	0.019	0.014	-0.006
	(0.011)**	(0.007)	(0.010)	(0.008)**	(0.005)***	(0.005)
PSF - Year +3	0.042	0.012	0.028	0.027	0.017	-0.000
	(0.015)***	(0.009)	(0.013)**	(0.010)***	(0.007)***	(0.008)
PSF - Year +4	0.049	0.018	0.032	0.026	0.022	-0.004
	(0.017)***	(0.010)*	(0.016)**	(0.012)**	(0.008)***	(0.009)
PSF - Year +5	0.060	0.022	0.049	0.020	0.026	-0.003
	(0.020)***	(0.012)*	(0.020)**	(0.014)	(0.010)***	(0.011)
PSF - Year +6	0.063	0.027	0.052	0.017	0.031	-0.006
	(0.025)**	(0.015)*	(0.023)**	(0.016)	(0.011)***	(0.012)
PSF - Year +7	0.066	0.031	0.046	0.022	0.035	-0.004
	(0.027)**	(0.016)*	(0.029)	(0.018)	(0.013)***	(0.014)
PSF - Year +8	0.084	0.035	0.063	0.031	0.041	-0.014
	(0.031)***	(0.017)**	(0.032)**	(0.020)	(0.016)***	(0.016)
Observations	31,914	32,328	32,300	35,674	35,890	35,879
y_mean	0.313	0.915	0.221	0.578	0.966	0.505

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta_{pre,i}s$ and $\beta_j s$ and their respective standard errors were defined as in equation 1.

Table A.7: Inequality in Access and Outcomes by Education of the Mother – *Cont.*

	Ln(Maternal Deaths) - Less Educated	Ln(Infant Deaths) - Less Educated	Ln(Births) - Less Educated	Ln(Maternal Deaths) - More Educated	Ln(Infant Deaths) - More Educated	Ln(Births) - More Educated
	(7)	(8)	(9)	(10)	(11)	(12)
PSF - Year -8	-0.023	-0.278	0.125	-0.019	-0.185	0.067
	(0.169)	(0.454)	(0.126)	(0.266)	(0.226)	(0.113)
PSF - Year -7	0.216	-0.084	0.050	-0.301	0.154	-0.001
	(0.172)	(0.253)	(0.105)	(0.256)	(0.181)	(0.098)
PSF - Year -6	0.252	-0.048	0.143	-0.032	0.024	0.123
	(0.306)	(0.264)	(0.154)	(0.191)	(0.183)	(0.139)
PSF - Year -5	0.283	-0.011	0.076	0.032	0.084	0.088
	(0.234)	(0.233)	(0.109)	(0.182)	(0.158)	(0.112)
PSF - Year -4	-0.063	0.140	-0.129	-0.269	-0.077	-0.175
	(0.297)	(0.192)	(0.110)	(0.270)	(0.148)	(0.115)
PSF - Year -3	0.337	-0.154	-0.083	-0.104	-0.178	-0.073
	(0.254)	(0.165)	(0.106)	(0.230)	(0.133)	(0.099)
PSF - Year -2	0.023	-0.244	-0.025	-0.174	0.052	-0.069
	(0.171)	(0.230)	(0.076)	(0.209)	(0.113)	(0.071)
PSF - Year 0	-0.013	-0.211	-0.014	-0.114	0.137	-0.078
	(0.201)	(0.154)	(0.052)	(0.193)	(0.112)	(0.052)
PSF - Year +1	-0.292	-0.155	-0.088	-0.077	0.188	-0.154
	(0.286)	(0.182)	(0.080)	(0.210)	(0.126)	(0.079)*
PSF - Year +2	-0.270	-0.058	-0.155	0.087	0.239	-0.289
	(0.261)	(0.219)	(0.081)*	(0.231)	(0.150)	(0.080)***
PSF - Year +3	-0.206	-0.079	-0.283	-0.196	0.296	-0.443
	(0.269)	(0.275)	(0.114)**	(0.263)	(0.175)*	(0.114)***
PSF - Year +4	-0.391	-0.345	-0.245	0.220	0.223	-0.498
	(0.295)	(0.329)	(0.133)*	(0.311)	(0.197)	(0.128)***
PSF - Year +5	-1.234	-0.526	-0.312	0.012	0.316	-0.637
	(0.606)**	(0.396)	(0.172)*	(0.368)	(0.237)	(0.163)***
PSF - Year +6	-0.586	-0.734	-0.360	0.450	0.207	-0.739
	(0.439)	(0.442)*	(0.194)*	(0.457)	(0.257)	(0.182)***
PSF - Year +7	-2.311	-0.939	-0.348	0.252	0.165	-0.853
	(1.020)**	(0.641)	(0.230)	(0.637)	(0.310)	(0.216)***
PSF - Year +8	-2.238	-1.276	-0.308	0.438	-0.142	-0.974
	(1.211)*	(0.558)**	(0.253)	(0.704)	(0.348)	(0.240)***
Observations	37,701	37,701	37,701	37,701	37,701	37,701
y_mean	-6.743	-5.158	1.149	-6.758	-5.236	3.157

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta_{pre,i}s$ and $\beta_j s$ and their respective standard errors were defined as in equation 1.

Table A.8: Impact by Baseline Hospital Infrastructure (Hospital in 1992 = 0)

	Prenatal Visits 7+	Birth at Hospital	Share C-Sections	MHR (Only ICD10=0, Non Deliveries)	Female Mortality Rate, per 1000 population 0-1yo	Maternal Mortality Rate, per 10k population 0-1yo	Infant Mortality Rate (Total)	PSF Teams per Capita (*1000)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PSF - Year -8	-0.015	0.007	0.004	0.152	-0.017	0.388	0.567	0.003
	(0.015)	(0.009)	(0.005)	(0.886)	(0.590)	(0.710)	(0.702)	(0.003)
PSF - Year -7	0.005	0.012	0.007	0.136	0.916	1.306	0.309	0.007
	(0.014)	(0.008)	(0.005)	(0.790)	(0.525)*	(0.659)**	(0.601)	(0.003)**
PSF - Year -6	-0.001	-0.003	0.006	0.268	0.756	-0.422	0.114	0.008
	(0.012)	(0.011)	(0.004)	(0.668)	(0.468)	(0.598)	(0.514)	(0.003)**
PSF - Year -5	0.003	-0.000	0.005	-0.093	0.679	-0.082	0.638	0.005
	(0.010)	(0.006)	(0.004)	(0.789)	(0.352)*	(0.459)	(0.485)	(0.003)*
PSF - Year -4	0.002	0.001	0.007	0.169	0.206	-0.165	0.080	0.003
	(0.009)	(0.005)	(0.004)*	(0.492)	(0.320)	(0.435)	(0.384)	(0.002)
PSF - Year -3	-0.002	-0.000	0.001	0.801	0.385	0.703	0.244	-0.004
	(0.008)	(0.004)	(0.003)	(0.402)**	(0.285)	(0.396)*	(0.365)	(0.003)
PSF - Year -2	0.008	0.001	-0.001	0.244	0.383	0.056	0.240	-0.003
	(0.006)	(0.002)	(0.003)	(0.286)	(0.255)	(0.362)	(0.273)	(0.002)
PSF - Year 0	0.002	-0.003	-0.002	0.619	-0.307	-0.567	-0.298	0.085
	(0.005)	(0.002)*	(0.002)	(0.307)**	(0.278)	(0.372)	(0.320)	(0.004)***
PSF - Year +1	0.003	-0.001	-0.002	0.849	-0.224	0.380	-0.258	0.102
	(0.008)	(0.003)	(0.003)	(0.441)*	(0.326)	(0.436)	(0.406)	(0.005)***
PSF - Year +2	0.008	-0.003	-0.006	0.814	-0.266	0.324	-0.403	0.118
	(0.011)	(0.005)	(0.004)	(0.559)	(0.420)	(0.493)	(0.475)	(0.006)***
PSF - Year +3	0.008	-0.002	-0.001	0.848	-0.297	-0.041	-0.734	0.130
	(0.013)	(0.006)	(0.006)	(0.708)	(0.467)	(0.551)	(0.568)	(0.007)***
PSF - Year +4	0.014	-0.004	-0.002	0.775	-0.552	0.552	-1.073	0.138
	(0.016)	(0.008)	(0.007)	(0.838)	(0.554)	(0.609)	(0.677)	(0.007)***
PSF - Year +5	0.011	-0.008	-0.000	0.455	-0.832	0.160	-1.396	0.149
	(0.018)	(0.009)	(0.008)	(1.034)	(0.633)	(0.727)	(0.828)*	(0.008)***
PSF - Year +6	0.008	-0.012	0.000	0.013	-0.790	0.745	-1.388	0.158
	(0.022)	(0.011)	(0.010)	(1.189)	(0.721)	(0.865)	(0.947)	(0.010)***
PSF - Year +7	0.003	-0.009	0.001	0.727	-0.857	-0.873	-1.600	0.160
	(0.027)	(0.012)	(0.013)	(1.422)	(0.911)	(1.028)	(1.249)	(0.011)***
PSF - Year +8	0.024	-0.009	0.002	1.333	-0.971	-0.919	-2.244	0.158
	(0.032)	(0.013)	(0.015)	(1.710)	(1.108)	(1.373)	(1.462)	(0.014)***
Observations	24,338	24,387	24,387	19,047	24,481	24,481	24,481	19.047
y_mean	0.491	0.955	0.393	8.619	17.85	4.900	17.24	0.126

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta_{pre,i}s$ and $\beta_j s$ and their respective standard errors were defined as in equation 1.

Table A.8: Impact by Baseline Hospital Infrastructure (Hospital in 1992 = 1) – *Cont.*

	Prenatal Visits 7+	Birth at Hospital	Share C-Sections	MHR (Only ICD10=0, Non Deliveries)	Female Mortality Rate, per 1000 population 0-1yo	Maternal Mortality Rate, per 10k population 0-1yo	Infant Mortality Rate (Total)	PSF Teams per Capita (*1000)
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
PSF - Year -8	0.014	0.007	-0.004	-1.928	-0.893	0.446	-1.347	-0.001
	(0.021)	(0.010)	(0.010)	(0.949)**	(1.375)	(1.008)	(1.113)	(0.005)
PSF - Year -7	0.001	-0.005	-0.003	-0.928	-0.691	-0.663	-0.116	-0.001
	(0.026)	(0.008)	(0.009)	(0.946)	(1.346)	(0.799)	(1.093)	(0.007)
PSF - Year -6	-0.003	-0.008	-0.006	0.702	-0.450	0.386	0.157	0.003
	(0.022)	(0.012)	(0.011)	(1.414)	(0.977)	(0.680)	(1.341)	(0.006)
PSF - Year -5	-0.004	0.006	-0.005	-0.720	-0.582	0.525	0.124	0.002
	(0.017)	(0.009)	(0.008)	(1.592)	(0.997)	(0.623)	(1.140)	(0.005)
PSF - Year -4	-0.012	-0.007	0.024	-0.301	-2.781	-0.094	-2.943	-0.009
	(0.014)	(0.005)	(0.018)	(0.809)	(2.130)	(0.620)	(1.619)*	(0.006)
PSF - Year -3	0.009	-0.007	0.014	0.055	-1.221	0.349	-0.825	-0.012
	(0.012)	(0.004)	(0.010)	(0.444)	(1.300)	(0.458)	(0.990)	(0.004)***
PSF - Year -2	0.006	-0.005	0.014	-0.837	-1.821	0.106	-0.949	-0.004
	(0.008)	(0.004)	(0.009)	(0.477)*	(0.996)*	(0.391)	(0.668)	(0.004)
PSF - Year 0	0.021	0.002	0.009	0.297	-0.918	-0.343	-0.744	0.050
	(0.008)**	(0.003)	(0.006)	(0.279)	(0.734)	(0.371)	(0.616)	(0.007)***
PSF - Year +1	0.028	0.008	0.014	0.969	-1.306	-0.018	-1.035	0.063
	(0.012)**	(0.004)*	(0.007)**	(0.452)**	(0.852)	(0.450)	(0.746)	(0.009)***
PSF - Year +2	0.040	0.014	0.015	0.577	-1.716	-0.364	-2.296	0.075
	(0.015)***	(0.006)**	(0.008)*	(0.634)	(1.020)*	(0.518)	(0.906)**	(0.010)***
PSF - Year +3	0.058	0.018	0.028	1.120	-2.819	-0.602	-3.595	0.082
	(0.019)***	(0.007)**	(0.011)***	(0.830)	(1.356)**	(0.625)	(1.205)***	(0.011)***
PSF - Year +4	0.069	0.023	0.035	1.609	-3.739	-1.286	-4.736	0.084
	(0.022)***	(0.009)***	(0.013)***	(1.054)	(1.579)**	(0.715)*	(1.474)***	(0.012)***
PSF - Year +5	0.073	0.028	0.049	2.183	-5.467	-1.769	-6.137	0.092
	(0.026)***	(0.010)***	(0.018)***	(1.234)*	(2.050)***	(0.880)**	(1.863)***	(0.012)***
PSF - Year +6	0.081	0.033	0.054	2.614	-5.902	-1.731	-6.966	0.104
	(0.030)***	(0.012)***	(0.019)***	(1.409)*	(2.213)***	(1.005)*	(2.081)***	(0.013)***
PSF - Year +7	0.092	0.037	0.061	3.156	-7.470	-3.178	-8.030	0.106
	(0.033)***	(0.013)***	(0.023)***	(1.593)**	(2.653)***	(1.107)***	(2.461)***	(0.015)***
PSF - Year +8	0.109	0.042	0.059	4.259	-8.654	-2.879	-8.361	0.110
	(0.038)***	(0.014)***	(0.027)**	(1.768)**	(3.060)***	(1.275)**	(2.872)***	(0.016)***
Observations	13,152	13,171	13,172	10,276	13,212	13,212	13,212	10.276
y_mean	0.387	0.937	0.303	8.546	15.49	5.296	19.76	0.125

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta_{pre,i}s$ and $\beta_j s$ and their respective standard errors were defined as in equation 1.

B Impact by Baseline Hospital Infrastructure: Robustness Checks

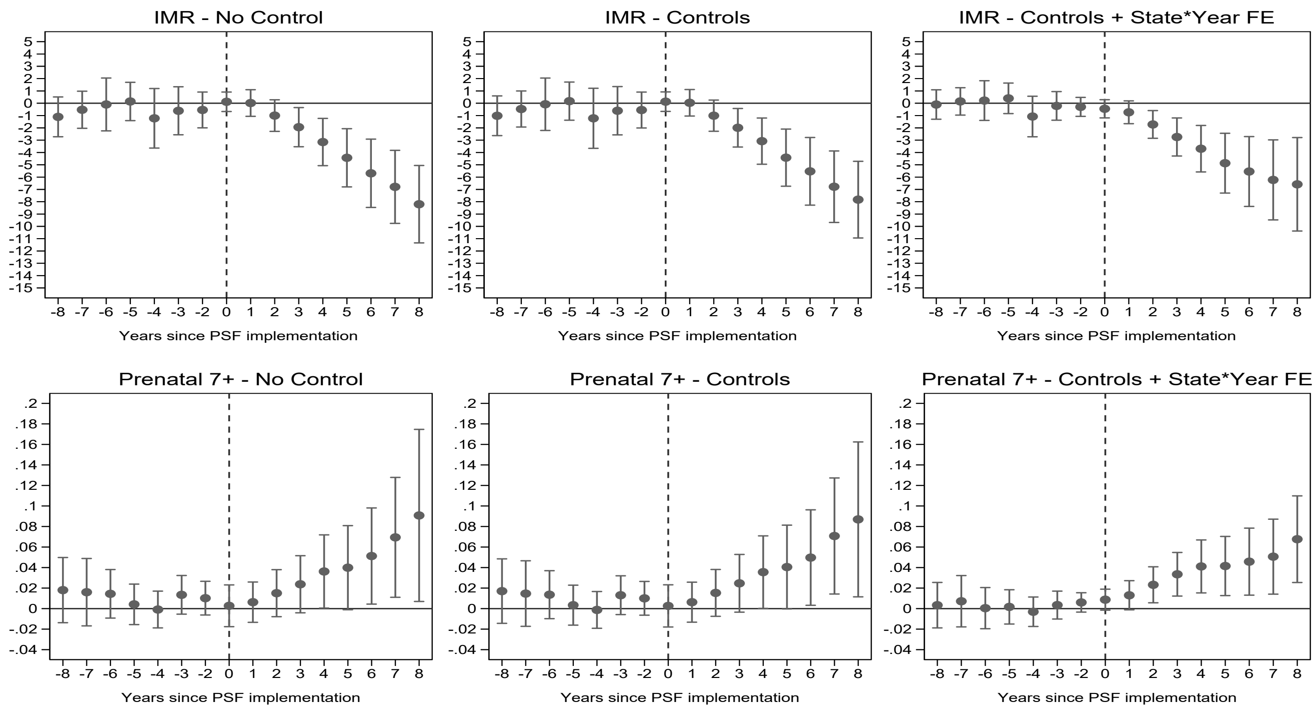
Table B.1: Impact by Baseline Hospital Infrastructure (Robustness Checks)

	Prenatal Visits 7+	Share C-Sections	Birth at Hospital	MMR	IMR	Neonatal	Mortality in 27 days - 1 year	LBW	Gestation Weeks 37+
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PSF	-0.061	0.085	0.015	0.121	-0.206	4.401	-4.606	-0.008	0.061
	(0.032)*	(0.069)	(0.020)	(0.204)	(6.971)	(4.791)	(2.397)*	(0.004)*	(0.019)***
PSF * Hospital	0.011	0.012	0.006	-0.082	-1.459	-0.742	-0.717	0.002	-0.003
	(0.008)	(0.005)**	(0.003)	(0.031)***	(0.503)***	(0.354)**	(0.231)***	(0.001)***	(0.003)
PSF * Income Per Capita	0.019	-0.023	-0.003	0.004	1.476	0.093	1.382	0.001	-0.010
	(0.009)**	(0.018)	(0.005)	(0.051)	(1.807)	(1.246)	(0.606)**	(0.001)	(0.005)**
PSF * % Urban	-0.036	0.043	0.005	-0.123	-10.001	-6.351	-3.650	0.000	-0.011
	(0.024)	(0.034)	(0.013)	(0.112)	(3.856)***	(2.661)**	(1.304)***	(0.003)	(0.012)
Observations	37,490	37,559	37,558	37,693	37,693	37,693	37,693	37,559	37,538

Notes: Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. All sample periods cover the interval between 1996 and 2004. All specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level.

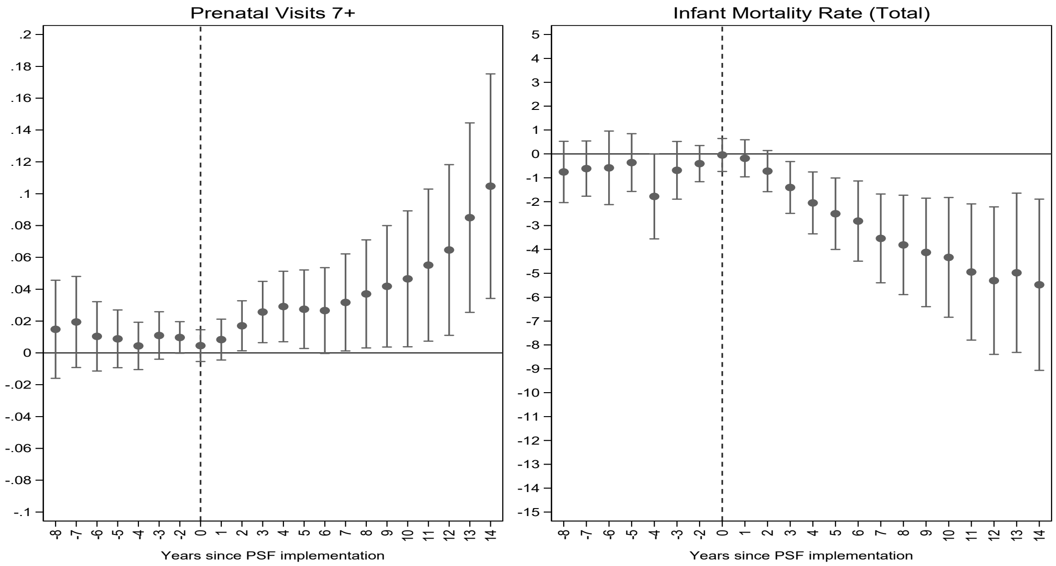
C Additional Robustness Checks

Figure C.1: Robustness Checks: Controls and State-Year Fixed-Effects



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}s$ and $\beta_j s$ and their respective 95% confidence intervals, based on variations of equation 1: (i) the specification "No Control" includes only year and municipality fixed-effects; (ii) "Controls" adds a dummy for the presence of hospitals in the municipality, the local coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time; (iii) "Controls + State*Yes FE" adds state-specific time dummies. Standard errors are clustered at the municipality level. Sample periods cover 1996-2004.

Figure C.2: Robustness Checks: The Role of Compositional and Long-Term Effects



Note: Each figure plots together the estimated coefficients $\beta_{pre,i}$ and β_j and their respective 95% confidence intervals, based on the estimation of equation 1. Specifications include municipality fixed effects and state-specific time dummies, controls for the municipality coverage of *Bolsa Família*, and a dummy indicating if the municipality left or interrupted PSF at a given point in time. Standard errors are clustered at the municipality level. Sample periods cover 1996-2010.